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MECCANO MAGAZINE

ON THE SUEZ CANAL
(see page 754)

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NEXT MONTH: SOUTHERN PACIFIC LOCOMOTIVES. PUBLISHED: 1st OCTOBER (PRICE 6d.)

MECCANO MAGAZINE

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With the Editor

In the Soup—and Out Again!

An interesting story came to light the other day when one of the speakers at the Liverpool Rotary Club told of an amusing incident that occurred some years ago at one of Dr. Barnardo's Homes. One of the boys who had an extraordinary appetite was in the habit of raiding the school larder during the night. On one of these expeditions he was disturbed by the watchman, known as "Stumpy" because of his wooden leg. Finding that "Stumpy" was on his track, the boy ran into the kitchen and jumped into a large copper, pulling down the lid, and he did not emerge from his hiding place until the coast was clear!

As the copper was half full of cold soup his plight may well be imagined, but by dint of hard work, he managed to scrape most of it off his clothes. Then he washed them, but of course they were not dry before morning, so his companions, who were true "friends in need," loaned him other clothing until his own had dried. Next day they even further assisted him by consuming the soup without a word of complaint!

The sequel to the story is the most interesting part, for the boy who jumped into the copper was one of the first British sailors to jump ashore on the Mole during the historic raid on Zeebrugge.

"Popular Fallacies"

Last month I mentioned on this page a few commonly accepted beliefs that still persist, even though they have been "exposed" by investigators at various times. There are many other incidents additional to those mentioned last month, as, for example, the idea that a whetstone is oiled to reduce the friction of the metal that is being sharpened on it. Actually the application of oil increases the friction, but it is applied because the tiny portions of metal rubbed off the blade would be rubbed into an unoiled stone. This would cause it to be burnished smooth and would lessen its cutting powers and oil is used to keep these minute metal particles in suspension, so preserving the original surface of the stone.

At recurring intervals we read in the newspapers that some inventor has re-discovered the "lost art" of hardening copper and that someone or other has offered him a fabulous sum for his secret. As a matter of fact, the ancient art of hardening copper is not lost, and we could to-day produce copper tools tempered as hard as any that the Egyptians made—were it a commercial proposition to do so. Copper tools are not made because this metal is more expensive than iron, and because a copper tool is not nearly as efficient as steel—as everyone knows. Apart from the standpoint of scientific curiosity, therefore, there is no commercial reason why copper tools should be made.

Another popular belief that is more difficult to "kill" is the fact that almost everyone believes steam is visible. What we see coming out of the exhaust of a locomotive as a white cloud is not steam, but simply minute particles of water that would be invisible were they in the state of steam. There are many other fallacies that I have not space to go into in detail—for instance, the fact that it is believed lightning never strikes twice in the same place; that the force of dynamite is always exerted downwards; that large lenses are more powerful than small ones; that small flies are the young of large flies; and that a ship sunk in a deep ocean never reaches the bottom, but continues to float submerged.

Even the old idea that it is "the exception that proves the rule" is a fallacy, for this idea goes back to the days when an old Latin proverb was translated into English. *Probat* was translated into "proves" and although it may mean this, it has another meaning also, and that is "to test," which is the sense in which the Romans used it. Thus the proverb is really incorrectly rendered in its present form and should read "it is the exception that *tests* the rule." The word "prove" continues to be used in the same sense as that in which it appeared in the original version of the proverb. For instance, when a printer proves his type and sends proofs to an editor for correction, what he is really doing is to *test* that his type has been correctly set and that no mistakes have been made by the compositors. The exception, therefore, really *tests* the rule and *proves* thereby that it was not a true rule!

Is Truth Stranger than Fiction?

I see that a famous novelist has been stating in all seriousness that truth is never stranger than fiction, but surely science proves him to be wrong? What could be stranger than the means by which an important discovery was made in connection with the manufacture of gramophone records? A workman eating his lunch in the room where there was a plating bath, playfully flicked a piece of cheese at one of his fellow workmen. The cheese missed its mark but fell into a bath in which wax discs for gramophone records were being plated. It so happened that when the plating of these discs was complete, they were found to be very much harder than the discs from other baths. An analysis of the liquid in the bath showed that it contained a minute proportion of casein, the presence of which investigations proved to be due to the piece of cheese that had accidentally fallen into the bath! In all plating work of this nature, casein is now added to the solution in the first instance. The result is that more records can be made from a single copper disc than was possible before, thus effecting a considerable economy.

Another discovery that would appear incredible in the pages of a novel was concerned with a factory in which quick drying varnish was produced. So well had the manufacturers succeeded in making a quick-drying varnish that the liquid hardened before it could be applied with a brush. One day the mixing machinery broke down and some partly prepared varnish was left in one of the mixers for several days whilst repairs were being done. When the machinery was repaired and work resumed, the chemists were surprised to find that the varnish had become as thin as water and that it remained in this state for the requisite time. The whole secret of successful manufacture in this case is that at a certain period in the process of manufacturing this varnish it must be allowed to stand for some days, and the amazing thing is that this was not discovered until the "chance" or "fate," or whatever we like to call it, caused the machinery to break down.

Such accidental discoveries as these are in a different category to those mentioned on this page last month, for it is a fact that accidental discoveries of importance are made from time to time—as, for instance, the discovery of X-rays by Röntgen, whilst he was studying the electric discharges in gases, and Pasteur's discovery of the germ theory of modern medicine, made whilst he was studying acid crystals.

The discovery of the first synthetic dye by Perkin, as described in the series of articles on coal that commenced in the February "*M.M.*" and ends in this issue, is another example of an "accidental" discovery. It is worth noting, however, that it is because accidents of this kind occur to those capable of making use of them that we realise their importance. An ordinary individual in Röntgen's laboratory, for instance, would no doubt have been interested to see the phosphorescent screen glow, but it required the trained mind and experience of Röntgen to track down the cause and eventually to discover the invisible rays.

FAMOUS CANALS OF THE WORLD.

III.—THE SUEZ CANAL

THE Suez Canal, the famous waterway that links the Mediterranean with the Red Sea, might well be described as the "Father of Canals," for although it is less than a century since it came into being, its ancestry can be traced to a waterway constructed hundreds of years before the Christian era.

The waterway owes its origin to Necho II., who became King of Egypt in 614 B.C. He was the first Egyptian monarch to pay attention to naval matters and early in his reign he organised two fleets, one for service in the Mediterranean and the other in the Red Sea. In order to connect the two seas and thus provide facilities for quickly transferring either fleet, Necho commanded that a canal wide enough to carry two ships abreast should be dug from the Nile to the Red Sea. This canal was to branch off from the Nile at a point near the city of Bubastis and pass by way of a natural valley to Heroopolis, and thence to the Red Sea. This sea is slowly receding from the isthmus, and the Gulf of Heroopolis, at that time the northern limit of the Red Sea, is now located north of the Great Bitter Lake.

The cutting of the canal from the Nile to the Gulf of Heroopolis was duly commenced, but unfortunately Necho's enterprise did not meet with the approval of the priests, who in those days had enormous influence and power. Strong protests to the King were followed by warnings and ultimately the project was abandoned.

In this partially developed state the canal cutting remained for about a century, until the reign of Darius, the famous Persian King mentioned in the Bible (Daniel, Chap. 9, v. 1). Under Darius operations were resumed and the canal was completed from the Nile, past Bubastis, for a total distance of 37 miles. Darius does not appear to have completed the entire canal, but the country traversed by the finished portion benefited greatly, small dried-up lakes becoming once more clean and sweet and abundant in fish and waterfowl.

Map showing Suez Canal

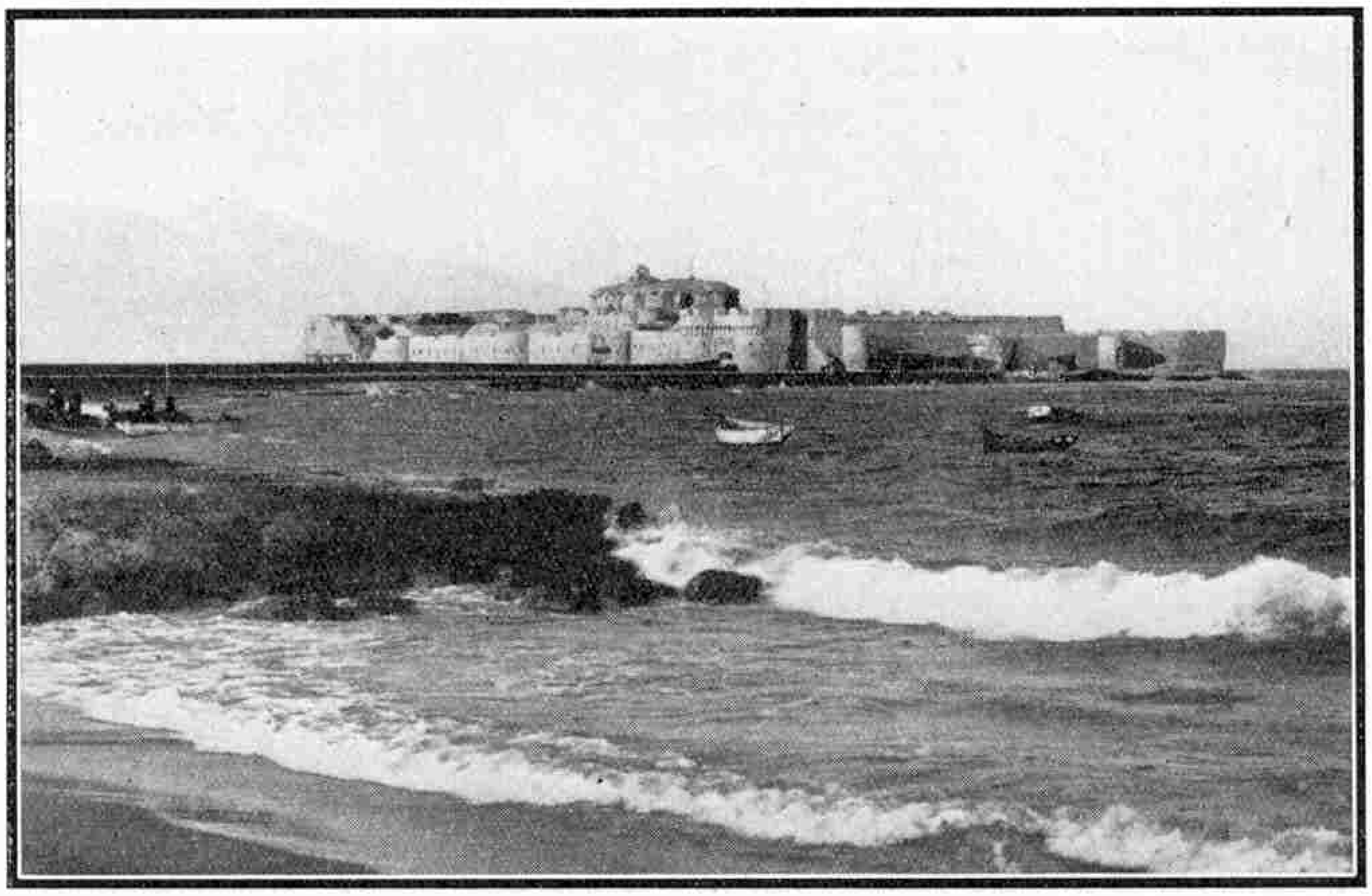
The canal was neglected by later governments, however, and gradually became choked up with sand. It was not until the time of King Philadelphus, 284–246 B.C., that the labour of Necho and Darius was renewed. Under the supervision of Philadelphus a city was built on the sands at the head of the Red Sea and named Arsinoë. The existing length of the canal was thoroughly cleaned out and a start made to complete the waterway, which was to join the Red Sea close to Arsinoë.

In carrying out the extension to the Red Sea an intervening ridge of sand had to be cut through. It is interesting to note that the first appearance of this ridge—which occurred long before the time of Philadelphus and when the Bitter Lakes formed part of the Red Sea—is associated with Moses' miraculous division of the waters, whereby the Israelites escaped from the Egyptians and the returning waters overwhelmed the pursuing hosts of Pharoah, as recorded so vividly in the Old Testament. The subsequent permanent appearance of this strip of elevated land is spoken of by early historians as having been prophesied by Isaiah in the words: "The Lord shall utterly destroy the tongue of the Egyptian sea" (Is. chap. 11, v. 15).

The waters cut off from the sea, and rendered stagnant by the dividing ridge of land gradually rising above the level of the Red Sea, ultimately dried up, leaving the numerous lake basins, the "Bitter Lakes" of to-day, lined with salt. When the canal was cut, however, these lakes were filled up again.

After a time operations on the canal were brought to a halt by the engineers discovering that the waters of the canals were a few feet lower than the level of the Red Sea. They declared that the canal, if completed, would become filled with salt water, which could not be supplied as drinking water to the towns in the valleys and was unsuitable for use in the fields. The engineers also asserted that the canal would lay the land open to serious flooding in times of heavy rain.

Philadelphus overcame these problems by constructing substantial floodgates at certain points. By this means the waters of the Red Sea at high tide were prevented from invading the canal, while at low tide surplus fresh water in the canal could be safely passed out. He thus had the satisfaction of seeing the ancient waterway completed and rendered of real benefit.



Site of the Ancient Pharos (lighthouse) at Alexandria

Under later rulers the canal was again neglected and once more it slowly silted up and became of little value.

The question of a canal from the Mediterranean to the Red Sea, by way of the Nile, came into prominence again during the reign of Trajan, Prefect of Egypt under Roman rule from 98 to 117 A.D. By this time the branch of the Nile flowing near to Bubastis had become less navigable. Trajan decided to practically remake the old canal, and began by choosing Cairo as the point of diversion from the Nile, in order to ensure an ample flow of fresh water into the canal. As a result of this change the canal as far as the Bitter Lakes had to be largely recut.

At the approach to the Red Sea also a new route was found necessary. The gradual upheaval of the land—which is still taking place—had by then destroyed Arsinoë's claims as a seaport. Trajan found that a wide stretch of sand separated the city from the sea, and the canal therefore was diverted past Arsinoë and continued to a town named Clysma—almost where Suez now stands—about 10 miles south of the previous terminus of the canal. At Clysma an extensive system of locks was built and the new canal was brought into service. It was then over 80 miles in length and 50 yards in width.

Although the practical value of the waterway had thus been demonstrated, successive governors of the country neglected it and again it silted up.

When the Arabs freed Egypt from Roman dominance in the seventh century the canal was again cleaned out and repaired in order that grain could be shipped along it to relieve the famine then being experienced in Mecca. It thus became an important route for the transporting of grain from Egypt to the holy cities of Mecca and Medina, and it was kept in good order and so used for about 130 years. In 767 misfortune again overtook the canal, for in order to prevent provisions being shipped to Medina, where an uprising was in progress, the Caliph ordered a section of the canal to be filled up north of the Bitter Lakes. The dump formed by this rough filling-up is the origin of the sandy ridge known to-day as the Serapeum Ridge. This act seems to have sealed the doom of the ancient waterway and for many hundreds of years afterward no mention is made in history of a canal from the Mediterranean to the Red Sea.

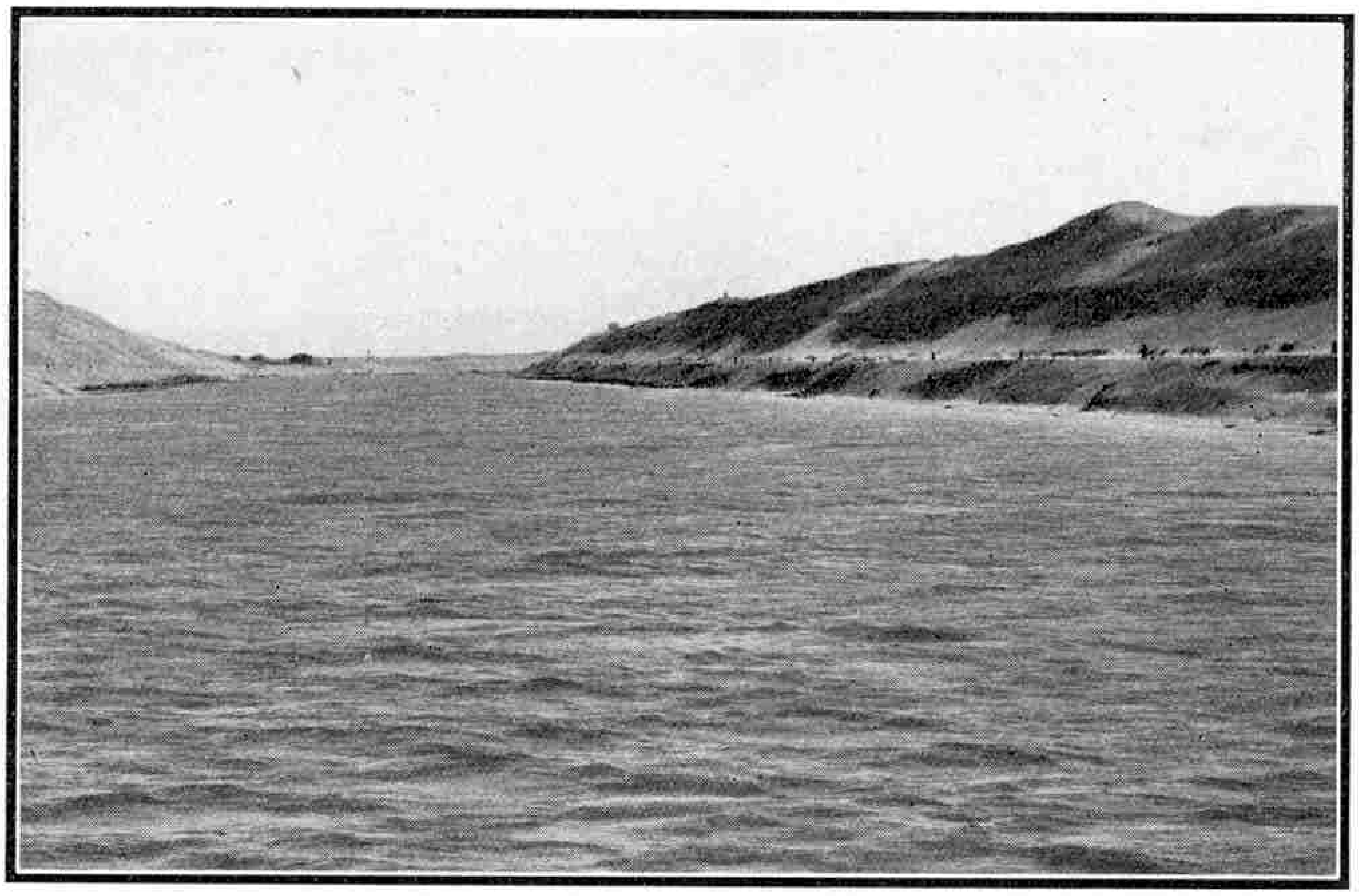
In 1798 Egypt was wrested from the Turks by Napoleon who, on viewing this latest addition to his empire, realised that a navigable channel across the isthmus of Suez would be of immense value to his ships, and would also open the way to further conquests in the southern hemisphere. A French engineer named M. Lepere was therefore called upon to survey the isthmus and the remains of the ancient canal. The result of his rough survey was a declaration that the level of the Mediterranean Sea was about 30 ft. lower than that of the Red Sea! This startling statement was strongly disputed by various prominent mathematicians but the belief that there was a serious difference between the level of the two seas prevailed, and the canal project was not pursued.

Lepere suggested that two canals should be constructed, one from the Nile near Bubastis to the Bitter Lakes and the other from the southern extremity of the Little Bitter Lake to the Red Sea. The former was to have a length of 77 miles and be 18 ft. in depth, while the latter was to be 13 miles in length. The cost of making these two waterways, exclusive of improvements, etc., at their entrances, was estimated by Lepere at £691,000. The Emperor was wholly in favour of a direct sea-to-sea canal, however.

If Napoleon had constructed his proposed canal it is very doubtful whether it would have been much patronised except by his fleet, for the Red Sea was very unpopular with sailing craft. Skippers preferred to take the traditional trade route round the Cape of Good Hope, despite the ocean risks entailed, rather than navigate a strange new channel across the isthmus, which would be particularly liable to protracted calms. Moreover, the Red Sea was known to contain numerous hidden shoals and reefs and had an evil reputation for contrary and changeable winds, in addition to being so deep that it was practically impossible for ordinary craft to secure anchorage.

Half a century elapsed before further official investigations for a canal were undertaken. New surveys of both the Mediterranean and the Red Sea were carried out in 1847 and disproved conclusively the theory that the two levels were appreciably different. Some variation traceable to the action of the winds and tides was ascertained, averaging at Port Said 9 in., and at Suez 3 ft. 10 in. This reassuring news gave fresh stimulus to schemes for constructing a Suez Canal.

In the 50 years that had passed since Napoleon's investigations, the development of steamships had given rise to a new demand for speed in travel. Overseas trade between the countries of Western Europe and the Far East was developing rapidly and a short cut from the Mediterranean to the Red Sea had become a commercial necessity. It should be remembered that the ancient canal projects already mentioned were for canals from the Red Sea to some point on the Nile, and that no direct sea-to-sea canal had so far been attempted.



The Suez Canal cuts through the hills of El Gisr

It was again the French who moved in the matter. In 1849 Ferdinand de Lesseps began to formulate a plan for excavating a great sea-to-sea canal across the isthmus of Suez as suggested by Napoleon, by a route that would take full advantage of the long depressions or sandy desert valleys that are a feature of the isthmus.

Ferdinand de Lesseps was the son of a French Consul-General and was born at Versailles on 19th November, 1805. He enjoyed a free education at the expense of the State, who undertook this in token of their appreciation of his father's services to his country. On completion of his education he entered the consular service and between 1825 and 1849 fulfilled successive appointments in various countries, including six years in Egypt, 1832–1838.

In 1849, the year following the outbreak of the French Revolution, he was sent to Rome to deal with certain differences that had arisen between Italy and France. He had hardly succeeded in his mission when he was suddenly recalled to France, where a Council of the Republic severely rebuked him for restoring peaceful relationship. Amazed at this complete change of front by the Republic, de Lesseps immediately resigned from the consular service. With leisure at his command he was now able to devote time to a long-cherished scheme for making a Suez Canal.

A very optimistic report of the land through which the canal would have to be cut had been given by General Chesney, who had made a survey in 1830. Discussing the practicability of any scheme to open up the isthmus for navigation, Chesney declared that: "as to the executive part there is but one opinion; there are no serious difficulties; not a single mountain intervenes; scarcely what deserves to be called a hillock; and in a country where labour can be had without limit and at a rate infinitely below that of any other part of the world, the expense would be a moderate one for a single nation; and scarcely worth dividing among the great kingdoms of Europe, who would all be benefited by the measure."

Having completed his plan, de Lesseps submitted it in 1852 to Abbas Pasha, Viceroy of Egypt for the Turkish Government at Constantinople, but his application was rejected. Abbas Pasha was succeeded as Viceroy two years later by Mahomet Said Pasha who, being in favour of the French engineer's scheme, requested him to visit Egypt to discuss the matter. On arrival at Cairo de Lesseps again submitted his plan for a Suez Canal, and the Viceroy summoned his advisers and generals to a conference with the Frenchman. De Lesseps was listened to with close attention as he propounded his scheme, and afterwards the entire party left Cairo to inspect the country through which such a waterway would have to be made.

Writing later of the incident de Lesseps related that: "I rode out with them on horseback, and as they were inclined to think more of a man who could jump a fence than of a savant or bookworm, they were well disposed towards me; and when the Viceroy showed them the memorandum I had drawn up they were unanimous in my favour. So I got my concession and this was the origin of the Suez Canal." On 30th November of the same year a document was signed in Cairo calling upon de Lesseps to organise a company under the name of "The Universal Suez Canal Company."

On behalf of the Viceroy, de Lesseps then arranged a conference of European engineers and experts to consider the canal scheme in detail. When this investigation was well in hand he turned his attention to obtaining the Sultan's consent to the project and to enlisting the financial aid of England, for although the Viceroy had optimistically undertaken to bear the entire cost of constructing the canal, de Lesseps felt that the offer was based more on enthusiasm than on available funds. Accordingly in July 1855 he visited Constantinople to interview the British Ambassador.

The interview proved disappointing, for Britain was opposed to the canal scheme, suspecting it to be an adroit French move to gain maritime supremacy in Eastern waters. There was also the further question of British interest in the Alexandria to Cairo railway project. It is interesting to know that Robert Stephenson had been one of a group of engineers who inspected the isthmus in 1847, but he had not been favourably impressed. Perhaps he was somewhat prejudiced against the rival to railways; at any rate he vigorously supported the Government's opposition to de Lesseps when the efforts of the latter to enlist British capital were discussed in the House of Commons.

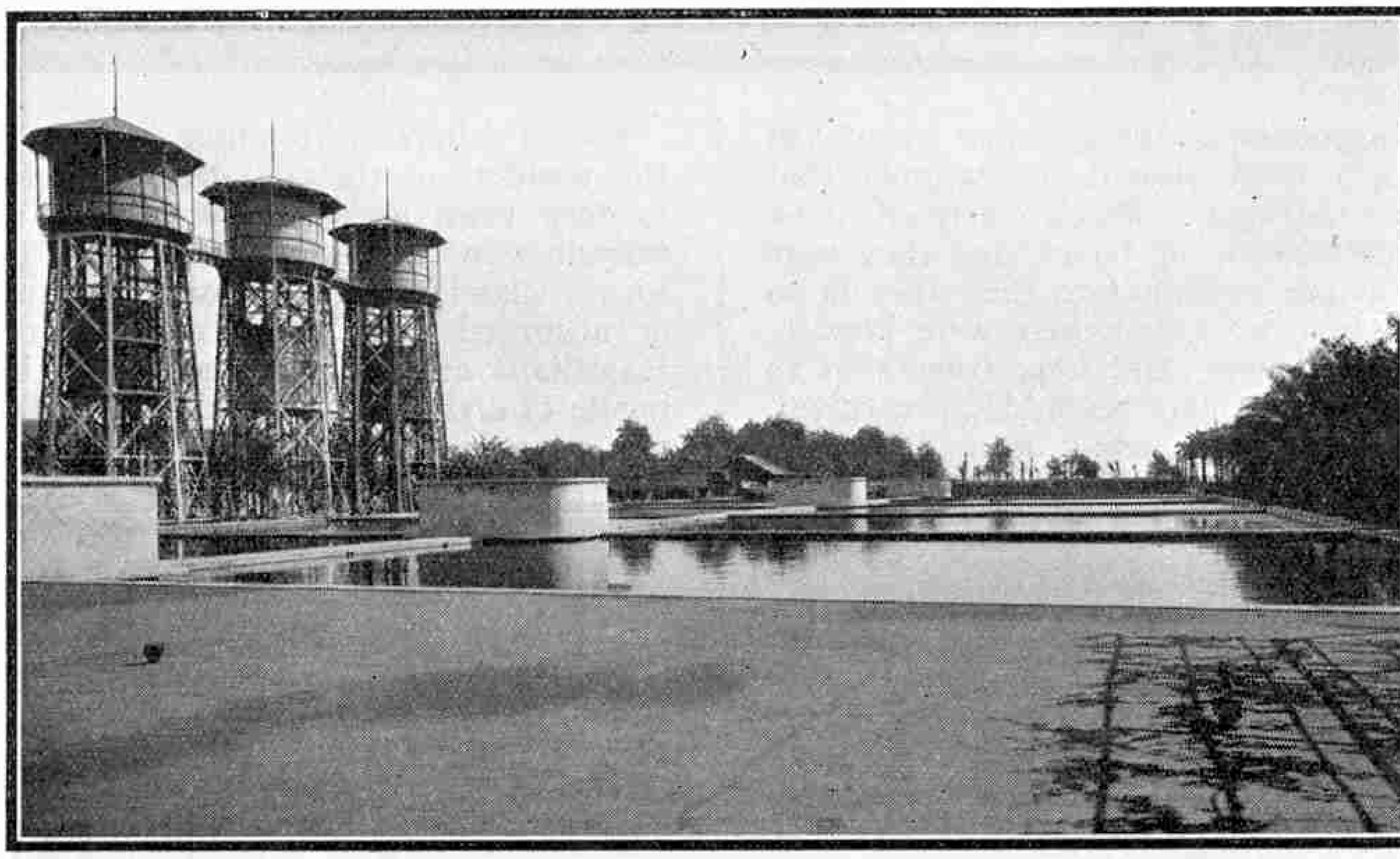
De Lesseps did not succeed in obtaining the sanction of the Sultan at Constantinople, for the latter was considerably influenced by the British Ambassador. The engineer had set his heart on overcoming British opposition, however, and he journeyed to England with that object. Lord Palmerston, then Prime Minister, gave him a courteous welcome but no prospect of financial support by the British Treasury, and, somewhat discouraged, de Lesseps returned to Paris and the conference of engineers.

The conference concluded its investigation and survey in January 1856 and gave a verdict in favour of a canal being made. With the exception of the three English members, all the engineers recommended a sea-to-sea canal, devoid of locks, but having a substantial harbour formed at each end by the erection of a seaward pier and dredging out to deep water. The English engineers strongly advocated a canal with a surface raised 25 ft. above sea-level, provided with terminal locks communicating at one end of the canal with the Bay of Pelusium and at the other end with the Red Sea, the water supply of the canal to be maintained from the River Nile. This difference of opinion led to a further review of the situation, but in June of the same year the conference declared itself definitely in favour of a sea-level canal.

In 1858 the Universal Canal Company was formed by de Lesseps, half of the estimated £8,000,000 required to construct the canal being provided by the Viceroy Said Pasha, while the other half was raised in Europe, France subscribing the greater part of it.

With a company at last formed and funds provided, de Lesseps was not long in purchasing the necessary plant and engaging such European labour as had been decided upon. Early in 1859 the expedition sailed for Egypt, where the first shovelful of earth was turned by de Lesseps, in the presence of his four chief engineers and 150 workmen, at Peluce on the 25th April of that year. Thus the cutting of the canal was begun, despite British opposition to the enterprise and with the sanction of the Sultan of Turkey as yet unobtained.

The Viceroy rejoiced that the scheme was to be carried out and in a signed concession dated 30th November 1854 and held by the company, he granted them some remarkable privileges. This concession not only provided for the formation of a "sweet water" (fresh water) canal for the use of the army of people to be employed, but declared that the company were to become the owners of all land, other than private property, that it became possible to irrigate by means of the canal! Authority was also given to them to work any quarries or mines in this inherited land, and to collect toll from landowners who used the sweet water canal. A further point of great importance was a guarantee to provide four-fifths of the native labour required to carry out operations.

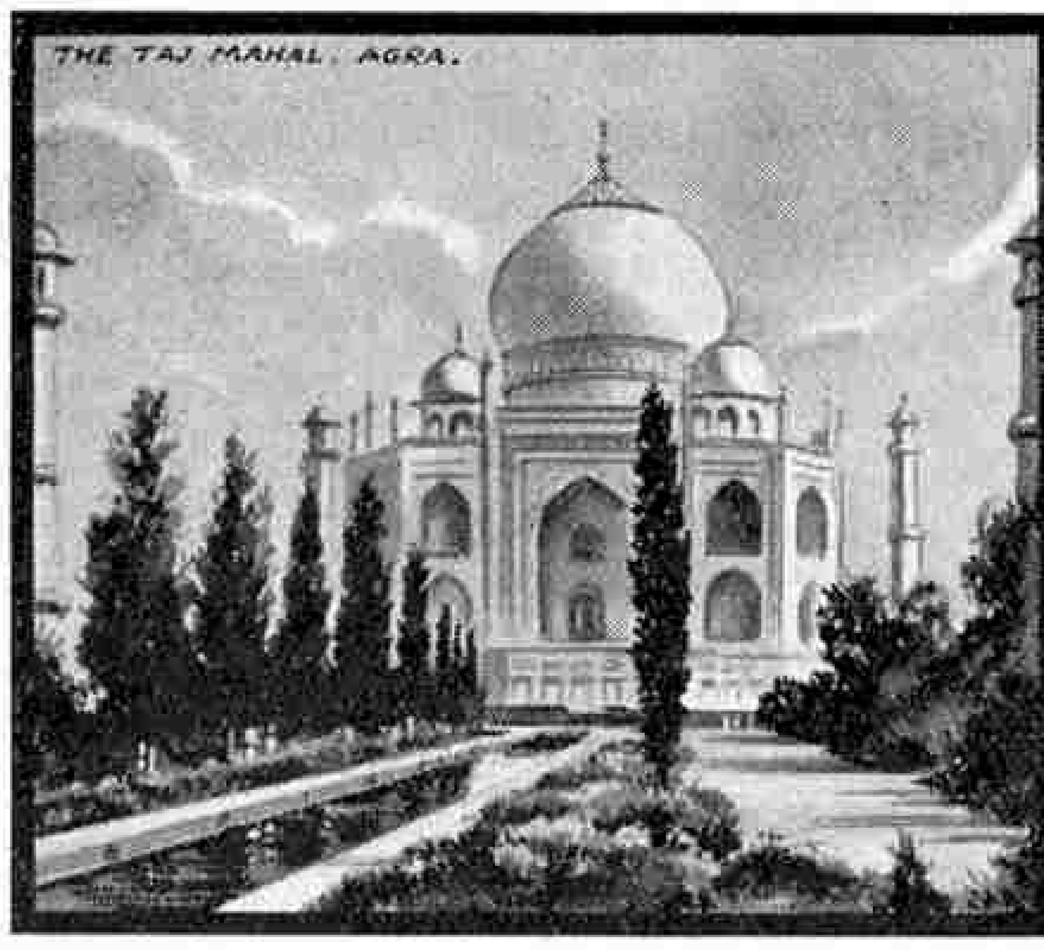


Reservoirs and filters of Suez Canal Co. at Port Said

The cutting of the sweet water canal was of primary importance, for upon an ample supply of water depended the health of the many thousands of workpeople ultimately engaged in the making of the larger canal. Where possible what remained of the ancient waterway was used and some 8,000 native labourers were set to work to clear out thoroughly the old channel.

The Freshwater Canal, as it is now generally known, was led off from the River Nile at Cairo and constructed across the isthmus to the vicinity of Tisma—a locality about halfway along the route selected for the Suez Canal. On approaching the canal route at Tisma the Freshwater Canal was diverted and, following a more or less southerly course, was constructed as adjacent to the Suez Canal route as possible, to where the latter terminated near Suez.

At Tisma, where the Freshwater Canal turns southward, a branch waterway was led off to the north-east and, passing Ismailia en route, terminated close to the Suez Canal, communication with which was provided by means of two locks. From Ismailia, adjoining Lake Tisma, to the northern terminus of the Suez Canal at Port Said, two 9 in. diameter cast iron pipes were laid along the Suez Canal embankment and the fresh water required was pumped through these. A supply was thus assured along the whole length of operations on the Suez Canal itself. The "sweet water" canal still furnishes fresh water to stations along its route, including the two extremes, Suez and Port Said.

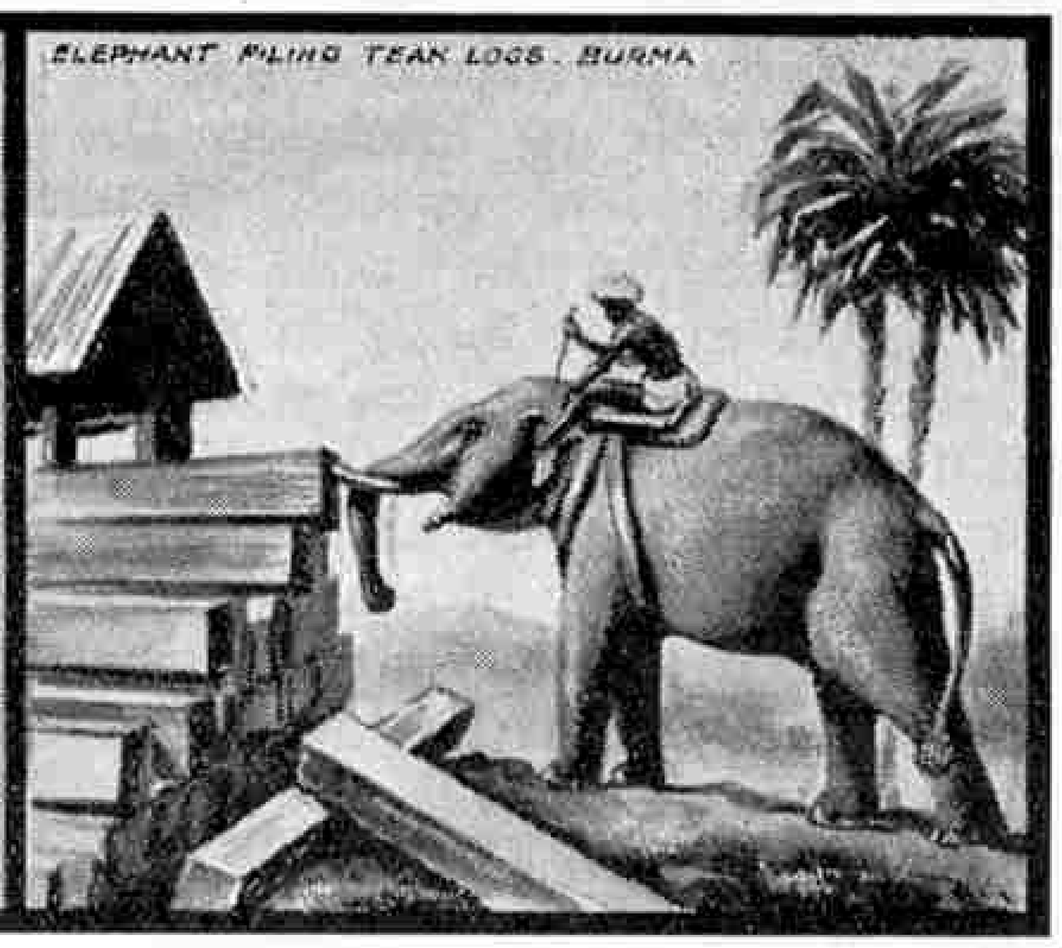


THE TAJ MAHAL, AGRA.

MY TOUR ROUND THE WORLD

by

FRANK HORNBY

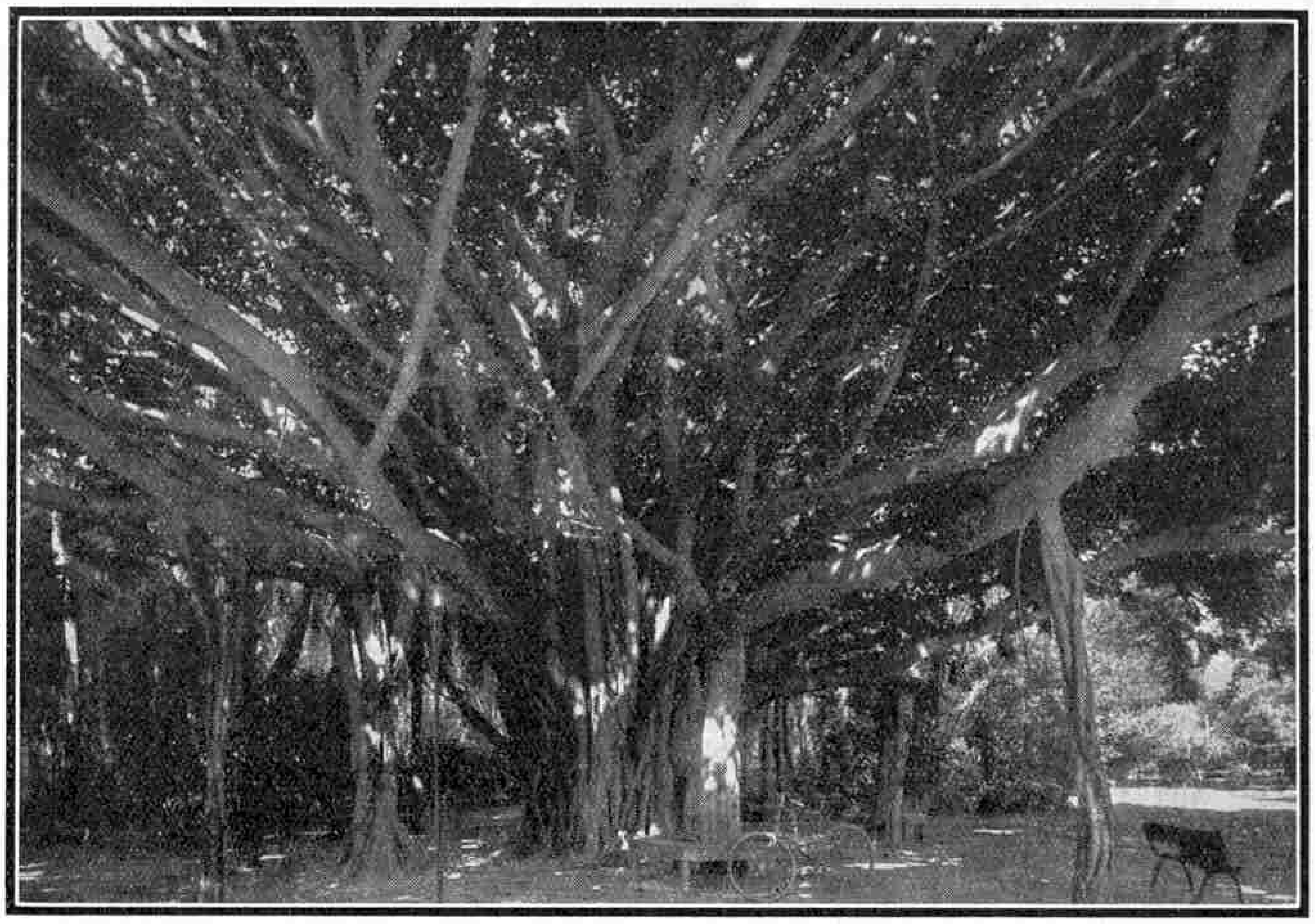


ELEPHANT PILING TEAK LOGS, BURMA

AFTER a short inspection of the principal features of San Francisco, I went aboard the steamer that was to take me to Japan. When I arrived, most of the passengers were already on board, and they were beginning to throw paper streamers to their friends on the quay. By the time we sailed there were literally thousands of these streamers stretching from ship to shore, and our departure strongly resembled a carnival. As the steamer moved gently away from the quay the streamers broke one by one and our voyage had commenced in earnest.

Very early in the 2,090-mile voyage the air became warmer and in a day or two we passed into summer. I was greatly interested to learn one day that we were as far away from land as it is possible to get in any part of the world. We were then 1,045 miles from Hawaii in one direction and the same distance from the American continent in the other. This statement surprised me at first, as it seemed to me that there must be many places quite as far away from land, if not farther. When I came to consider the matter, however, I realised that the shapes of the great continents and the multitudes of islands scattered over the ocean made it difficult to find any place even as much as 1,000 miles from land of some kind.

Our course was directed towards the famous Hawaiian Islands and within six days from leaving America the island of Oahu with its beautiful beaches backed by green-blue mountains appeared in sight. I had heard a great deal about the warm welcome given by the natives to visitors and certainly the reports were not exaggerated. We were greeted in the friendliest manner possible, and the islanders threw garlands of flowers around our necks to welcome us to their wonderful land.

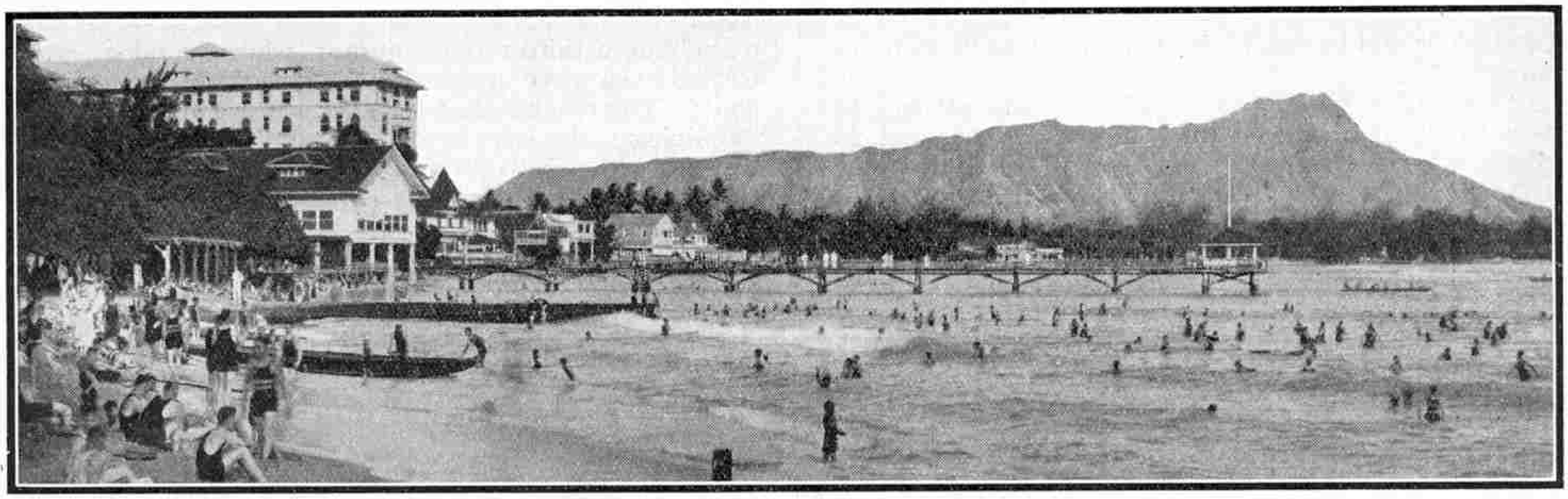


A large Banyan tree, Honolulu

I went ashore at Honolulu and revelled for a while in the wonders of the island. Honolulu itself is quite a modern town and is very bright and pleasant. The introduction of Western civilisation has not been good for the islanders, however, and they are becoming extinct or absorbed in other races. Generally speaking the Hawaiians are tall and handsome, but the noise and bustle of civilisation is not to their liking. They would prefer to be left to live in the same manner as their ancestors, who had no ambitions and for whom nature had made such bountiful provision that work was almost entirely unnecessary.

The Hawaiian Islands are remarkable in many respects. The climate is delightful, the temperature never falling below 52°F. or rising above 90°F., while the rainfall is quite moderate. The islands may indeed be said to enjoy perpetual summer. Flowers of one kind or another bloom all the year round and in summer the streets are lined with the pink and gold blossoms of flowering trees.

I had a most enjoyable motor tour round the island of Oahu. I was greatly interested in the sugar cane and pineapple plantations, which stretched for miles with scarcely a break. The gardens of the cottages in the villages through which I passed might almost have been in England as regards the greenness of their lawns. In the tropics one expects to find grass looking dry and burnt up, but in these wonderful islands there is the lavish growth of the tropics without the parching heat to be found in many other places near the equator. I suppose this is largely due to the fact that the islands are, as one might say, in the very centre of the Pacific Ocean, and the vast mass of surrounding water moderates the climate and prevents any great extremes. It



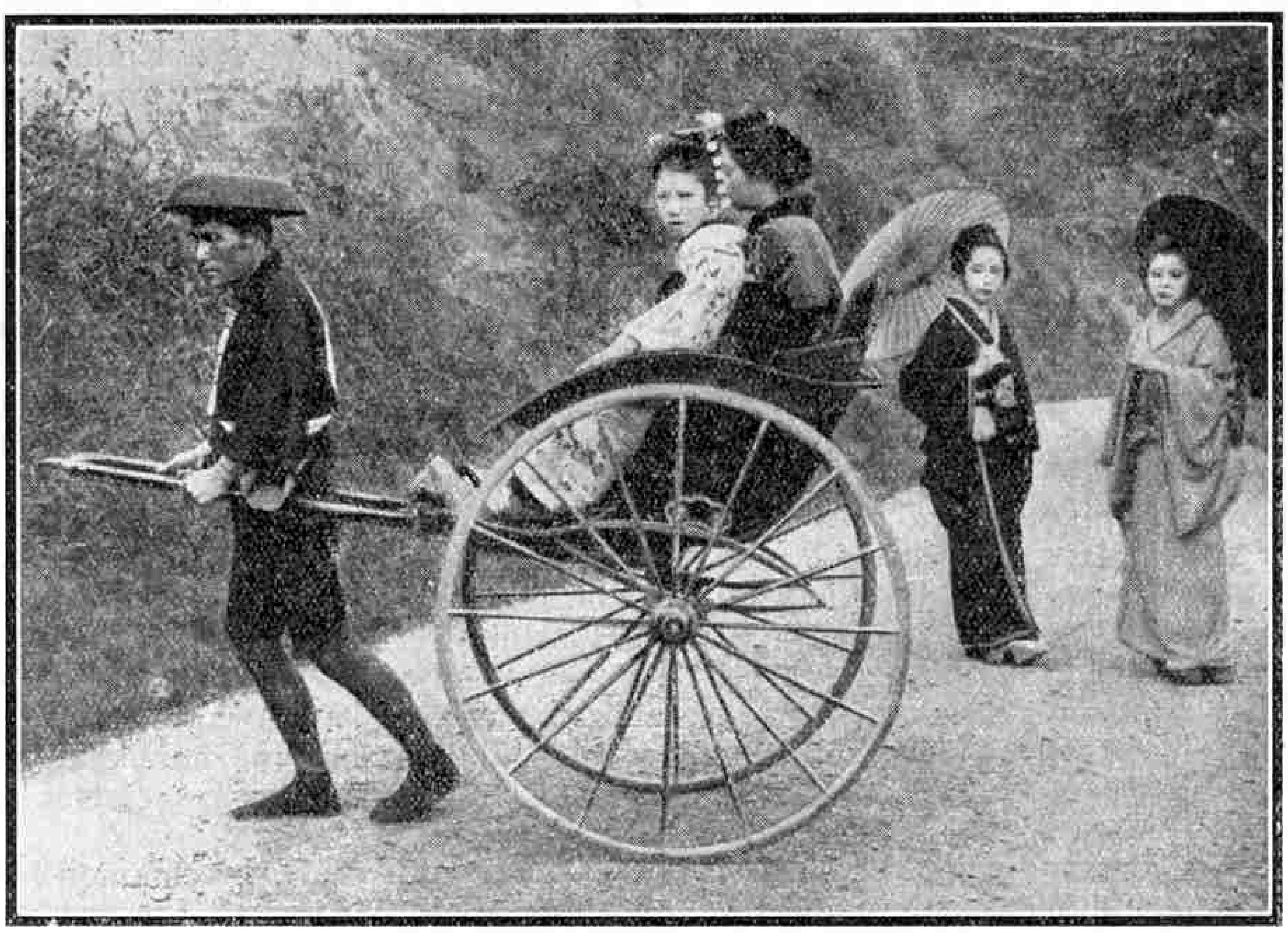
The famous Waikiki beach, Honolulu, where thousands of visitors from the United States, the orient and the antipodes enjoy themselves in a perfect climate

struck me as being very curious to see miles of hedges composed of such plants as hibiscus and crotons which at home can only be grown in hot-houses. Coco-nut palms, the banyan tree and the bread-fruit tree grow in abundance.

On the outskirts of Honolulu I was shown the duck farms kept by Chinese. These appear to be very flourishing and the numbers of ducks are surprisingly large. In an English city I think most of us would be astonished to meet with a flock of two or three hundred ducks waddling homeward, but in Honolulu it is by no means an uncommon sight to see a lean Chinaman armed with a long wand driving a flock of this size and displaying as much skill in controlling his quacking and waddling charges as a sheep dog shows in dealing with a flock of sheep!

One of the greatest features of Honolulu is the sea bathing, which is not surpassed anywhere else in the world. Although my time was limited I managed to squeeze in a visit to the famous Waikiki beach and I saw there swimming that astonished me. The islanders are accustomed to the water from early infancy and indeed they feel as much at home in the water as on land. Swimming to them appears to be no effort whatever and after watching some of their feats I did not feel at all surprised that Hawaiian swimmers have held world's championships.

The favourite water sport is surf-riding. You swim out to sea taking with you a small flat board and then, either standing or kneeling on the board, allow the great waves to carry you ashore on their foaming crests. A tumble means nothing worse than a ducking in the refreshing grey-green water and the reward of success is the indescribable thrill of riding upon the crests of waves that come rolling in from 3,000 miles of open ocean.



A Japanese rickshaw at Tokio

When the steamer left Honolulu the islanders once more hung garlands of sweet-smelling flowers around our necks and the ship and the wharf were gay with red, green, yellow and blue streamers.

As we steamed away into the Pacific and the islands gradually disappeared I thought of the terrible death of Captain Cook, to whom the discovery of the Hawaiian Islands—called by him the Sandwich Islands—is generally attributed. As most "*M.M.*" readers will know, Cook was killed by natives on the island of Hawaii in 1779. What a contrast between that terrible scene and the peace and calmness of to-day!

The steamer was now heading for Japan and during the trip I had the interesting and curious experience of missing a day out of the week. When a steamer sails westward, the clock has to be put back each day by an amount proportionate to the distance travelled. The necessity for this will be clear if we compare the respective times at New York and at London. When the sun is overhead at New York, the time is about five hours after noon at London; in other words, a clock set at twelve when the sun is overhead in London would, if taken to New York, register five o'clock in the afternoon when the sun was overhead. In order to avoid the confusion that would arise from this difference, the clock is put back a total of five hours during a voyage from England to America. As a general rule the change is made at midnight and in the case of a ship travelling at the rate of 500 miles a day the clock would be put back approximately 28 minutes daily.

In travelling round the world the daily alterations made would amount to a total of just one day and, in order to avoid being a day behind everyone else on returning to his starting point, the traveller must miss a day somewhere on the journey. This is always done in the Pacific Ocean, as by international agreement the meridian of longitude farthest from Greenwich, 180° W. or E., has been fixed as the line in crossing which the change must be made. This particular meridian was selected because it lies almost entirely across the ocean, and fewer people live on or near it than is the case with any other meridian. As a matter of fact the line actually passes through several groups of small islands and two bends have been arranged in order to avoid these. If this had not been done we should have the curious state of affairs that when it was Saturday on the Eastern shore of a small island through which the line passed, it would be Sunday on the Western side!

Surf riding at Honolulu

We crossed this line on Wednesday, five days out from Honolulu, and the next day accordingly was Friday, Thursday being missed out. If we had been sailing in the opposite direction, that is eastward, a day would have been subtracted and the week would have had two Wednesdays in it!

In crossing the line I was reminded of a book that used to thrill me in my young days and which I read many times—Jules Verne's "*Around the World in 80 Days.*" I expect most "*M.M.*" readers have enjoyed that story and will remember that Phineas Fogg set out to accomplish his world trip in 80 days for a large wager. I well remember the keen interest with which I followed the hairbreadth escapes and thrills of the hero's journey. I was bitterly disappointed when Phineas arrived in London a day late, and equally excited when the faithful servant who had accompanied him rushed in on the stroke of midnight to say that he had made a mistake in the date and that the journey had been completed in the time allowed and the wager won. Phineas had travelled eastward and had forgotten to subtract a day!

Life on a steamer during a long trip would soon become very monotonous if some kind of entertainment were not provided. It is usual for a committee to be formed among the passengers to arrange a programme of games and other events, so that the time may be pleasantly spent during the voyage. Many attractive schemes were carried out during my trip but the one that interested and amused me most, on account of its novelty, was a "*Hard Times Dinner and Dance.*" On this occasion the dining saloon was transformed into a room resembling a third-rate restaurant, while the saloon was treated even more drastically, for it had sawdust on the floor! The regular electric lights were switched off and the dining tables were lighted by candles held in bottles. The tables themselves were covered with sombre-covered cloths and each passenger's cutlery was wrapped in a paper serviette.

As for the passengers, a casual observer would have taken them for a thorough set of ruffians! Where many of them had obtained their disreputable clothing I have no idea. It was evident that some of the male passengers had raided the crew's quarters for overalls and other apparel, while many of the garments were clearly improvised from old sacks. Taking all this into account, however, several of the costumes were really extraordinary, and I admired the ingenuity with which they had been made and, incidentally, the courage of those who appeared in them!

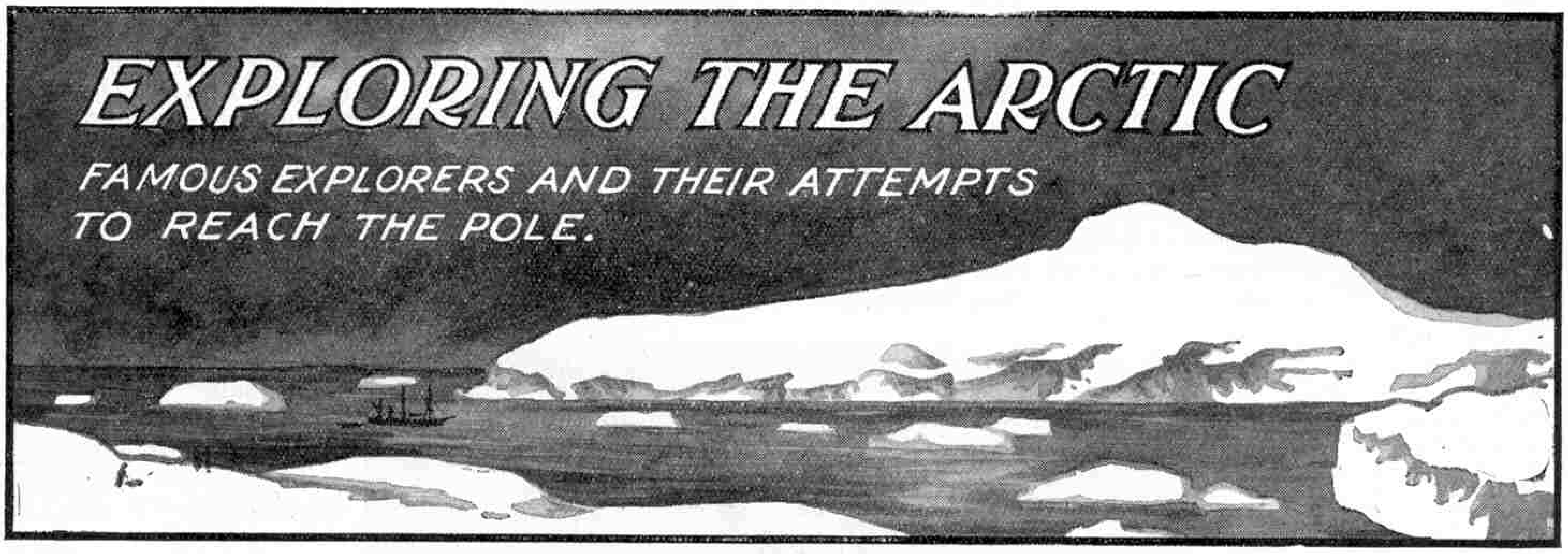
Fortunately the "hard times" principle was not applied to the food, and we all enjoyed dinner in such unusual surroundings. The menu, by the way, struck me as being particularly ingenious. The various dishes were given most fantastic descriptions which included the names, characteristics and peculiarities of various passengers, and naturally caused great amusement, particularly to those of us who had escaped being dragged into the limelight in this manner!

The voyage ended at Kobe, the flourishing Japanese seaport situated on the western shore of Osaka Bay on the Inland Sea that separates the main Japanese island, Honshiu, from the smaller island of Shikoku.

First impressions of a foreign country are always interesting and often very strange. On landing at Kobe two things struck me immediately—the "rick haws" and the peculiar musical clatter heard as the people walk along.

The rickshaws are the common conveyances for people riding about town. To Western e es they look rather like overgrown perambulators with two large wheels fitted with pneumatic tyres and two long shafts. In spite of their unpromising appearance I found them exceedingly comfortable to ride in, and I was astonished at the endurance of the rickshawmen, who are able to maintain a steady speed for a very long period. This native means of conveyance is gradually being superseded by the motor car, and while such a change is unavoidable it seems to me a great pity from a picturesque point of view.

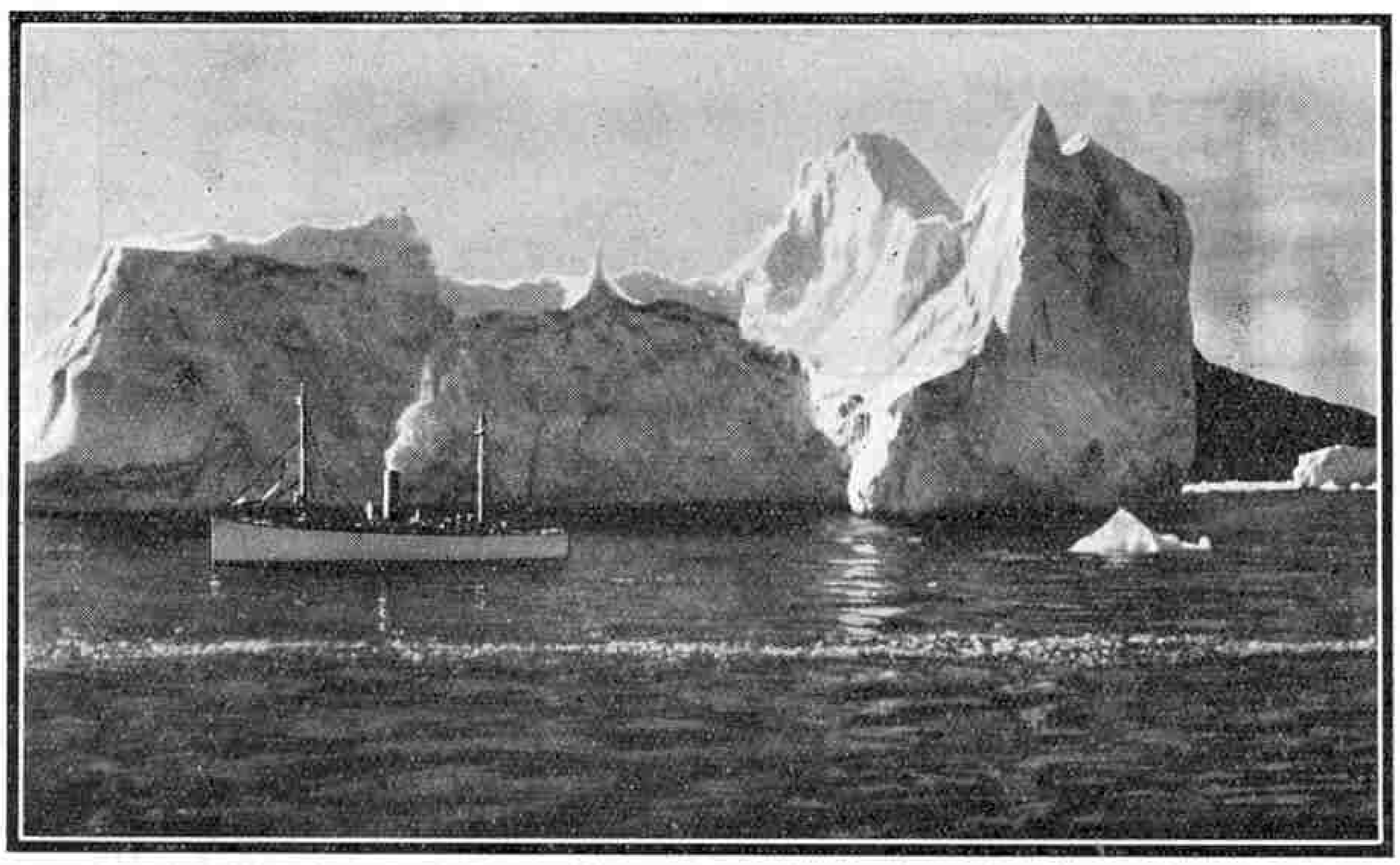
The peculiar sounds heard as the crowds hurry along the streets of a Japanese city strike the ear of a stranger very pleasantly. They are produced by the use of the native footwear, the "gata," which (*Continued on page* 806)



XIII.—THE SEARCH FOR FRANKLIN

LAST month we told the story of Franklin's last expedition, so far as it can be reconstructed from the gleanings of the search parties sent out during the succeeding ten years. In the present article we propose to take up the story of the most important of the attempts to find the lost explorer.

Efforts were still partly directed to the discovery of a possible north-west passage—nothing being known, of course, of the discovery made by the members of the Franklin expedition—as it was with this aim in view that Franklin had planned his course. He had sailed into Lancaster Sound with the intention of turning south or south-west after traversing Barrow Strait. Some of the expeditions therefore followed his course, while others worked their way eastward from Bering Strait or overland to the north coast of Canada in the hope of coming across his track.


An Ice patrol boat close to an iceberg in the Arctic

The growing anxiety regarding his fate led to the despatch of the "*Enterprise*" and the "*Investigator*" as early as 1848. Sir James Ross, who had served with Franklin in previous expeditions and had, in the meantime, done splendid work in the Antarctic, was in charge of the expedition. He sailed into Lancaster Sound and after wintering there he and Lieutenant M'Clintock made a long sledge journey to the west and south-west over the possible routes of Franklin's expedition but without finding any traces of the missing explorer.

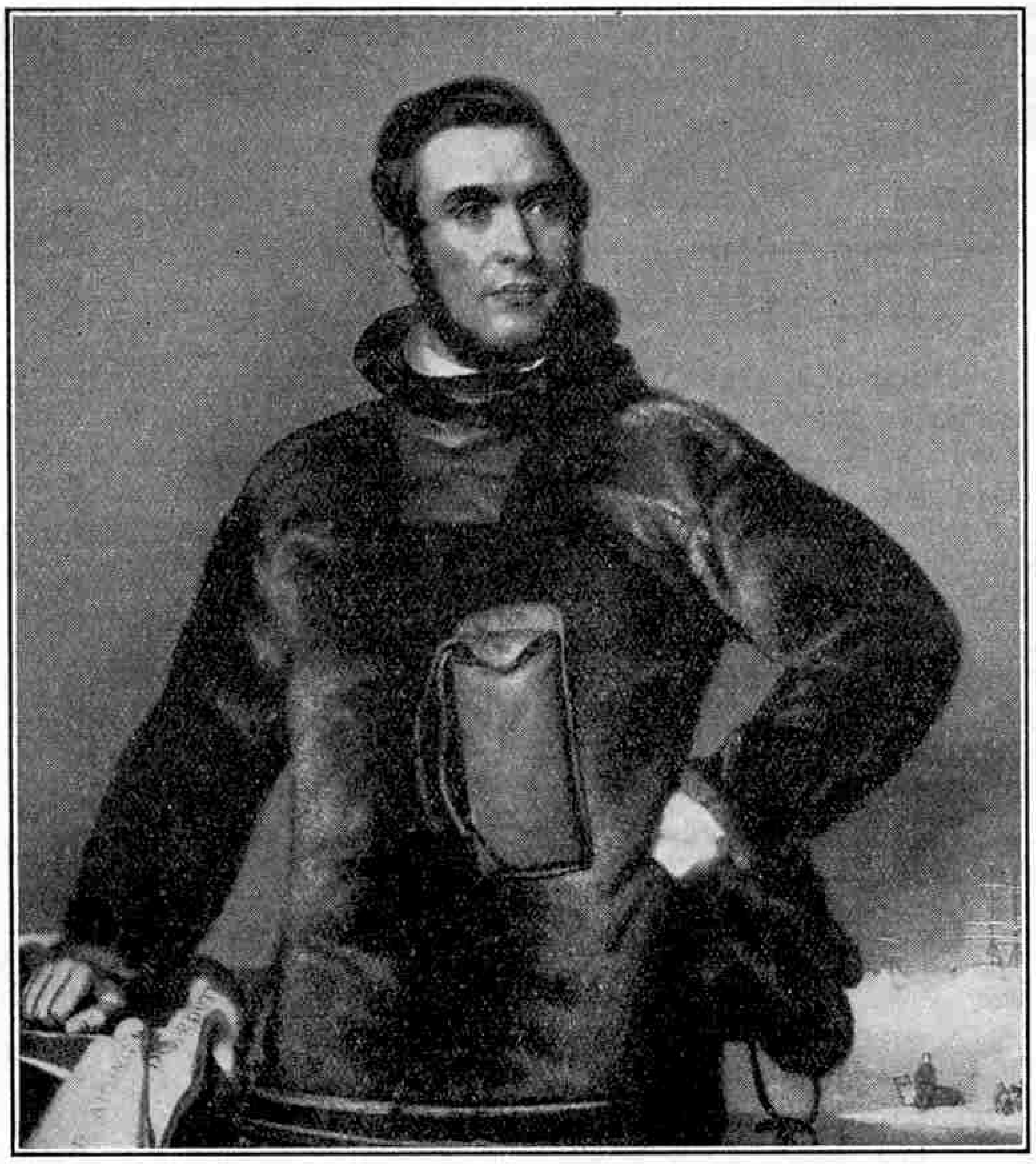
This expedition, like Franklin's, experienced great difficulty in penetrating the formidable ice barrier that confronted them after passing through Lancaster Sound. The Sound is a highway from the east to a section of the Polar Sea that has no direct communication with the warmer waters of the Atlantic and Pacific Oceans, and is therefore packed with ice-floes of stupendous thickness and massive proportions. To make matters more difficult, there is a natural drift of this ice through the Sound towards Baffin Bay. The nature of this drift was made clearly evident in a later expedition when the "*Resolute*" was abandoned to the east of Barrow Strait on 14th May, 1854, and on 10th September of the following year was sighted and taken in tow by an American whaler in Davis Strait. She must have been carried by the floes through Barrow Strait and Lancaster Sound into Baffin Bay and thence south for nearly 1,000 miles! The American Government purchased the boat and eventually presented it to the British Government after refitting it.

Part of Franklin's difficulties were no doubt due to the nature of the ice in the sea north of the American continent. In passing down Peel Sound and Franklin Strait his ships were protected from the pressure of this ice to some extent, but on emerging from the Strait to the west of Boothia they were caught firmly in the ice, from which they were never to free themselves.

Ross's return without any news thoroughly alarmed the country and an extensive search was organised, in the course of which no fewer than ten vessels actually reached the south-east end of the Wellington Channel at the western end of Barrow Strait at about the same time in 1850. These included a vessel under the command of an American explorer, De Haven, and the schooner-yacht "*Felix*," owned and commanded by the veteran Sir John Ross, then 74 years of age. In addition, other vessels under Captain Austin and Penny sailed to renew the search in Lancaster Sound, while Captain Collinson with the ships of the Ross Expedition was sent round Cape Horn to enter the Polar seas from the Bering

Strait, which Franklin had hoped to attain.

The work of Sir John Ross on this voyage was overshadowed by the memorable flight of a carrier pigeon that he released from Cornwallis Island, and which reached its home in Stranraer, Scotland, in five days, after covering 3,000 miles! The American expedition also failed to find any traces of the lost explorers, and its most remarkable adventures were met with on the way home again. Before proceeding far the two ships of the expedition were frozen in. They drifted up the Wellington Channel and back again, and then eastward with the ice for eight months through Lancaster Sound and Baffin Bay, during which time they covered no less than 1,050 miles before being finally released from the grip of the ice.



Captain Penny

The members of other expeditions were more successful. One of the vessels under Austin's command was commanded by Captain Ommaney and it was he who first found traces of Franklin, for on 23rd August, 1851, he came across Franklin's winter quarters of 1845-6 on Beechey Island.

A remarkable circumstance was the discovery of 700 tins of beef. The art of canning meat was not so well understood in those days as it is now and a large proportion of the tins of beef supplied to Franklin's expedition came under suspicion before leaving England. The discovery of the dump on Beechey Island suggested further difficulties in this respect, and some authorities have described the failure of the expedition to the inadequate supply of good meat left. Franklin took with him a supply of Admiralty beef to last three years and there is no doubt that lack of a staple food of this kind would be responsible for illness and sickness.

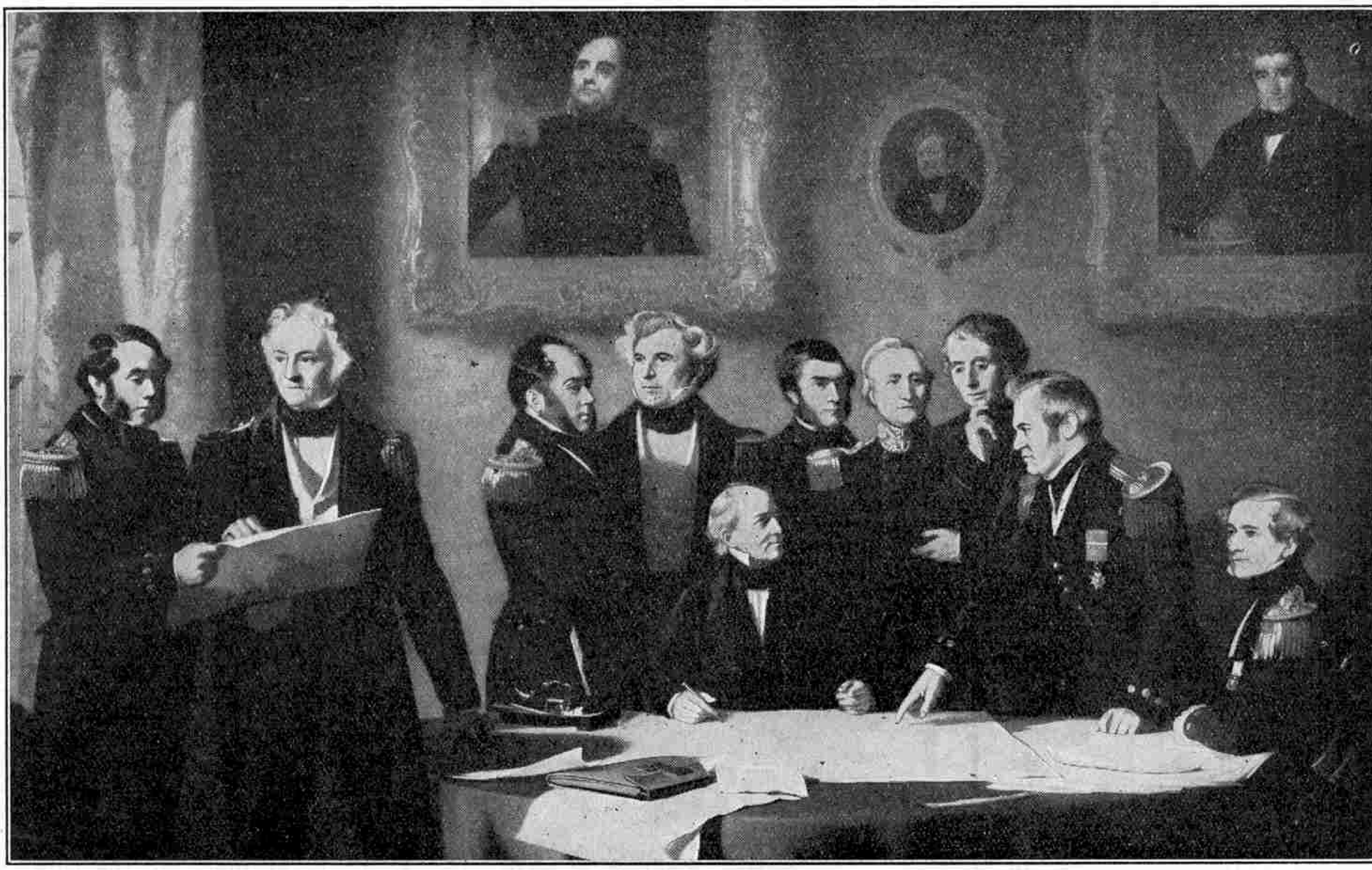
As recently as 20th April, 1926, fresh light was thrown upon this question. One tin of beef from the dump had been brought back to England and on that date, 81 years after packing, it was opened in the City Bacteriologist's Laboratory in Liverpool. It was found to be in good condition and appeared quite eatable. Analysis revealed no defects and a few rats fed on it suffered no ill effects. The beef as originally packed must have been quite sound, for it had even survived the journey to the Arctic and subsequent storage for 76 years.

Other discoveries were made by Penny, a whaling captain who was in command of the two brigs "*Lady Franklin*" and "*Sophia*." Four days after the discovery of the tins of beef by Ommaney, the graves of three of the men of the "*Erebus*" and "*Terror*" were discovered. It was quite clear that these men had died during the winter spent at Beechey Island, but their graves and a few scattered articles were the only additional traces of Franklin found in these regions. The news was of great importance, however, since for the first time there was evidence of the direction in which Franklin's ships were possibly to be found, and the "*Prince Albert*" was sent to convey the facts to England.

In the following years the search was continued, but without any conspicuous success. From his winter quarters on Beechey Island Franklin might have sailed either to the south or south-west, but there was also the possibility that ice conditions had compelled him to attempt a more northerly passage. A discovery made by Penny suggested that the northern passage had been adopted. On a journey to the north of the Wellington Channel, Penny was somewhat surprised to find himself stopped by open water in what are now known as the Penny Straits. It transpired later that during his first summer Franklin had been baffled in his attempts to find a southern course, and in the attempt to find a new route had actually proceeded north for about 150 miles by the Wellington Channel and the Penny Straits, this being the first time the journey had been made. The return was made down the west coast of Cornwallis Island and along Barrow Strait to Beechey Island, the winter quarters of 1845-6, from which the fatal southern journey was commenced.

The expedition under Captain Austin consisted of four ships and was in every way a model as regards method and discipline. It was the members of this expedition who developed sledging methods to the wonderful pitch of efficiency noted at the end of last month's article. A thorough search of the coast was made during this journey, one party under M'Clintock covering 770 miles in 81 days in the journey to Melville Island. Ommaney and Osborn, commanders of two of the vessels of Austin's little fleet, marched southward and discovered Prince of Wales Island, while Brown explored the western shore of Peel Sound. In all, 1,500 miles of coast line were covered and of these 850 were new ground.

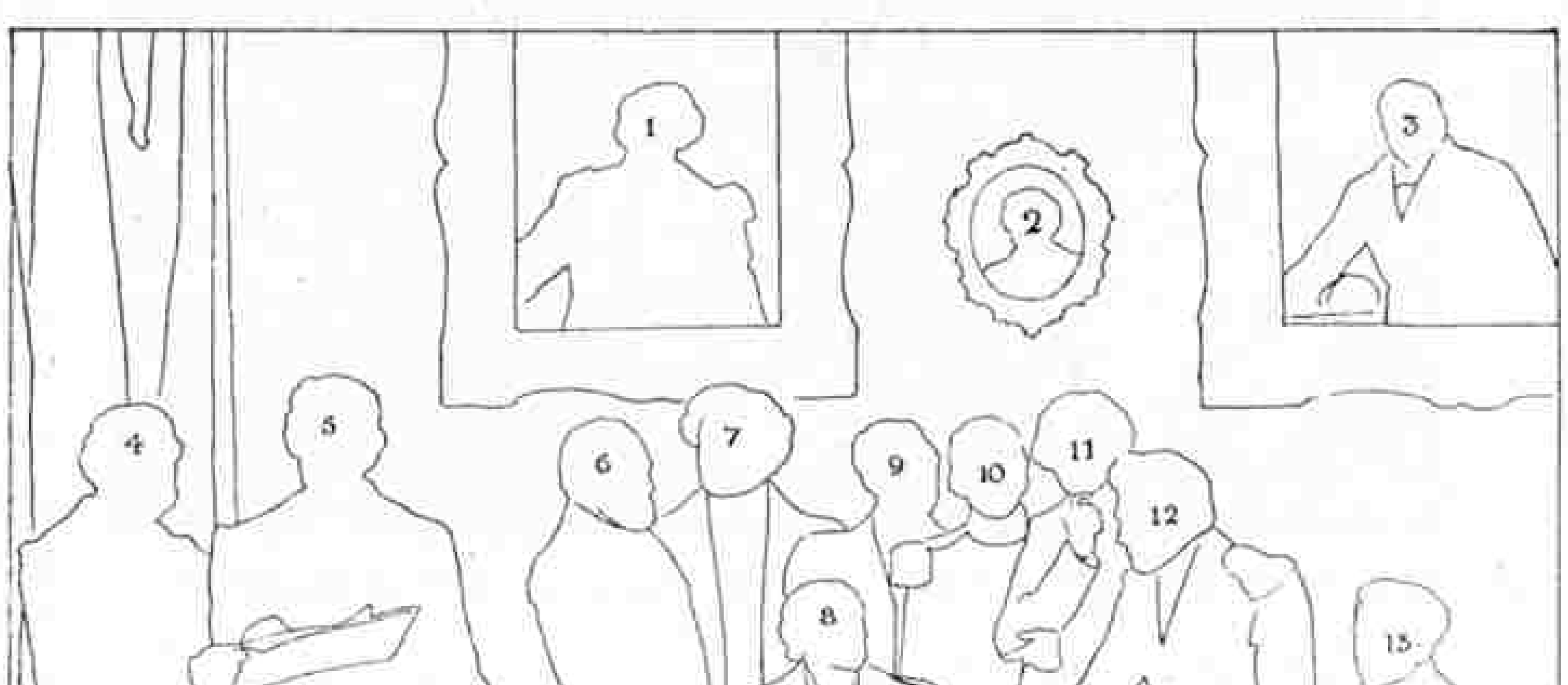
Austin then departed but his ships returned in the following year, this time under the command of Sir Edward Belcher. Sledging parties again set out under Kellett, M'Clintock, and others, and even the remarkable mileage of the previous year was exceeded, no fewer than 8,558 miles being covered. In spite of these exhaustive searches, covering practically the whole belt of land and sea to the west between Lancaster and Jones Sounds, no signs of Franklin were discovered beyond those



By permission] **The Arctic Council Discussing a Plan of Search for Sir John Franklin** [*National Portrait Gallery*

by Ommaney and Penny already mentioned.

After taking home the news of the discovery of Franklin's winter quarters the "*Prince Albert*" was sent out again by Lady Franklin in 1851 under the command of Captain Kennedy, who took Lieutenant Bellot of the French navy with him as a volunteer. Kennedy wintered at Batty Bay in North Somerset and in a remarkable sledge journey discovered that the latter was an island separated from the north of Boothia by a strait to which the name Bellot Strait was given. Had the explorers turned south at this point they might have come across the traces of the Franklin expedition that were discovered later by M'Clintock. They missed this possible discovery by turning north, but they had the satisfaction of having discovered the north point of America, which had been sought by English seamen in vain for three centuries.



(1) Sir John Franklin. (2) Commander J. Fitzjames. (3) Sir John Barrow, Bart, F.R.S. (4) Sir George Back, F.R.S. (5) Sir William E. Parry, F.R.S. (6) E. J. Bird. (7) Sir James Clark Ross. (8) Sir Francis Beaufort, K.C.B., F.R.S. (9) Sir John Barrow, F.R.S. (10) Sir Edward Sabine. (11) W. A. B. Hamilton. (12) Sir John Richardson, F.R.S. (13) F. W. Beechey.

As already mentioned, Captain Richard Collinson was also sent out in 1850 in command of the "*Enterprise*" and the "*Investigator*," the latter in charge of Commander Robert M'Clure. This expedition sailed by Cape Horn so as to commence the search from the west. Before reaching the Arctic the ships had become separated, but Collinson went on to complete what has been described as the most remarkable voyage ever accomplished by a sailing ship in the Arctic regions. It lasted for over five years, during which period the vessel crossed the Atlantic and Pacific, nearly completed the north-west passage by water, and found two north-west passages over the ice practicable by sledge parties. Collinson came even nearer to the discovery of Franklin's fate than Kennedy, for he passed within 30 miles of the spot where the ships had been abandoned.

During his first summer Collinson was forced to turn back from the Beaufort Sea by the heavy ice pack. After wintering (1850) at Hong Kong he sailed up the Prince of Wales Strait but found his progress blocked by ice. Once more turning back he sailed up the west coast of Banks Land, but again was compelled to retreat, and he spent the following winter in Walker Bay at the southern entrance of the Prince of Wales Strait. During the winter sledge parties explored the district and one party under Lieutenant Parkes reached

(*Continued on page 798*)

THE CONQUEST OF THE AIR.—XXVII.

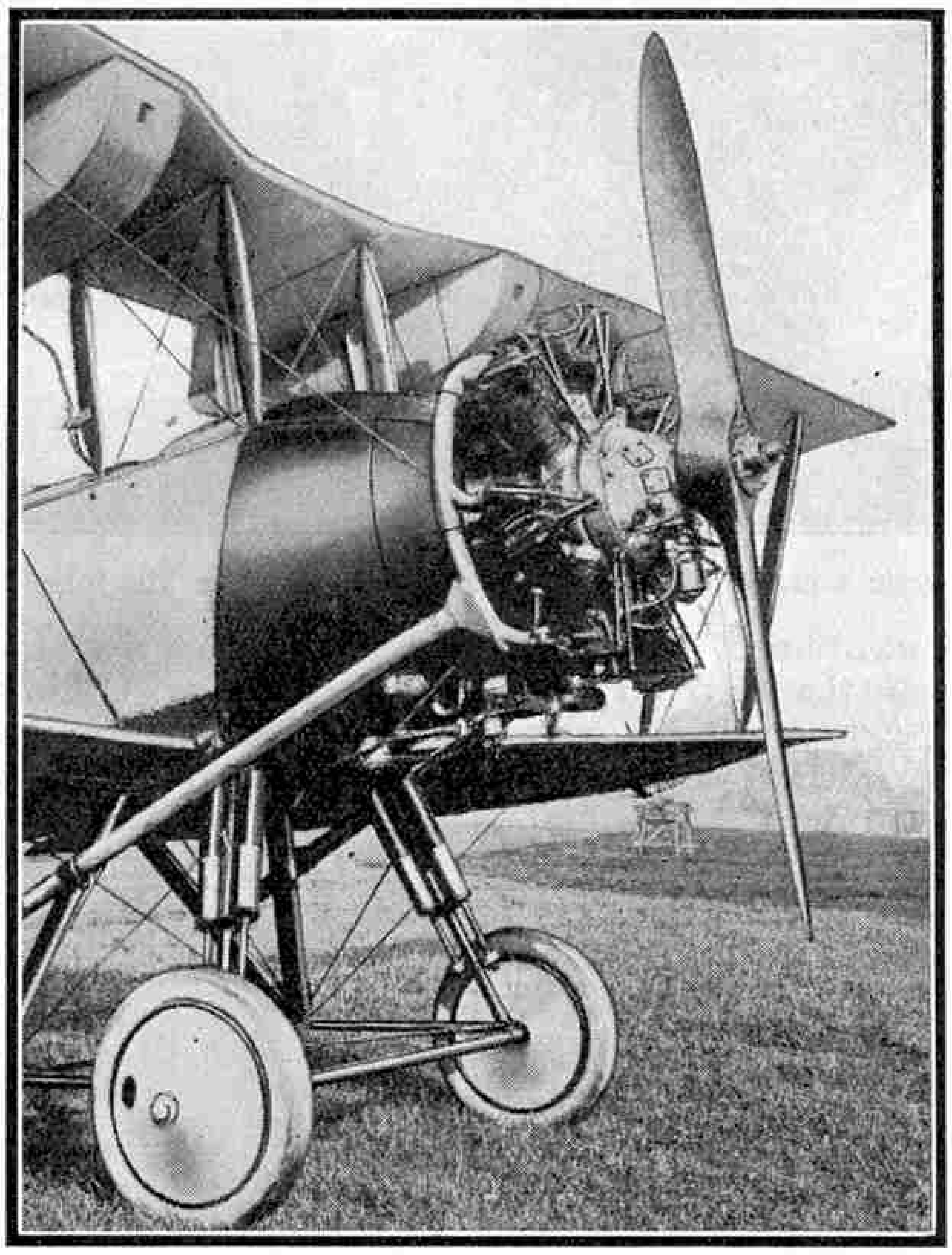
The Pioneer British Aviator:

Mr. A. V. Roe's Remarkable Career

LAST month's "*M.M.*" contained an article by the famous aeroplane designer, Mr. A. V. Roe, in the course of which he gave his views on future developments of flying. This article was written before the recent successful flights across the Atlantic Ocean by Capt. Lindbergh and by Messrs. Chamberlin and Levine, and these achievements show that Mr. Roe's prophecies were by no means fantastic.

The importance of Mr. Roe's pioneer work in aviation cannot be overestimated and an outline of his career and of the development of his famous machines will be of interest.

It is a matter of historic interest that the first flight over British soil was made by Mr. A. V. Roe in a machine designed and constructed by himself. When the news of the achievements of the Wright brothers in America reached this country he was among the few who accepted the accounts of the flights made by these pioneers and he wrote a letter to "*The Times*" in support of his views. It is amusing now to recall that the Engineering Editor of "*The Times*" added a footnote to this letter in which he said that all attempts at artificial flight in the manner suggested by Mr. Roe were not only dangerous to human life but were foredoomed to failure from an engineering standpoint!



Avro "Gosport," Gnome Monosoupape 100 h.p. engine

Mr. Roe, however, was convinced that artificial flight could be made a practical success, and from 1906 onward he devoted his time and savings to this end.

His first step was to build a full-sized flying machine. For this he made arrangements to use a 24 h.p. 8-cylinder Antoinette engine. Whilst awaiting the engine he made several flights, in which he started off with the aid of tows from motor cars. But these ended in crashes, as the towers would hang on too long in their excitement!

The engine finally reached him in the spring of 1908 and on 8th June of that year he accomplished the first flight ever made in England, covering about 60 yds. at a height of some 2 ft. from the ground.

At this point Mr. Roe's troubles began. First of all he received notice to quit Brooklands, where he had never been popular with the management, who seemed to have forebodings of the track being covered with the wreckage of aeroplanes. Then the War Office refused him leave to erect his shed alongside that of Mr. Cody at Laffan's Plain. Finally he succeeded in renting a couple of railway arches near some large open fields at Lea Marshes in north-east London. There he brought a tractor triplane that he had built in the stable of his brother's house at Putney and with it he made many successful flights.

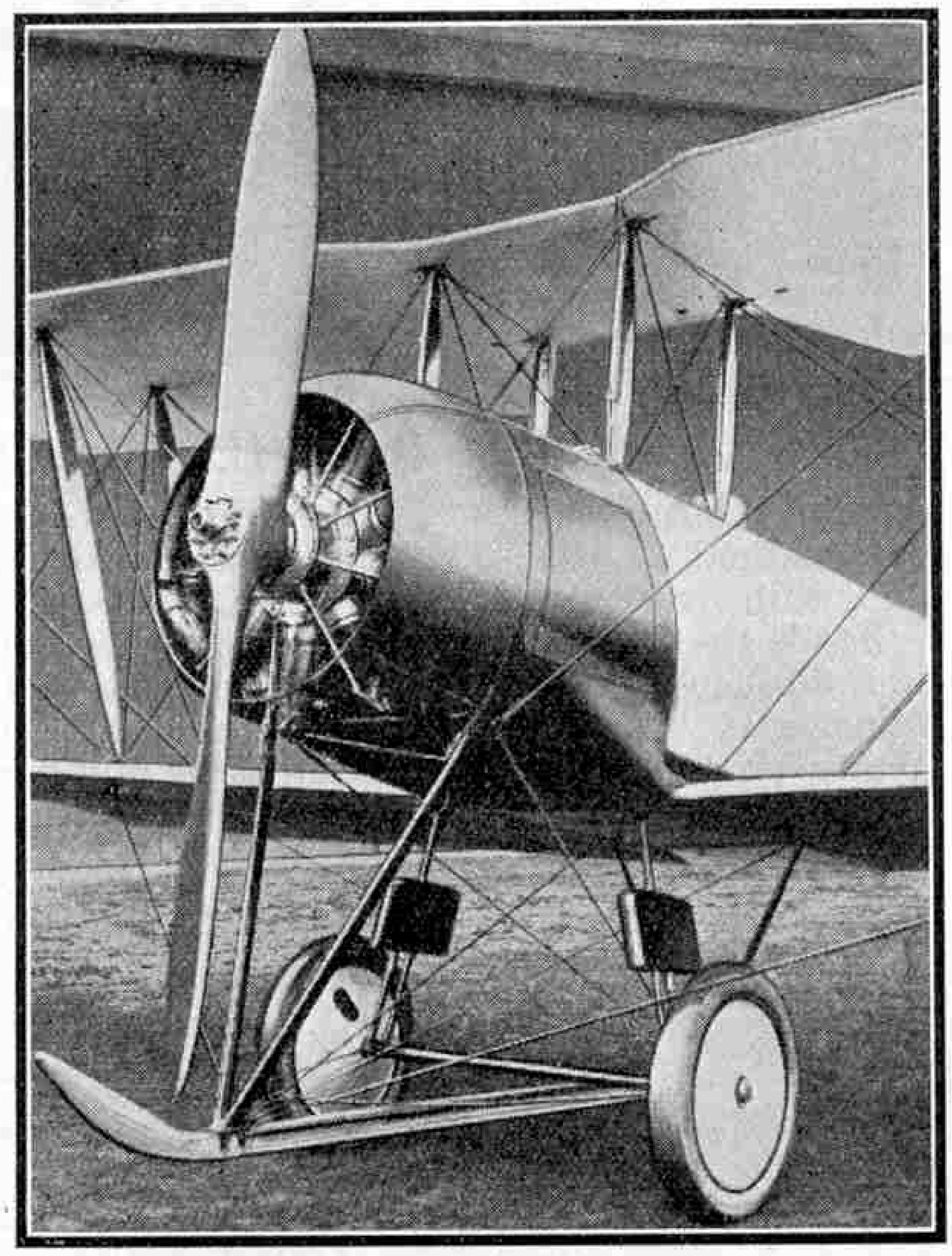
These early flights were certainly short and low, and the nick-name "Roe the hopper" was probably well-deserved. But when it is remembered that his motive power was only a 9 h.p. J.A.P. motor cycle engine which, together with its reduction gear, weighed nearly as much as the subsequent 50 h.p. Gnome, it was undoubtedly a remarkable achievement. After many mishaps his flights gradually improved, however, until at length he was able to cover a distance of 300 yds. at a height of from 6 ft. to 10 ft.

An amusing story is told of a young woman who went down to commit suicide in the river Lea, but went home again when she saw the aeroplane. She had only changed her mind with regard to the manner of her suicide, however, for she wrote to Mr. Roe urging him to let her take his place in the machine so that his life would be saved at the expense of hers. Mr. Roe very tactfully promised that he would allow her to fly the machine when he had perfected it, thus leaving her something to which she could look forward!

There was some doubt at this time as to whether flying in public places was legal. Mr. Roe tried to avoid trouble by utilising the early hours of the morning for his trials, but the local authorities actually instituted police court proceedings after their officials had succeeded in catching him in the act of preparing to fly. It so happened that Bleriot flew the channel at that time and the case was dropped in view of the obvious absurdity of placing obstacles in the way of progress.

Mr. Roe then moved on to Wembley Park, where the recent Empire Exhibition was held, and there he made constant flights with increasing success. Other people at this time had begun to see the possibilities of aviation and Mr. Roe must have smiled when he heard that the centre of the track at Brooklands, from which he had been evicted only a year or two previously, had been converted into an aerodrome. Shortly afterwards he returned to Brooklands and in partnership with his brother produced a 35 h.p. tractor triplane that attracted a great deal of attention.

A. V. Roe & Co. Ltd. have pioneered a number of different types of aircraft. They built the first enclosed aeroplane to fly, they experimented with and built twin-engined aeroplanes during the Great War, and since the war they have built a remarkable variety of machines of all sizes. These included the Avro Ava, a large bombing machine that could take the equivalent load of 60 passengers for a half hour flight. The most famous of their productions is the Avro 504. The interesting story of this machine is well told in Sir Walter Raleigh's fascinating book "*War in the Air*," from which, by permission of the Controller of H.M. Stationery Office, we publish the following extract.



Avro 504 N, Siddeley Lynx 180 h.p. engine

"After a visit to America they (the Roes) settled down to their work and had their revenge on the War Office by producing the famous Avro machine, so named after its inventor. In its original form it was a tractor biplane with a Gnome engine of fifty horse-power, shortly afterwards increased to eighty horse-power. It became, and has remained, the standard training machine for the Royal Air Force. It is sufficiently stable, and yet sensitive, and can fly safely at high or low speeds. It set the fashion to the world in tractor biplanes.

"Mr. Roe had never believed in the front elevators of the early American and French aeroplanes, with the pilot sitting on the front edge of the plane, exposed to the air; nor in the tail held out by booms, as it is in the pusher machines, with the airscrews revolving between the body of the machine and the tail. For his perfected machine of 1913 he had the advice of technical experts and mathematicians, but the general design of the machine was his own, worked out by pure air-sense, or, in his own words, by 'eye and experience.'

"Early in 1914 the German Government bought an Avro Seaplane, which soon after was the first heavier-than-air machine to make the voyage from the mainland to Heligoland. No machine designed in the early days of flying can compare with the Avro. As it was in 1913, so, but for improvements in detail not easy to detect, it remained throughout the war. Its achievements in the field belong to the beginnings of war; it raided the airship sheds of Friedrichshafen, and, handled by Commander A. W. Bigsworth, it was the first of our machines to attack and bring down a Zeppelin.

"For fighting purposes it has had to give way to newer types, but as a training machine it has never been superseded, and even those aeroplanes which surpass it in fighting quality are most of them its own children."

Sir Walter Raleigh's description of the Avro 504 as an unsurpassed training machine is thoroughly justified. Its sound design, incorporating every essential for training purposes, has made it the standard training machine, not only in Great Britain but in many other parts of the world. Quite recently, for instance, 10 of the latest type of Avro training aeroplanes concluded their tests at the aerodrome at Woodford, Cheshire, and were despatched to the Argentine Republic to be used in training army pilots. This is the first order received from the Argentine Army authorities, but several machines have been supplied already to the Argentine Navy, and also to the neighbouring country, Peru.

The original 504 of 1913 has, of course, undergone many modifications and improvements, although it shows very little external change, and the 504 R "Gosport" is the latest development of this world-famous machine. It is light in construction, yet strong enough to withstand the rough handling to which a training machine is subject, and it possesses many interesting features that specially adapt it to its special use.

The end portions of the top main planes have been cut away at both leading and trailing edges as far as the main spars. In this way a better overhead view is provided, an important point in a training school where several machines may be in the air together at the same time. The machine can be flown equally well and landed with equal safety from either cockpit, while the long central skid with its diverging cables seen in the illustration on this page prevents the machine from turning over in the event of a forced landing in cornfields or long grass. Every part is standardised so as to ensure complete interchangeability.

Now that flying clubs in various parts of England are becoming so popular, instructors and pupils, in view of the modern aids to flying, sometimes express wonderment at the way pioneers managed without these aids.

It is impossible not to be astonished at the rapid strides in aviation made between 1908, when Mr. Roe made the first flight in England, and 1913, when the earliest Avro 504 was built, and the great increase in safety and reliability is largely the work of this pioneer. Members of flying clubs accustomed to the appearance of the light aeroplanes such as the Avro Avian now used could be forgiven for hesitating to trust themselves to Mr. Roe's earliest machine, but as Mr. Roe has remarked pioneers themselves feel lucky if they have further fields to conquer.

THE STORY OF COAL

VIII.—EXPLOSIVES USED IN THE GREAT WAR

LAST month the story of the discovery of mauve by Perkin and the resulting foundation of the synthetic dye industry was told, with particular reference to indigo and alizarin. Beside the class of vat and mordant dyes to which these two belong there is another class, comprising what are known as "direct" dyes, which includes by far the greater proportion of coal tar products.

Many thousands of colours that can be used by direct application to the fibre are known, practically none of which exist naturally, and of these well over 1,000 are on the market to-day and are used regularly in dyeing. Their production involves the manufacture of 250 products intermediate between the "crudes," or primary coal tar products such as benzene, naphthalene and anthracene, and the finished materials. The most important of these "intermediates" are beta-naphthol, aniline, and benzidine, complex organic substances that are used in the manufacture of approximately 80, 84, and 110 different dyes respectively. The extraordinary number of substances obtainable from coal tar need occasion no surprise, however, for in the tar itself no fewer than 82 different chemicals have been identified, from aniline and carbolic acid discovered by Runge in 1834, to the substance found in 1919, which is known to chemists by the somewhat alarming name of dimethylnaphthalene.

Courtesy] [*Imperial Chemical Industries Ltd.*

Air view of explosives factory at Ardeer. The earth embankments round the huts are clearly visible

The achievements of the modern chemist in extending the range of colours are among the most remarkable of all scientific efforts. Not content merely with the production of a new colour, the chemist goes far beyond this and attempts to find exactly how the atoms of the elements are contained within the molecules of various dyes and, if possible, how dyeing properties and colour are connected with the arrangement of the atoms and groups of atoms. Very often he is able to improve a colour or make a coloured chemical available as a dye by deliberately changing the nature of the group of atoms in one particular place in the molecule. In the case of indigo, for instance, he succeeded in substituting an atom of sulphur for a group containing one atom of nitrogen and one of hydrogen, thus producing a new colour, Durindone Red B. This still possesses all the characteristics of indigo in being a fast vat dye, but the colour has been changed from blue to red!

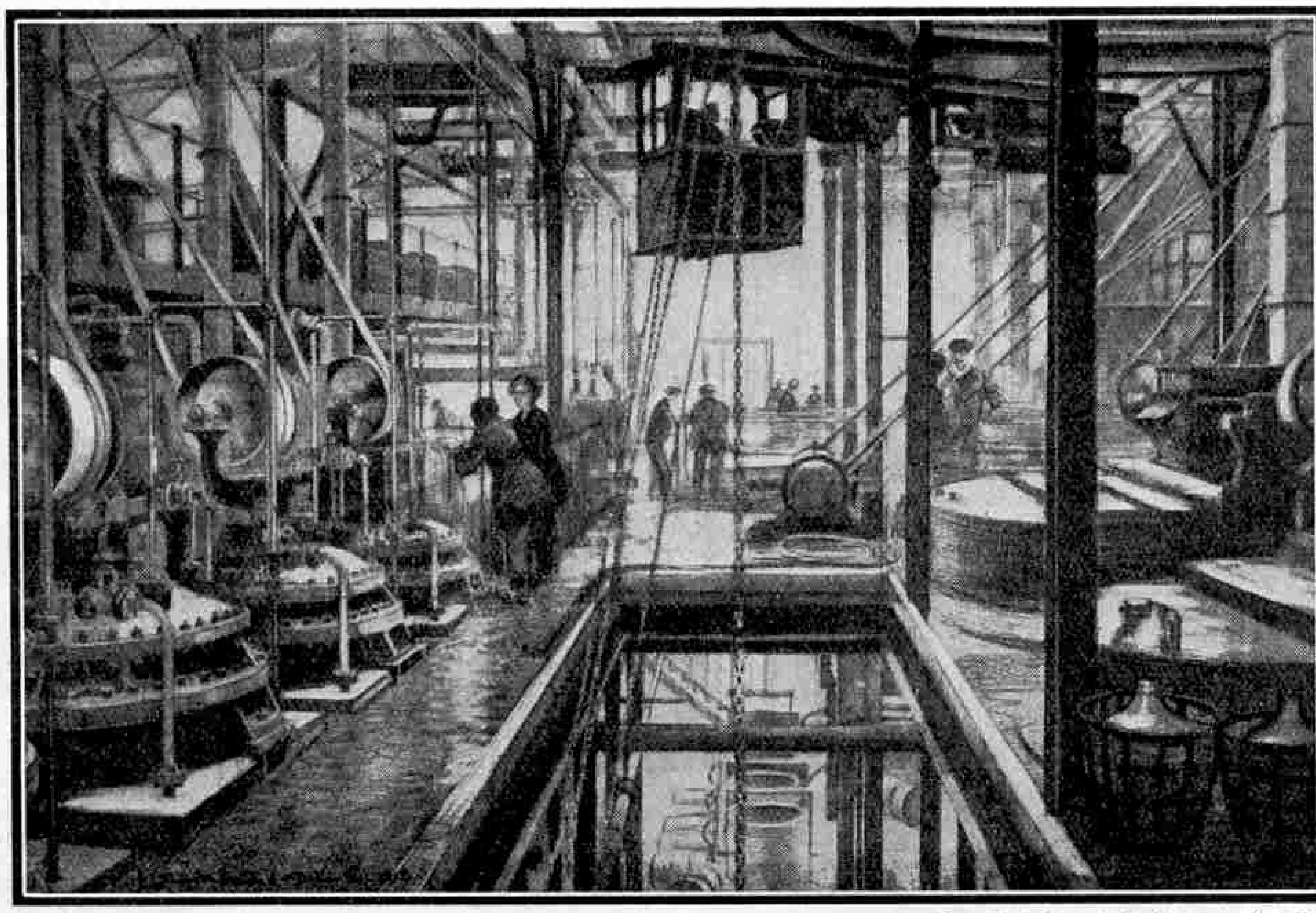
In another case four atoms of hydrogen have been replaced in the molecule of indigo by atoms of bromine, a heavy red liquid with an irritating vapour that is chemically similar to chlorine, the well-known bleaching gas. The substance thus formed is still a blue dye, but the colour is far more brilliant than that of indigo itself and the dyeing properties have been improved.

A very striking point is that the position of the new atoms or groups introduced is of great importance. The introduction of bromine in some positions changes the colour to a brighter and greener blue, while in others the effect is to change the colour towards purple.

That the relative positions of the atoms introduced are of importance may be illustrated by the simple example of benzene. In each molecule this compound has six atoms of hydrogen and six of carbon. When two of these atoms of hydrogen are replaced by two atoms of bromine, it has been found that three different compounds are thereby produced, and as these compounds have exactly the same composition, each containing six atoms of carbon, four of hydrogen, and two of bromine, the difference between them must be due to the difference in the position of the hydrogen atoms displaced.

An interesting instance of this is provided by indigo itself. The hydrogen atoms in it are easily replaced by bromine atoms, as we have already seen, and by replacing two of these from particular positions the far-famed Tyrian Purple is produced. This is a dyestuff made originally from a Mediterranean shell fish that no doubt extracts the bromine from sea water, which contains a minute percentage of compounds of which bromine forms a part.

For years the purple dye made from this shell fish was used for colouring the robes of the Roman Emperors, and possibly was used even earlier for dyeing the curtains of Solomon's Temple. It obtained its name from the fact that it was chiefly made and used in the ancient Phoenician city, Tyre. It was too costly for ordinary use, a pound of wool dyed with it being worth £28 sterling 2,000 years ago, and was strictly reserved for imperial use, a restriction to which we owe the phrase "born in the purple." It has long since disappeared as a dye on account of its high cost and the increasing scarcity of the shell fish from which it was made. The cost and the value of the dye in former times is readily understood when we learn that it would be necessary to dissect about a quarter of a million of the little molluscs in order to obtain an ounce of Tyrian Purple!



Courtesy] [*British Dyestuffs Corporation Ltd.*

A battery of autoclaves in a modern dyestuffs factory. Heating chemicals under pressure in these cast iron vessels is a common operation in the manufacture of dyes

By patient work, Friedländer, a German colour chemist, extracted a small quantity of it and succeeded in finding its composition and in indicating how it could be produced on a commercial scale. Its manufacture to-day from coal tar products would be quite easy and its cost would be comparatively low, but as a dye it has very little merit, its dull shade having no attractions in comparison with other purples more easily obtained. Either tastes have changed considerably or purple dyes were so scarce in the days of the Roman Emperors that any dye of that colour possessed an artificial value because of its rarity. It has been suggested that some secret process known only in the dye houses of Tyre made the shade more attractive, but in view of the close scientific study now made of dyeing processes this is quite unlikely.

Several materials obtained from coal tar derivatives are used in the manufacture of inks and stains. The process of staining is not quite the same as dyeing, but may be described as the saturation of a porous material with a coloured liquid in such a manner that the colour may afterwards be dissolved out again by the liquid in which it was originally dissolved. This is not the case with a dye, which is absorbed or firmly fixed in the fibre of the material dyed in some manner. A true idea of the dyeing process will in all probability be founded on the properties of colloids which have been the subject of recent articles in the "*M.M.*"

Stains are used for home dyeing in various forms and, as already noted, inks are closely connected with them. In the case of the latter, gum is added in the proportion of about 20 grains to the ounce to reduce absorption, thus preventing the ink from spreading too far and also moderating its flow from the pen. Printing inks consist of a pigment ground up in a mill with boiled linseed oil or varnish instead of gum. This makes them stiffer than ordinary inks, and those printing inks that are stiffest and richest in pigment are used for high-class work.

Ordinary black ink is made from galls and iron sulphate, commonly known as green vitriol. These are placed in a bottle with water and shaken daily for a few weeks, after which a little gum is added. Aniline dyes are largely used in making coloured inks, and those made in this way are sufficiently viscous in themselves and do not require the addition of gum.

Indian ink, the black ink that is not destroyed by exposure to the atmosphere or chemicals, may also be regarded as a product of the coal tar industry, for it contains pure carbon obtained by burning some of the solid hydrocarbons that are among the distillation products of the tar. Combustion is carried out with an insufficient supply of air so that the fumes carry unburnt carbon with them and deposit it as soot in the flues. This is moulded into a cake with a little glue and rubbed up for use with water or suspended in a weak gum solution. The immunity of Indian ink already referred to is due to the fact that carbon is a very stable substance that does not dissolve in any solvent or react chemically with many substances.

In the course of work on the coal tar derivatives many other substances have been discovered that have proved of value. A very noteworthy instance of this is saccharine. This is a white crystalline powder made from toluene, and its most remarkable property is its extraordinary sweetness. It is, in fact, no less than 500 times sweeter than pure cane sugar. It has been used at times as a substitute for sugar, but only in times of shortage of the latter, as during the Great War, because unfortunately saccharine has no food value whatever. Its use in cakes and liquors is now entirely forbidden. Its greatest value is as a sugar substitute for individuals suffering from diabetes, to whom ordinary sugar is to all intents and purposes a poison, while saccharine is practically harmless.

Many other well-known drugs are prepared from coal tar products. These include the well-known substances phenacetin and antipyrine, two drugs that are very valuable in the treatment of fevers, neuralgia and headache. Other fine chemicals that are included amongst tar products are many substances used as developers in photographic work, such as amidol, metol and pyrogallol. These are substances of the same nature chemically as phenol, and their use as developers depends on their reducing power, or capacity for absorbing oxygen.

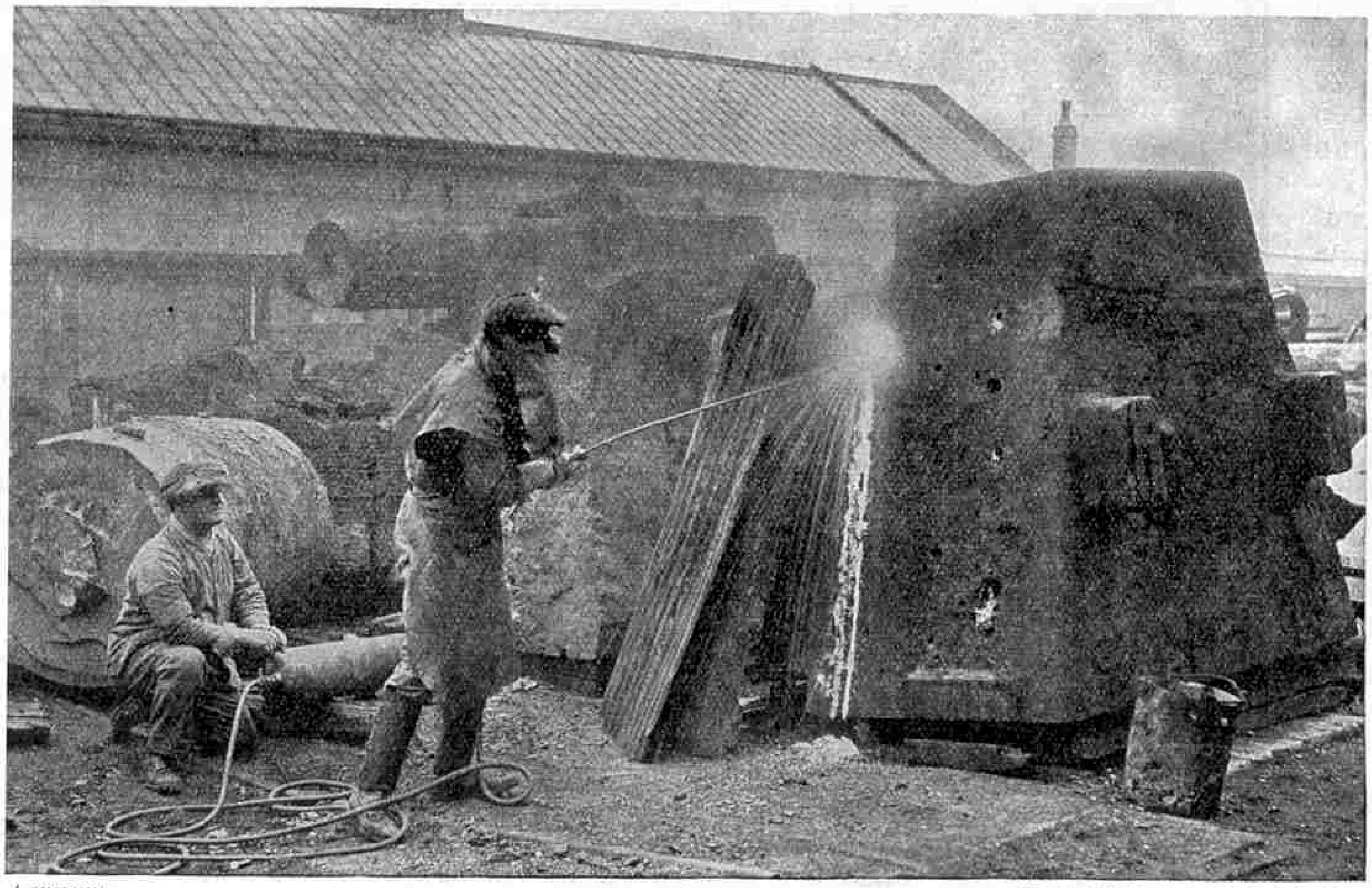
Of all the materials manufactured from coal tar products the most interesting are probably the high explosives, and it was lack of them during the early stages of the war that brought home to us the necessity for establishing chemical industries in Great Britain on a firmer basis. Three explosives of great value are made regularly from coal tar products. These are lyddite, T.N.T., and tetryl, but before dealing with these it will be as well to obtain a clear idea of what explosives are and why they explode.

The earliest explosives used were of the ordinary burning variety, such as gunpowder. This material is a mixture of carbon, sulphur and nitre. The first two of these substances burn fairly readily in air and the purpose of the addition of nitre is to supply them more easily with the oxygen that they require for burning. By powdering and grinding the three together, we make sure that the necessary oxygen is actually on the spot in sufficient quantity to enable the carbon and the sulphur to burn completely away. The result is that the powder burns through very quickly indeed, one hundredth of a second only being required for the complete burning of two pounds of gunpowder. By packing the powder in a closed space, the very rapid expansion due to the heat and formation of a large volume of gas in burning produces what is called an explosion, which may be regarded, therefore, as the concentration of power in an exceedingly short time.

Gunpowder is what is called a "low" explosive, for in recent times other substances, commonly referred to as "high" explosives, have been discovered that act far more violently. The difference between a low and a high explosive may easily be gathered from the fact that two pounds of gun cotton—a typical member of the latter class—require only one fifty-thousandth of a second for complete combustion! Thus the power of an explosion of guncotton is developed in one five-hundredth of the time required for the development of the power in the case of gunpowder! With a high explosive, then, full pressure is developed almost instantaneously, and the shattering effect of the explosion of a charge of gun cotton is far greater than that of a corresponding quantity of gunpowder.

Another difference between these explosives lies in the method of bringing about the explosion. Gunpowder is a very dangerous substance, although easily made. A spark or a rise in temperature may result in its combustion, while the application of any small flame is certain to start the process. If the gunpowder is in a closed space an explosion will result, while if in the open a large hot flame is produced. High explosives on the other hand are often far more stable. One of the most important of them is trinitrotoluene, or T.N.T. as it is usually called. This is a highly efficacious explosive. When a fire occurred in a factory in which it was being made during the war large quantities of it in store merely burned away in a normal manner. If, however, the material is given a shock its molecules are disintegrated almost immediately with a terrific explosion. In order to give it the right kind of shock to produce this effect another explosive, that is itself very easily shocked into explosion, is used. A sensitive explosive used for this purpose is known as a detonator.

The molecules of some compounds break up explosively on very small provocation. An example is ammonium iodide, which may be prepared in small quantities by allowing ammonia solution to act on iodine. A brown powder is produced that may be dried on a sheet of blotting paper. When dried, great care must be taken not to disturb it in any way, for even the shock produced by a fly walking across the paper with the dry substance on it is sufficient to produce an explosion! Needless to say, this substance is too sensitive to be used as a detonator and the one commonly used is fulminate of mercury. To produce the full effect the high explosive to be used is packed tightly in a strong enclosure along with a small quantity of the detonator. The latter is so arranged that at the right moment a shock is supplied to it when it, in turn, by exploding, shocks the high explosive into action.



Courtesy] [Imperial Chemical Industries Ltd.

Boring holes with a jet of oxygen in a solid steel casting in readiness for breaking it up by exploding charges of dynamite within it

The high explosives that have been found most useful are all nitro-compounds. They are usually made by the action of nitric acid on some base. Glycerine, for instance, may be turned into a violent explosive by acting upon it with nitric acid to form what is known as nitroglycerine. In the preparation of these nitro-compounds water is always produced and it is necessary to remove this as it is formed, as the dilution of the nitric acid by it would prevent the process of nitration from being carried out completely. Sulphuric acid, or oil of vitriol, is used for this purpose, so that in nitrating any base a mixture of the two acids is added. There are variations in this process depending upon the particular base that is being nitrated. As a rule a considerable amount of heat is liberated in the course of nitration and stirring apparatus and cooling coils are used to minimise this as far as possible.

Great precautions are necessary in the manufacture of explosives of all kinds, and particularly in the manufacture of high explosives on account of their sudden and violent action. The workers wear special clothing, usually of rubber, to prevent any rise in temperature by accidental friction. Metal is rigorously excluded to avoid the possibility of sparking, while carrying matches is of course forbidden.

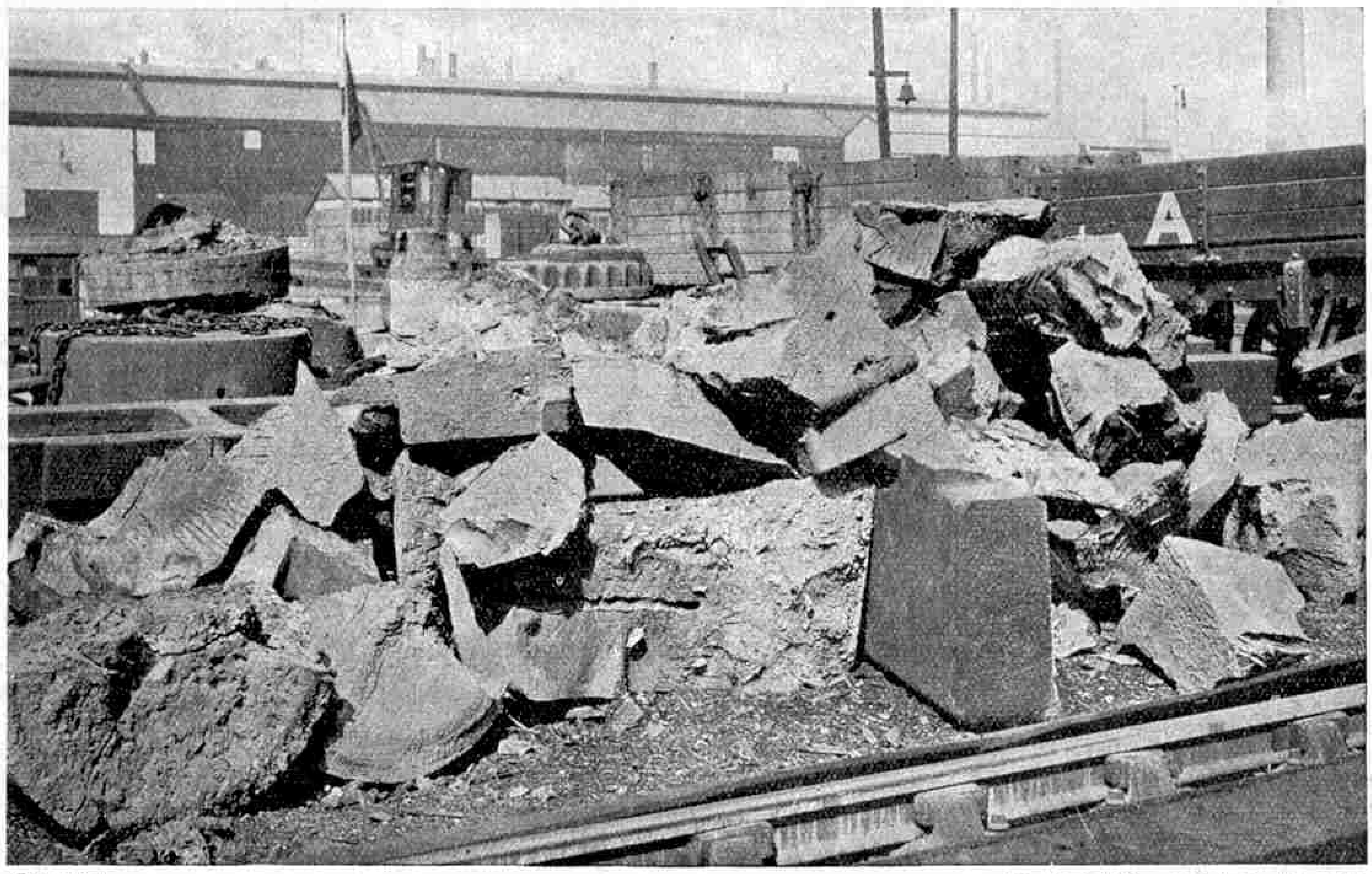
An air view of a large explosive factory will show a large number of small buildings scattered over a wide area, and the buildings themselves are not easily visible as they are low and surrounded by thick earth embankments with sloping sides. The object of thus separating the sections of a factory is to localise the effects of any accident as far as possible, and the adoption of these precautions undoubtedly reduced the mortality during the war of 1914-18 when high explosives were being made on a large scale. By the explosion of one pound of lyddite sufficient energy is developed to blow a weight of one ton to a height of one hundred yards in the air, and the importance of exploding it where it is needed will be readily appreciated!

Nitro-glycerine is an explosive very largely used for blasting work. For this purpose it has been found safer to transform it into dynamite, which is done by soaking kieselguhr, an earthy substance, with the explosive. This explosive is not one of the coal tar products, but these are prepared in a similar way.

The first to be used on a large scale was picric acid, the chemical substance that is the basis of the high explosives lyddite and melinite. The former derives its name from Lydd, the place in which it was first made and tested, and it came into prominence by its use in the Boer War 28 years ago. The name melinite was given to the other explosive because of the honey yellow colour of melted picric acid.

The source of picric acid is the carbolic acid or phenol, as chemists call it, obtained from the middle oil of tar distillation. This is washed with caustic soda, which extracts the phenol by combining with it to form the substance known as sodium phenate, from which the addition of dilute acid liberates the phenol once more as an oily liquid that solidifies into colourless crystals.

Nitration of the phenol then produces picric acid, the chemical name of which is trinitrophenol. It is a yellow crystalline substance and was formerly of some value as a dye, but its use for this purpose was abandoned partly because of its poisonous nature and partly because better yellows became available. Workers with picric acid suffer in health and become yellow and jaundiced in appearance.



Courtesy] [Imperial Chemical Industries Ltd.

After the explosion. The effect of the high explosive on the steel casting shown in the photograph on the opposite page

The supplies of phenol obtained from coal tar during the war proved quite inadequate. A method of making it from benzene was tried but this proved long and troublesome in practice. The result was that the famous T.N.T. or trinitrotoluene was introduced instead.

Picric acid has another defect that made the discovery of a substitute a matter for congratulation. It readily forms compounds with metals, for example with iron, and these compounds are far more easily shocked into explosion than the acid itself. The new explosive, T.N.T., is much safer in this respect.

T.N.T. had been used by the Germans for some time prior to the outbreak of war. Toluene, the raw material for its manufacture, is one of the constituents of the light oil obtained during distillation of tar, and it is obtained pure, as already explained in previous articles in this series, by the use of the process of fractional distillation. It is transformed into the explosive by the usual process of nitration.

T.N.T., as usually prepared, is a reddish-brown crystalline substance, but when pure is light lemon in colour. It is a very stable substance and in fact sufficient T.N.T. to blow up entire buildings has been kept for many years in bottles in the store rooms of chemical laboratories! There was no danger, of course, as it is practically impossible to cause T.N.T. to explode except with the aid of a detonator. Nevertheless the first fire that occurred in a T.N.T. factory during the war was no doubt a source of great anxiety to the chemists watching it, for they were by no means certain what the behaviour of the explosive would be in the circumstances.

For actual use in shells T.N.T. was not used alone, but was mixed with ammonium nitrate, forming what was known technically as amatol. In the later years of the war the amatol used contained only 20 per cent. of T.N.T.

It was the introduction of these high explosives on a tremendous scale that was the outstanding feature of the war of 1914. Ordinary shrapnel soon proved inadequate in itself, as it was absolutely useless for destroying trenches and gun shelters. As already explained, T.N.T. was preferred to picric acid, although it was slightly less violent in action. Complete combustion is rare with both explosives, with the result that dense black clouds of free carbon are liberated when a shell containing them bursts. It was from this effect that the names "Jack Johnsons" and "Coal Boxes" used by the troops in France were derived.

The difficulties experienced by the Allies at the beginning of the war with regard to the supply of explosives was nothing in comparison with the difficulties of the Germans in the later stages.

While the tar industry was being developed in this country it was possible to fall back upon other sources of the raw materials required in making explosives, with results that were tolerable if not entirely satisfactory. One instance of this was the supply of toluene for T.N.T. It had been discovered that a minute proportion of toluene was contained in petroleum from Borneo, and practically the whole of the required supply for 1915 was obtained from this source. As the output from coke-oven plants and gas works increased to the required amount in the later stages of the war, the extraction of this small proportion of toluene was discontinued.

The resources of the Germans diminished as time went on and in their efforts towards the end of the war to prepare a sufficient quantity of suitable explosives they used nitro-compounds prepared from all sorts of weird materials. The lack of really suitable materials, however, was rendered evident by the inferior quality of the German explosives, and this contributed greatly to the final collapse of the Central Powers in 1918.

There seems very little connection between the atmosphere surrounding a gasworks or tar distillery and that of a hay field, but the characteristic scent of the latter is due to coumarin, a substance easily obtained from carbolic acid. Thus the essence used in making the well-known scents, Jockey Club and New-mown Hay, is actually obtainable, by a few chemical changes, from a corrosive poison. In addition to coumarin it is possible to prepare many other scents and essences from coal tar including those present in hawthorn blossom, meadow sweet, jasmine and musk.

Doctors also owe something to coal tar. For instance, several anæsthetics of the local type, such as the stovaine and novocaine used by dentists, are obtained indirectly from this universal source. That tar is also the source of a valuable antiseptic is not regarded as surprising by those who recall the use of hot pitch after amputations by the surgeons of Nelson's day. In reality there is no connection, for the hot pitch simply cauterised the wound while the modern product, trypaflavine, a yellow dye, has the remarkable property of attacking the germs of blood-poisoning in the blood itself without interfering with the white corpuscles, or germ fighting cells, already present. It is thus an ideal antiseptic.

The instances here given of the products obtainable directly or indirectly from coal tar do not exhaust the list by any means. The tar is such a mine of chemicals that many further developments will no doubt take place, and it will remain for years one of the most valuable of industrial products.

Civil Aviation in Italy

Civil aviation is making rapid progress in Italy. Four well-established airways are now operated by Italian companies and it is noteworthy that each of these routes is worked separately by an individual firm, no undertaking of the nature of the Luft Hansa having been launched so far.

The first airway was established on the 1st April, 1926, between Turin and Trieste, and was operated as a summer service only. On its suspension in October 1926, a service between Venice and Trieste was maintained and arrangements were made for a south-eastern extension of the line along the eastern Adriatic coast to Zara. Another permanent line passing through Venice operates between Vienna and Rome. The third route connects Genoa, Rome, Naples and Palermo, while the fourth line runs between Brindisi and Constantinople via Athens and the Isle of Lemnos.

Projected new routes include one from Brindisi to Lausanne joining up the towns on the eastern coast. This line will have branches also from Milan to Innsbruck via Merano, to Zurich, and to Genoa via Pavia. Another important development is the extension of the Vienna-Rome line to Tripoli on the North African coast, by way of Messina and Syracuse. A flying boat service will connect Rome with Terranova and Cagliari, the Sardinian ports.

At present 26 machines and 33 pilots are employed on the permanent lines. Seven Dornier Wal machines operate on the Genoa-Palermo line while the same number of Savoia 55 flying boats serve the Brindisi-Constantinople route. Consideration is being given to the development of airships and it is stated that the largest semi-rigid airship in the world will be completed this year in Italy and will be used on a service between Rome and Buenos Aires.

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The Luft Hansa Air Fleet

The aircraft fleet of the Luft Hansa now comprises 50 triple-engined passenger aeroplanes; 18 twin-engined passenger seaplanes; 137 single-engined passenger aeroplanes and 15 machines reserved for newspaper work.

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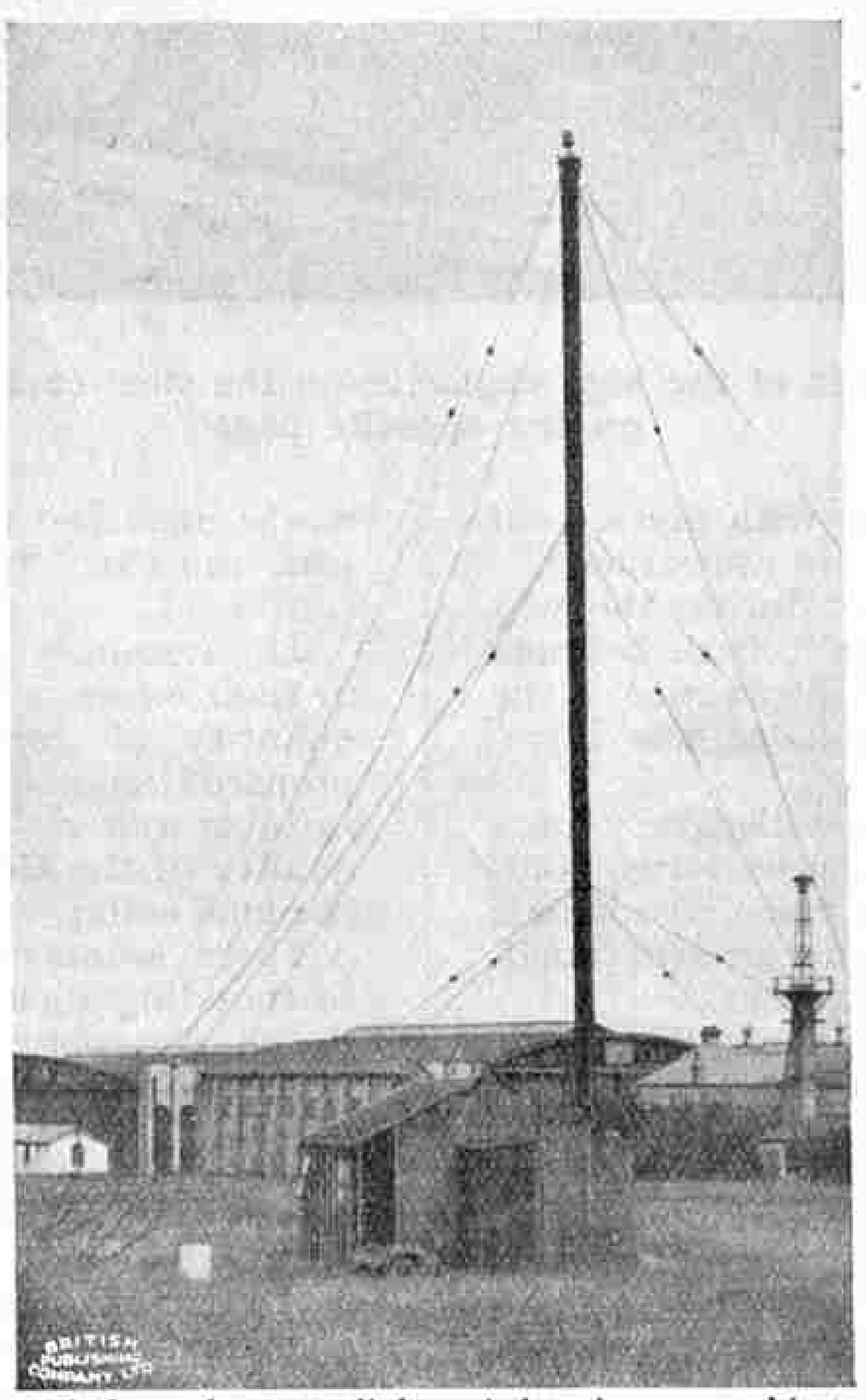
A Himalayan air service is to be operated by two English pilots by permission of the Maharajah of Kashmir and the Rajah of Poonch.

Russian World Flight Project

It is reported that a rigid airship larger than any other in the world is to be constructed by the Soviet authorities, who intend using the vessel for short propaganda flights through Russia. Subsequently a world-flight is to be attempted, and it is considered that it will be possible to complete this journey in 22 days, provided the average winds are favourable.

Wireless and the Aeroplane



Wireless plays a vital part in airway working. The above photograph, published by the courtesy of Imperial Airways Ltd., shows the shed and mast of the direction-finding apparatus at Croydon. (See also illustration on next page)

A Trans-Atlantic Air Service

An air service between Europe, Dakar and South America is to be inaugurated in the early autumn by the Latecoere Company. A contract granting to this company the concession for the transport by air of mail between Europe and South America has been ratified by the President of the Argentine Republic.

Plans for New American Airship

The results have been announced of the United States Navy's competition for a design for a new airship of 6,500,000 cu. ft. gas capacity, for which a prize of approximately £10,000 was awarded. An interesting rule of the competition prohibits the winner of the prize from competing for the contract for the ship.

The new aircraft will be capable of carrying five aeroplanes and a crew of 45 officers and men. It will be 780 ft. in length and 135 ft. in diameter, and its duties will be to operate with the Navy. With a cruising speed of 57 m.p.h. it will have a range of 12,500 miles, while at the maximum speed of 80 m.p.h. its radius of action will be about 7,000 miles. The construction of the vessel will occupy about three years and its cost is estimated at between £760,000 and £900,000.

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Cherbourg as an Air Port

The French Naval authorities have granted permission for foreign aircraft to use the port of Cherbourg, subject to certain restrictions in regard to particular areas. This permission makes it possible that Cherbourg will become an international air port within the near future. A plan for the construction of a pontoon to be moored in the harbour to serve as a base for commercial aircraft has been put forward by the Cherbourg Chamber of Commerce.

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German Air-Railway Co-operation

Figures recently published show that the average distance of each commercial flight in Germany is decreasing, indicating an increased use of the short national services. This development may be traced directly to the reduction in the cost of short-distance flights. For example, the cost of the journey between Berlin and Leipzig is only four per cent. cheaper by first-class express train than by air, while the first-class express train fare between Berlin and Breslau is actually six per cent. more than the cost by air.

An agreement has been reached between Luft Hansa and the German State Railways which, it is anticipated, is likely to be the forerunner of ultimate co-ordination of rail and air transport. Passengers by the aeroplane services can now consign their luggage by rail without paying the passenger fare, the express package rate only being charged.

German Long-Distance Aircraft

The large number of international air services operated by the Luft Hansa has caused German aircraft designers to concentrate to a great extent upon machines suitable for long-distance flights. At present the largest aeroplane operating on German services is the Junkers G.31, an all-metal craft driven by three Junkers motors and having a radius of flight without landing of about 625 miles. The Dornier Superwal is another machine of similar type. Two Rolls-Royce engines each of 650 h.p. are fitted and the aeroplane has a radius of action of about 1,250 miles.

A newer machine, the Rohrbach Rocco seaplane, is fitted with two 650 h.p. Rolls-Royce Condor engines driving four-bladed wooden propellers. The most modern aircraft features are incorporated in the design of this machine, which has a normal flying speed of about 110 m.p.h. and a radius of action of about 825 miles. The hull is in the form of a ship and a strong keel supports the whole frame. It is divided into watertight compartments so arranged that the machine will float even when two adjoining compartments are leaking. If the boat-shaped floats were to be stove in, the machine would be supported by watertight chambers in the ends of the planes. The two cabins provide accommodation for 10 passengers and sound-deadening covering is fitted to the walls of these cabins to enable conversation to be carried on while the engines are running.

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Electrical Equipment of R.100

The airship R.100 now under construction for the Air Ministry at North Howden, Yorkshire, is to be equipped with an electrical system providing for compartment and navigation lighting, compartment heating, cooking and water heating and wireless signalling. An installation of 25 k.w. has been found sufficient to satisfy the conditions and this will be installed by the Metropolitan-Vickers Electrical Company in the machinery car. The small petrol motors used for starting the main propelling motors will be employed to drive the generators. Special safety features will be included to ensure that no open sparking can take place at any part of the circuit.

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Sparrows' Strange Nesting Place

A remarkable disregard for noise is shown by 12 sparrows that have built their nests a few feet above the engine test beds of Imperial Airways at Croydon Aerodrome. Some idea of the noise that the sparrows have to endure may be gained from the fact that, after overhaul, the 450 h.p. Napier "Lion" engines are run at full throttle for hours on end! It is supposed that the birds are prepared to endure all this uproar for the sake of the heat that rises from the engines and warms their nests.

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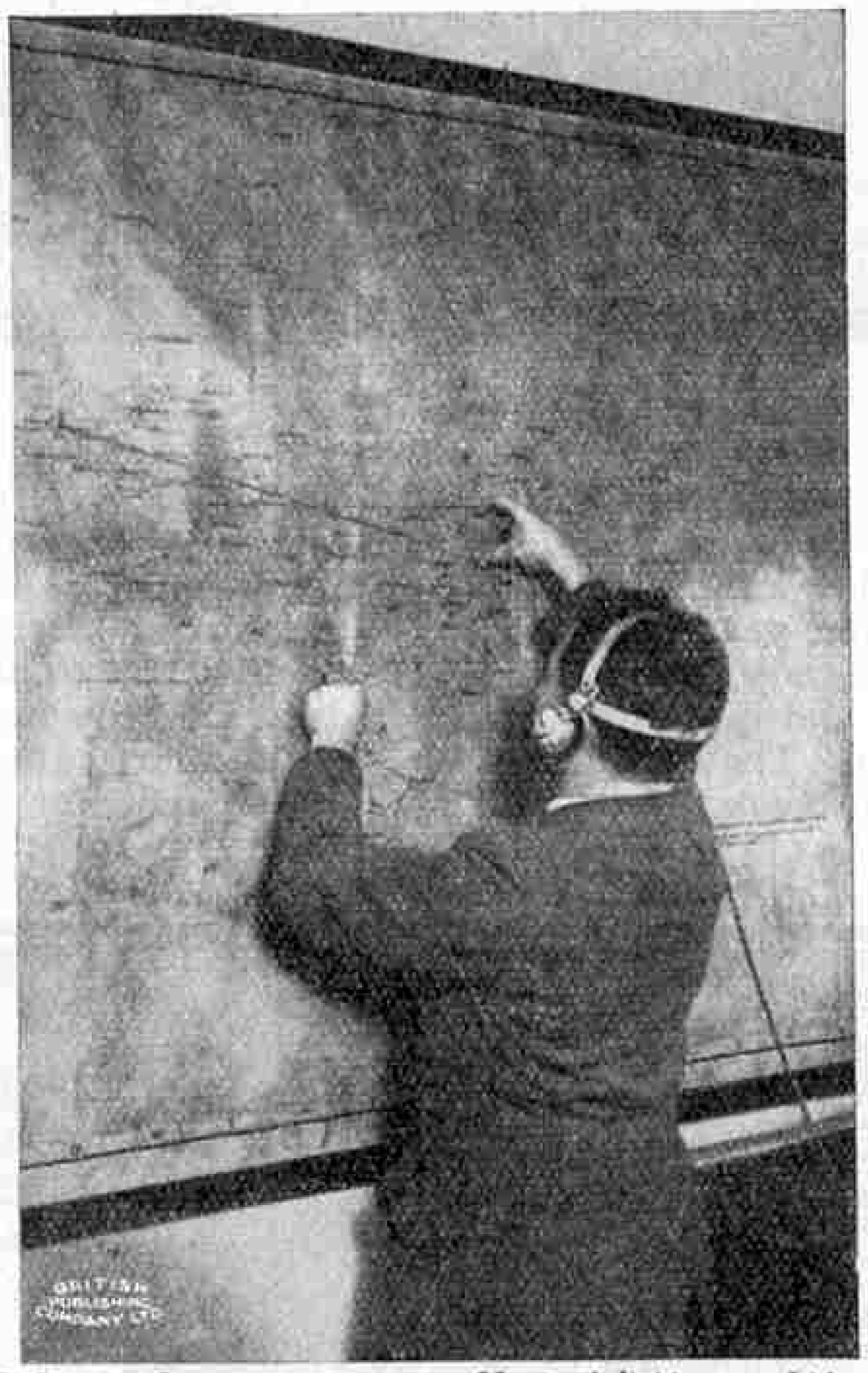
Seven Miles High

A world's altitude record for seaplanes of 37,995 ft., that is over seven miles, has been set up by Lieut. C. C. Campion of the United States Navy, and has received the official confirmation of the National Aeronautical Association. The previous record was held by Lieut. Demougeot of the French Navy with a height of 30,470 ft., about 5½ miles.

International Register of Aircraft

At the Pan-American Commercial Aviation Conference held in Washington, two interesting decisions were reached. The first was to ensure that all commercial aircraft companies should indicate on their machines the nationality of the State in which they are registered; and the second banned the transport by commercial aircraft of arms, munitions or explosives.

Plotting the Position



Courtesy] [*Imperial Airways Ltd.*

Plotting the position of an air express in flight after bearings on it have been taken by means of the directional wireless system

At the meeting it was pointed out that to prohibit this type of transport would prevent the carriage of urgently required mining explosives and similar goods, the purpose of which was entirely commercial. Against this view it was argued that revolutions that might possibly break out in certain States would be fostered by the knowledge that arms and ammunition could be rushed to any required spot in a very short time.

* * * *

Organisation of European Airways

At a recent conference, representatives of the civil air administration of Great Britain, France, Belgium, Holland, Switzerland, Germany and Czecho-Slovakia discussed the organisation of European air routes. Several important matters bearing upon air safety were put before the assembly and the German Government were asked to ensure that knowledge of the civil aviation regulations in force over their territory should be circulated to all aviators. Means for the prevention of aircraft collisions in foggy weather were also considered and attention was drawn to the necessity for constant inspection of the trailing aerials used by aircraft for wireless communication.

In this connection it is interesting to note that European airways are to be further extended by the establishment of eight new Spanish air ports.

The "Outside" Loop

For the first time in the history of aviation an "outside" loop has been performed. In this evolution the nose of the aeroplane is turned downward when starting the loop instead of upward in the usual manner. This feat was performed by Lieut. J. A. Doolittle, the well-known American pilot, while flying at the aerodrome at Dayton. He commenced the loop at about the height of 8,000 ft. while flying at a speed of 150 m.p.h. The machine descended about 2,000 ft. in making the loop and it was estimated that a speed of 280 m.p.h. was attained at the lowest point of the arc. When Lieut. Doolittle landed there appeared to be traces of hemorrhage in his lungs but it is stated that he had recovered completely by the following day. This feat was attempted in 1912 by two American pilots, but they failed to right their machines, crashed and were killed.

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Adventures of Air Mail Pilots

Many strange adventures are experienced by pilots employed on the air mail services and some of those that have befallen American pilots recently provide interesting examples of the courage required by the men engaged in this class of work.

One pilot, while attempting to climb to 18,000 ft. to get above a storm, allowed his aeroplane to fall into a tail spin. He righted the machine, but successively got into four more tail spins and eventually lost consciousness and crashed. Marvellous to relate he was unhurt beyond a few bruises and scratches. Another pilot, while flying through a blizzard, had the unpleasant experience of finding his machine and engine so choked that he was obliged to land twice to knock off the accumulated ice. Eventually his engine stopped altogether and the machine crashed, but he escaped practically unhurt.

To be caught in an electrical storm is an unpleasant and dangerous experience. A certain mail pilot found himself in this predicament and was forced to fly near the ground in order to search for a suitable landing place. While doing this he passed through a cutting at a speed of 130 m.p.h. scratching the sides with the tips of his wings. Yet another pilot while flying through dense fog crashed into a small wood and cut a patch 50 ft. in width through the tops of the trees.

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Pulham Airship Shed to be Removed

The huge airship shed at Pulham, Norfolk, is to be removed to Cardington, Bedfordshire. When re-erected it will be 812 ft. in length and 156 ft. in height, an increase on its present measurements of 56 ft. and 35 ft. respectively. The inside span will be 180 ft. and the shed will be large enough to accommodate both R.100 and R.101, the new airships at present under construction at Howden and Cardington.

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A New Gliding Record

The German aviator Ferdinand Schulz, who recently broke the world's record for straight-line gliding, covering 38 miles, has succeeded in setting up another world's record by gliding a distance of 100 miles. Schulz holds also the world's record for gliding duration, having on one occasion remained in the air for 14 hours.


The THINKER by A·RODIN

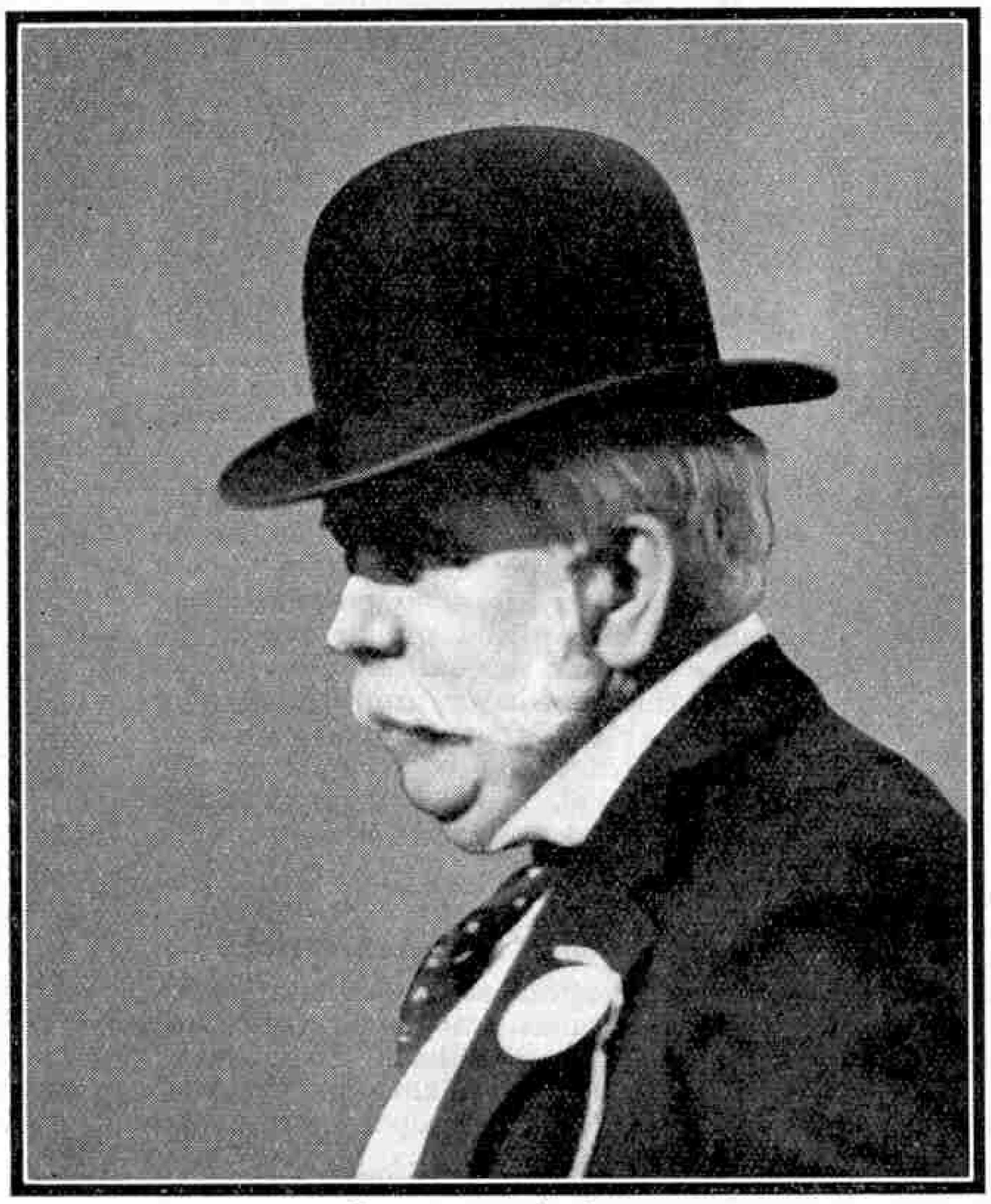
LIVES OF FAMOUS INVENTORS

VII. GEORGE WESTINGHOUSE—INVENTOR OF THE AIR BRAKE

GEORGE Westinghouse, the inventor of the air brake that bears his name, was born at the village of Central Bridge, New York, on 6th October 1846. His father was a successful manufacturer of agricultural machinery and ten years after the birth of George he opened a works at Schenectady, New York, where the construction of small steam engines and machinery for mill and agricultural purposes was carried on. The father was himself an inventor of considerable ability and took out several patents, dealing mainly with agricultural machines of various kinds.

At school George displayed considerable aptitude for mathematics but he lagged sadly behind in literary subjects and appears to have been somewhat of a trial to his teachers. His father looked forward to the boy joining him in business and subsequently qualifying to be his successor, and with this object in view George was encouraged to spend much of his leisure time in the drawing office and workshops. It soon became evident, however, that the particular operations carried out in the works did not interest the boy. On many occasions when he was supposed to be giving the workmen a helping hand he was discovered at his bench engrossed in devising some mechanical contrivance of his own invention and which had no bearing at all upon the productions of the works.

This apparent waywardness and perversity sorely tried his father who, curiously enough, entirely failed to recognise the symptoms as signs of inherited inventiveness. We are told that on one occasion he lost all patience with his son, snatched up the contrivance upon which he was then working and threw it on the scrap heap. The boy's eyes blazed with anger, but he managed to keep back the bitter words that sprang to his mind. This incident was witnessed by a foreman who sympathised with the lad's feelings and told him of a room up in the loft where "the boss" never went and where he could work quietly with no one to interfere.


George Westinghouse

When his period of schooling was over, Westinghouse commenced work seriously in his father's factory and continued there until the following year, when the outbreak of the American Civil War stirred his imagination so greatly that he slipped away from home to enlist. His father was quickly on his track, however, and brought him back home. A further period in his father's works followed, but in 1863 he obtained permission to re-enlist and joined a cavalry regiment, subsequently being transferred to the engineers corps of the Navy.

In 1865 Westinghouse returned to civil life and in compliance with his father's earnest desire that he should improve his education he entered the Union College, Schenectady. The experience of his school days was now repeated. Art and literature were as unattractive to him as ever and often when he was supposed to be deep in study he was actually sketching mechanical contrivances on his shirt cuffs! The headmaster appears to have been a man of foresight, for he realised that the youth's true place was in the workshop and not in the class room. Finally, after a period of some three months the father became pursuaded that this was the case and allowed his son to leave.

Thus released from distasteful studies, Westinghouse joyfully returned to his workshop bench and settled down to develop the many original ideas crowding his thoughts. He began by patenting a rotary engine that he had commenced modelling during his naval service. He does not seem to have ever exploited this patent, but in later life he was fond of experimenting with the engine during leisure hours. The model engine was of the 4-cylinder reciprocating type, the cylinders being placed radially around a central valve casting wherein was a rotary valve for distributing the steam. This model was subsequently elaborated by Westinghouse and his brother John, who successfully constructed a high-speed engine with multiple cylinders and developing 40 h.p., which was used to operate the machinery in the Schenectady workshops.

In 1867 Westinghouse took out his second patent, this being for an improved railroad switch. This minor invention was the outcome of his having one day watched the arduous efforts of a breakdown train gang to replace some derailed coaches on the track. He was impressed by the need of some effectual apparatus to aid in restoring vehicles to the track, and before the end of the day he had sketched out his solution of the difficulty. This consisted of a re-railing "frog" to guide the wheels of the derailed engine or coach back to the rails.

A year later he took out a patent for an improved railway frog. He had observed that the frogs formed the sections of railway track most frequently under repair and had set himself to produce a frog that should be of much greater durability. He did this by designing a cast-steel frog that was not only reversible but also many times more durable than the cast-iron frogs then in use. By "reversible" is meant that the frog was so made that when worn out on one side it could be turned over and the other side similarly used, but this advantage was not referred to in the patent, the term " improved " relating to an arrangement of a chair beneath each end of the frog.

While Westinghouse was journeying from Troy to Schenectady one day in 1866, the New York Central train in which he was travelling was held up at an isolated spot for a considerable time, owing to the line being blocked by the debris of two freight trains that had been involved in a " head on " collision. On surveying the chaotic scene Westinghouse realised that if each train had been equipped with some means of effectual and speedy braking the accident probably might have been averted.

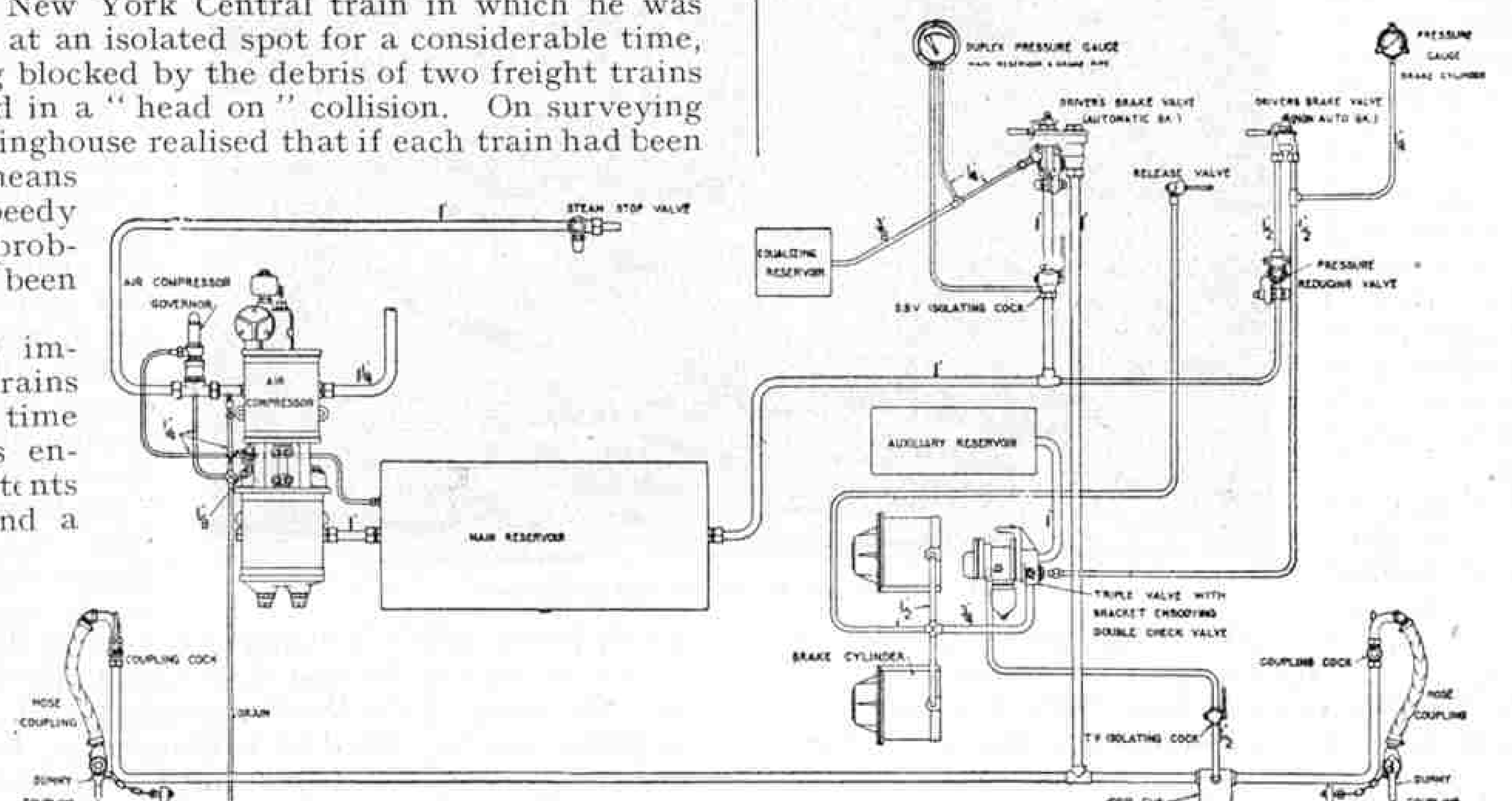
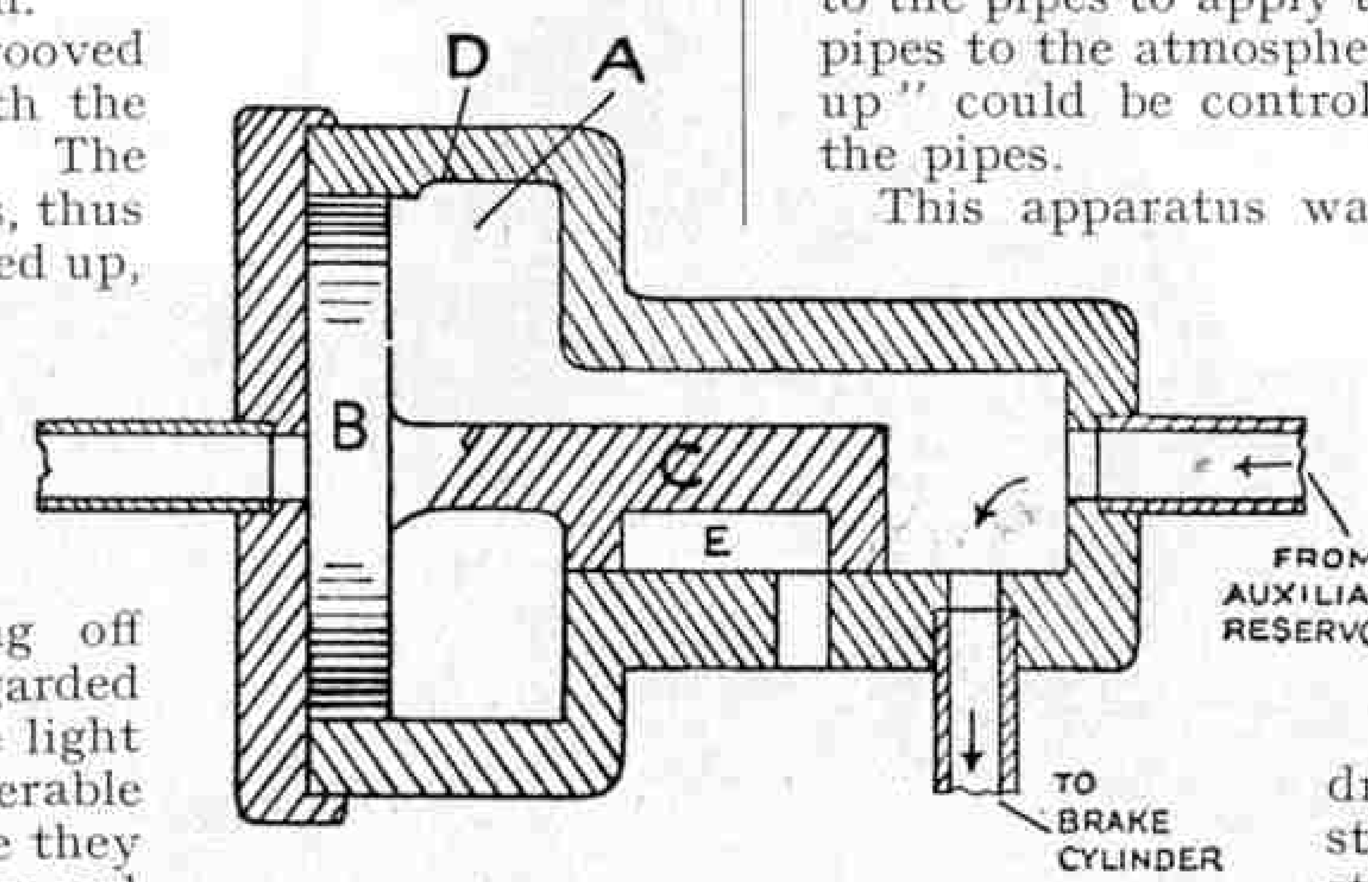


Fig. 1

Diagrammatic arrangement of Westinghouse Brake on engine with tender, showing engine fittings

The need of some improved safeguard on trains recurred to him from time to time while he was engrossed with the patents already referred to, and a visit to Chicago happened to be the means of further impressing the subject upon him. At Chicago he was invited by the superintendent of the Chicago, Burlington and Quincey Railway to look over a new train, styled the " *Aurora Accommodation*," that had recently been introduced. The innovation that most attracted Westinghouse was the method of braking employed, this being a system of chain brakes invented by Augustine I. Ambler of Milwaukee, U.S.A. The brake levers of each coach were connected to a long chain passing beneath the carriages from the rear of the train to the engine, where it was attached to a windlass mounted thereon.

Application of the brake brought a grooved wheel of the windlass into contact with the flange of the locomotive driving wheel. The friction drive set up rotated the windlass, thus drawing in the chain which, as it tightened up, pulled forward the respective brake levers, causing the brake blocks to close upon the carriage wheels more or less simultaneously.



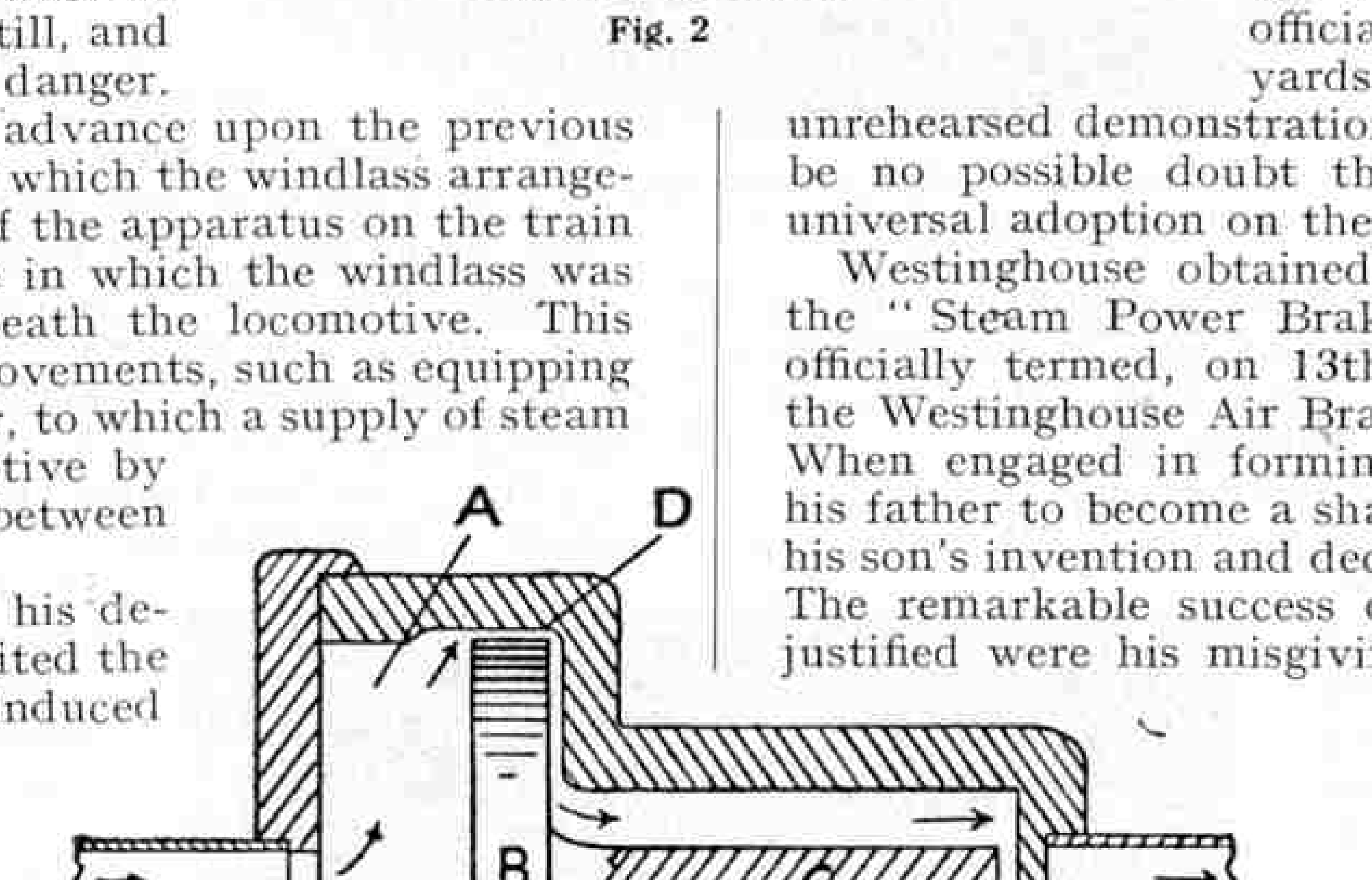
BRAKE APPLIED.

Fig. 2

In the early days of railways braking was accomplished by means of hand-operated mechanism and by shutting off steam. Such methods could not be regarded as effective, however, because even the light trains then in use travelled a considerable distance by their own momentum before they could be pulled up. The heavier the train and the faster it was travelling, the longer was the period required to bring it to a standstill, and consequently the greater was the danger.

Ambler's invention was a decided advance upon the previous methods, but it had several defects, of which the windlass arrangement was one. After his inspection of the apparatus on the train Westinghouse designed a chain brake in which the windlass was superseded by a steam cylinder beneath the locomotive. This scheme led him to evolve further improvements, such as equipping each coach with its own brake cylinder, to which a supply of steam was to be conveyed from the locomotive by way of a continuous pipe linked up between the carriages by flexible couplings.

Here Fate took a hand in shaping his deliberations. A lady canvasser who visited the Westinghouse works at Schenectady, induced the young inventor to subscribe for a certain magazine. In due course the copies began to arrive and in glancing through one of them Westinghouse was struck by an illustrated article dealing with the Mont Cenis tunnel, at that time in course of construction. The article described the operation of the rock drills employed in boring the tunnel by compressed air conveyed through pipes from reservoirs 3,000 ft. away. Suddenly there flashed across his mind a brilliant idea—if compressed air could operate drills at a distance in this manner, it could also operate a continuous train brake ! He set to work immediately to design a compressed air brake and took out preliminary patents in 1867.



BRAKE RELEASED.

Fig. 3

The earliest form of Westinghouse brake was known as the " straight air " brake, because the air from the storage reservoir on the locomotive was admitted to the brake cylinders direct, and not through any intervening mechanism. The operating power was compressed air, generated by a compressor and passed through a storage reservoir, both of which were situated on the locomotive. From this reservoir the air, compressed to about 60 or 70 lb. per sq. in., passed to the brake pipe, a tube approximately one inch in diameter running the length of the train, and thence to one face of a piston working inside a brake cylinder. The other face of the piston was in direct communication with the atmosphere. The force of the compressed air drove the piston outward, and thus the levers and rods governing the brake blocks were set in action, and the brake blocks forced on to the wheels.

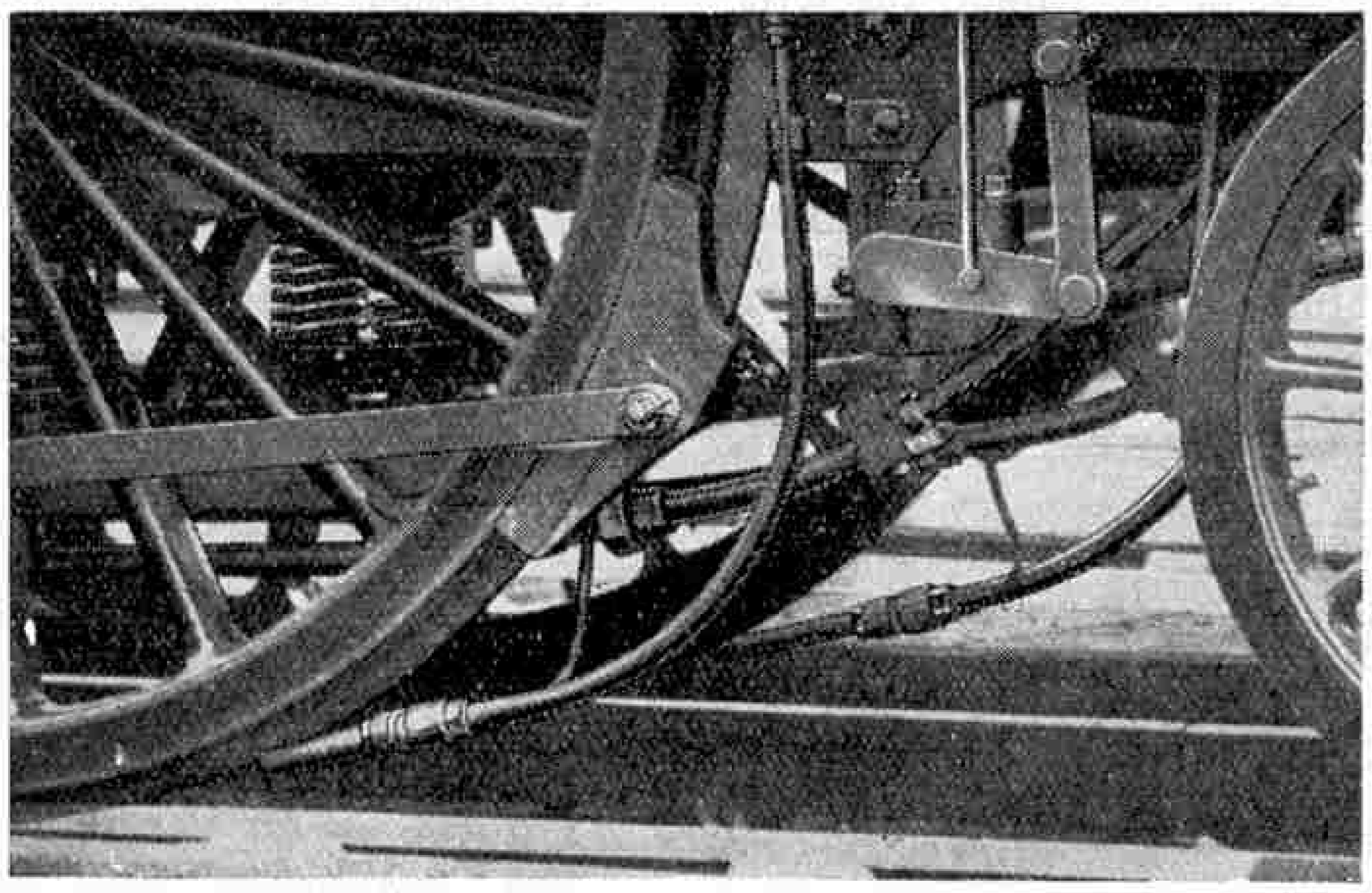
This sequence of events followed the application of the driver's brake valve, which passed the compressed air from the reservoir to the pipes to apply the brakes, and from the brake cylinders and pipes to the atmosphere to release them. The speed of the " pull up " could be controlled by the pressure of the air passed into the pipes.

This apparatus was first tested in September 1868, on the " *Steubenville Accommodation*," a train on the Panhandle Railroad, Pennsylvania, and consisting of a locomotive and four coaches. The trials were even more sensationally successful than the optimistic inventor had anticipated, for during the first run a disaster was prevented by the efficiency of the new brake. Just as the train was leaving Pittsburg tunnel the driver observed a horse and a heavy wagon standing on the track at the crossing. Instantly the new brake was applied, and to the obvious relief of the driver and the officials, the train came to a standstill some yards away from the obstruction. This unrehearsed demonstration was the deciding factor. There could be no possible doubt that the brake was destined for almost universal adoption on the railways of the world.

Westinghouse obtained his first patent proper in respect of the " Steam Power Brake," as this remarkable invention was officially termed, on 13th April, 1869, and some months later the Westinghouse Air Brake Company was founded at Pittsburg. When engaged in forming this company Westinghouse invited his father to become a shareholder, but the latter had no faith in his son's invention and declined to risk any money in the venture ! The remarkable success of the company later proved how unjustified were his misgivings.

The success of the Panhandle Railroad test aroused great interest in the invention, and Westinghouse was asked by the Pennsylvania Railway to equip with his apparatus a train of six coaches. The train was made ready for him and was duly fitted up. The Association of Master Mechanics, a body of experts drawn from numerous railways, was at that time in conference at Pittsburg, and the Pennsylvania Railway offered them for test the six-coach train equipped with the new straight-air brakes. Westinghouse could not have wished for a finer opportunity to bring the merits of his invention before the railway world. A stiff trial had been decided upon and the train was hauled over the section of the company's system passing through the Alleghany Mountains to Altoona. In negotiating the eastern slope of the mountains the air brakes were wholly relied upon to control the speed of the train, while on the steepest gradients opportunity was taken to pull the train up by means of the apparatus. The brakes never failed to respond quickly and effectually to the demands made upon them, and the trial greatly impressed the experts.

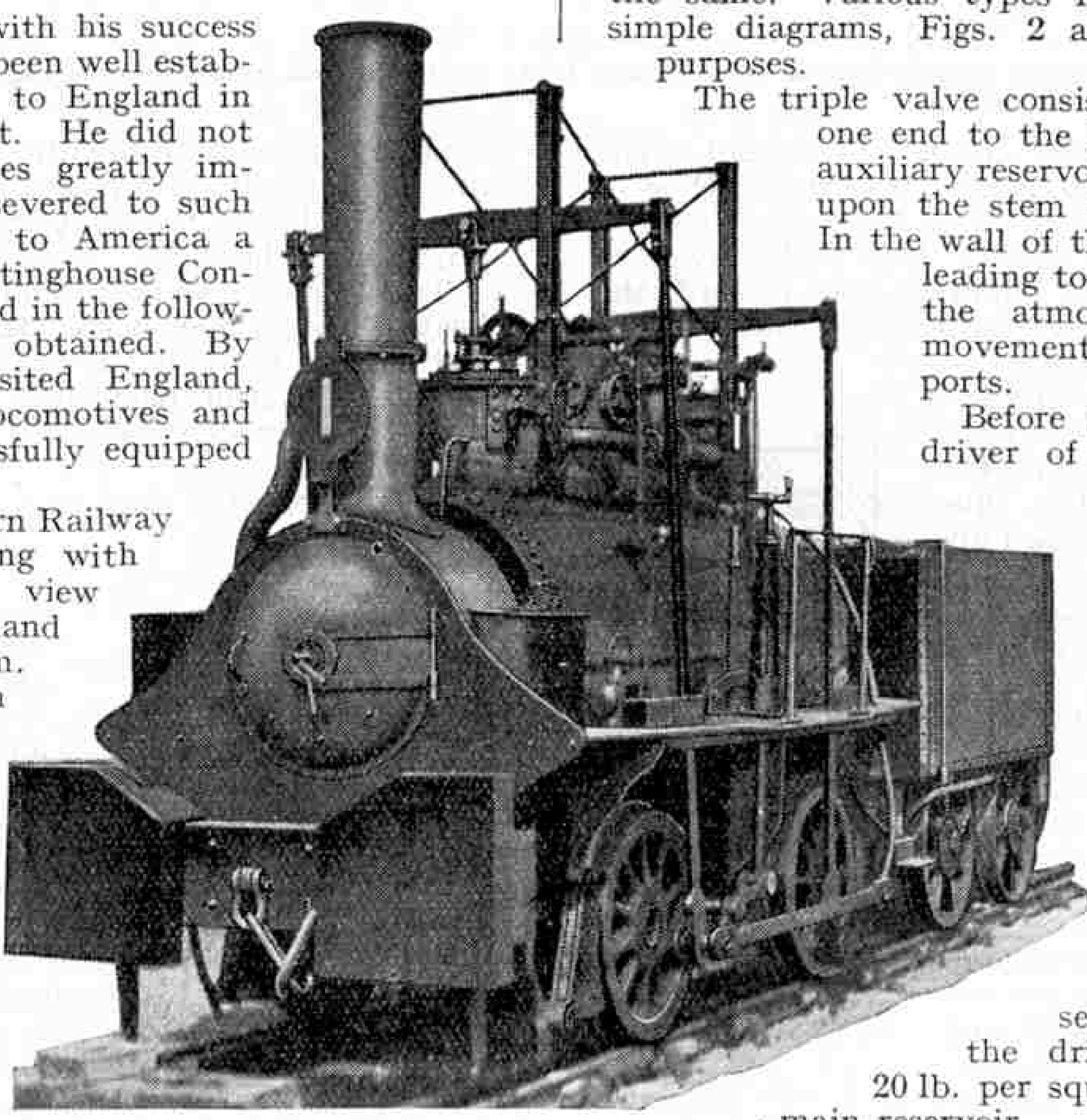
A longer train—this time comprising ten coaches—was then similarly equipped and hauled to Philadelphia and other important cities in the States, where successful demonstrations of the brake soon brought the Westinghouse Company several handsome orders. Within the ensuing five years the company fitted the straight-air brake to 2,281 locomotives and more than 7,250 coaches.



Early form of engine brakes and sand pipes

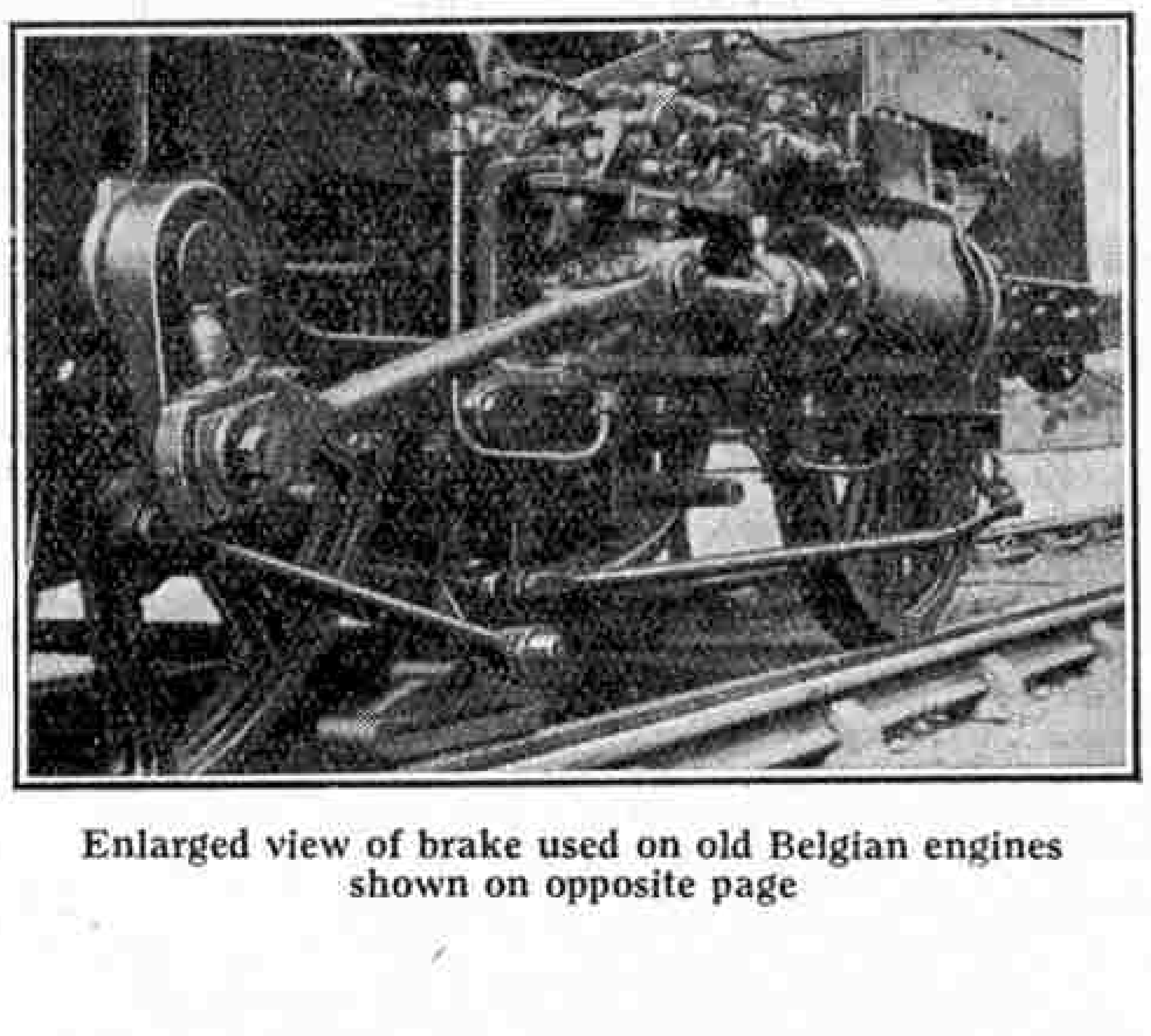
Westinghouse's ambition grew with his success and, the air brake business having been well established in America, he crossed over to England in July, 1871, to introduce his patent. He did not find the British railway companies greatly impressed by his claims, but he persevered to such good purpose that on his return to America a second company, termed the Westinghouse Continuous Brake Company, was formed in the following year to cope with the business obtained. By the time Westinghouse again visited England, in March 1874, close upon 150 locomotives and over 700 coaches had been successfully equipped with straight-air brakes.

In the same year the North Eastern Railway Company commenced experimenting with the Westinghouse brake, with a view to adopting it in place of the hand brakes then in use on their system. Three trains were equipped with the new device, and the first trial run was made on 18th March, between Newcastle and Berwick, with a train made up of engine and tender (weighing 45 tons), seven coaches and two vans. Westinghouse was one of the 35 passengers who travelled on the train, the weight of which totalled about 101 tons gross. On both the outward and the return journey the train was successfully pulled up by means of the brake when negotiating steep gradients, one stoppage on the outward journey being effected at Christon Bank, where the gradient is 1 in 150. There the train was brought to rest from a speed of 40 miles an hour in 22 seconds, in a distance of less than 300 yards.



Hetton Colliery Locomotive (0-4-0) built 1822, showing triangular brake blocks

Further successful trials with the Westinghouse straight-air brake were held by the N.E.R. during the ensuing three years, notably on the Durham, Consett and Newcastle route, over gradients as steep as 1 in 60. Successful as this type of brake proved, it had certain short-comings that no one realised more fully than Westinghouse himself. The source of the braking power was on the engine. Therefore its effect was felt at the front sooner than at the rear, giving an unevenness of braking governed by the time that elapsed in the passage of the compressed air from the driver's valve to the rear coaches, a factor of great importance in a long train. Again, in the event of a portion of the train breaking loose—no uncommon experience on heavy mountain grades—the whole of the compressed air escaped to the atmosphere and the train became entirely out of control. This latter defect was far and away the more important, and it was to the evolution of a brake that would automatically come into play under such conditions that Westinghouse turned his attention.



Enlarged view of brake used on old Belgian engines shown on opposite page

He realised that the brake, to be successful, must be kept off artificially, and be applied automatically on the destruction of the artificial conditions and, with this principle as his guide, he set to work.

The ultimate outcome of his efforts was a wonderful piece of mechanism patented on 13th May, 1873, and known as the "triple valve" which, together with auxiliary reservoirs, was placed under each coach. The result was a completely automatic brake and it is significant to note that the triple valve, the secret of success in the first automatic brake, remains to this day the heart of the Westinghouse system. It has been improved, modified and amplified at various times, but its principle remains the same. Various types have been introduced but the two simple diagrams, Figs. 2 and 3 will suffice for explanatory purposes.

The triple valve consists of a cylinder, A, connected at one end to the brake pipe and at the other to the auxiliary reservoir. The cylinder houses a piston, B, upon the stem of which a slide valve, C, is fixed. In the wall of the cylinder there are two ports, one leading to the brake cylinder and the other to the atmosphere. The slide valve, in its movement with the piston, passes over these ports.

Before the commencement of a run, the driver of the train must charge the main reservoir, the brake pipe and the auxiliary reservoirs with compressed air. This is done by running the air compressor until the main reservoir is fully charged, usually to a pressure of about 90 lb. per square inch. The driver then places the handle of his brake into the position for charging the brake apparatus on the train. The compressed air is fed to the train pipe and, through the triple valve, to the auxiliary reservoirs on each coach, at a pressure determined by the setting of the feed valve connected to the driver's brake valve, usually about 20 lb. per square inch below the pressure in the main reservoir.

To apply the brakes the driver releases some of the air from the brake pipe, thus reducing the pressure below that of the auxiliary reservoir. The compressed air in the auxiliary reservoir immediately moves for freedom and forces the piston of the triple valve forward until its head blocks the groove D. In the piston's move forward it carries the slide valve clear of the exhaust port E, leading from the brake cylinder to the atmosphere, closing the opening to the latter. The opening to the brake cylinder, which is at atmospheric pressure, now presents the only path for the compressed air to take, and entering, it forces forward the brake piston controlling the blocks and applies the brake. The position of the triple valve in the "on" position is indicated in Fig. 2.

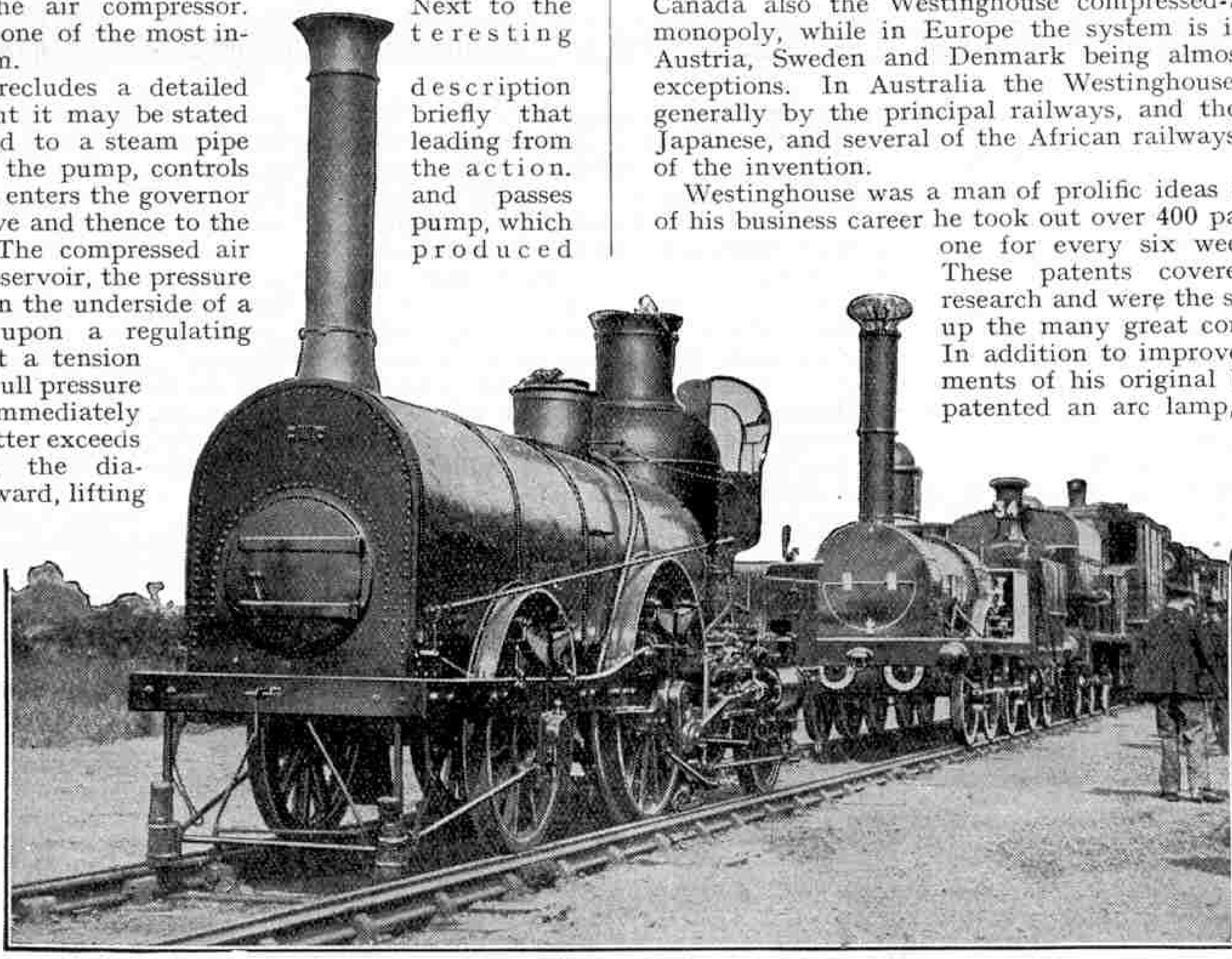
In order to release the brakes, the driver restores the pressure in the brake pipe which, being now greater than that in the auxiliary reservoir, causes the triple valve piston to return to the "off" position. Thus the slide valve is carried back to open the exhaust port and the compressed air in the brake cylinder escapes to the atmosphere, thereby releasing the brake blocks.

So far we have referred to voluntary

operation of the system by the driver. Exactly the same thing happens, however, if a fracture in the train pipe occurs from any cause, such as a portion of the train breaking loose. An immediate escape of compressed air would then take place and the brakes would go " on " almost instantly. Furthermore, until the fracture was sealed the train could not be moved. This last point indicates very clearly the enormous power exerted by the Westinghouse brake. A powerful engine, working at full pressure, could not move if the brakes were fully applied.

In an earlier paragraph we mentioned that the supply of compressed air in the main reservoir was maintained automatically by the air compressor. Next to the triple valve, this is one of the most interesting features of the system.

Lack of space precludes a detailed description of the apparatus, but it may be stated briefly that a governor, attached to a steam pipe leading from the engine boiler to the pump, controls the action. Steam from the pipe enters the governor and passes through a steam valve and thence to the pump, which it sets in motion. The compressed air produced passes to the main reservoir, the pressure from which acts upon the underside of a diaphragm placed upon a regulating spring that is set at a tension equal to the normal full pressure in the reservoir. Immediately the pressure in the latter exceeds the spring tension, the diaphragm is forced upward, lifting a pin valve and allowing the compressed air to escape into a piston chamber. The piston in its turn is forced out and closes the steam valve, thus cutting off the steam supply and stopping the pump. When the pressure in the main reservoir falls below the required pressure, the reverse actions take place and the steam supply is re-admitted.



Old Belgian Locomotives, showing curious brake gear

The air pressure brake thus fulfils the essentials for a reliable railway brake, which are as follows :—The brake must be kept off artificially ; it must be automatic in action ; it must be possible to apply it with greater or less force as the occasion demands ; and it must be possible to maintain repeated braking applications.

Westinghouse introduced his original automatic brake in England on the occasion of his second visit, and the superiority of the new brake over the earlier straight-air type was quickly appreciated. The N.E.R. carried out trials with the automatic brake during the period 1874-1877, and the adoption of this system of braking was practically decided in March 1877, after exhaustive tests with a train of 12 vehicles had been carried out with splendid results. Each coach had two brake blocks, and a speed indicator was fitted up in the experimental van. Stoppages were made promptly with the train travelling at speeds reaching up to 64 miles an hour.

An accident to a night express from Edinburgh to London, involving the loss of five lives, occurred close to Morpeth Station a week later and resulted in the Board of Trade ordering the immediate adoption of a reliable continuous brake. Westinghouse automatic brakes were subsequently fitted to many of the fast trains of the N.E.R., and when the inventor made his third visit to this country, in 1875, he was gratified to find that his brake was being adopted by several other important railways.

A rival to the Westinghouse brake appeared in 1872, in the shape of a vacuum brake patented by John Y. Smith of Pittsburg. Westinghouse had no intention of being ousted from the field, however, and after closely studying Smith's invention he found room for improvement in it, and subsequently devised and obtained patents for various modifications.

Mention must be made of the remarkable series of tests carried out on 9th June, 1875, on the Nottingham and Newark section of the Midland Railway. Trials were then made of many important methods of train-braking, including Westinghouse's automatic compressed-air brakes ; Westinghouse's and Smith's vacuum brakes, and various types of hand, chain and hydraulic brakes, each being claimed by its inventor as the most superior. Trains comprising 13 coaches and two vans were used for the trials. The Westinghouse automatic compressed-air brake won easily by stopping its train, travelling at 50 miles per hour, in a distance of 777 ft. Clarke's hydraulic brake came second with a distance record of 901 ft. while Smith's vacuum brake achieved a stoppage in a distance of 1,477 ft.

Although vacuum automatic brakes are nowadays the principal type used on British railways, they passed out of favour in America many years ago, and over there the Westinghouse and contemporary types of compressed-air brakes are in universal use. In Canada also the Westinghouse compressed-air brake enjoys a monopoly, while in Europe the system is in very general use, Austria, Sweden and Denmark being almost the only notable exceptions. In Australia the Westinghouse brake is favoured generally by the principal railways, and the Chinese State, the Japanese, and several of the African railways are also large users of the invention.

Westinghouse was a man of prolific ideas and in the 48 years of his business career he took out over 400 patents, an average of one for every six weeks of that period ! These patents covered many fields of research and were the seed from which grew up the many great companies he founded. In addition to improvements and developments of his original brake, Westinghouse patented an arc lamp, an electrical meter for registering alternating current, a dynamometer and one of the earliest forms of automatic telephone exchange.

At Pittsburg in 1883 he became interested in natural gas distribution. It was common knowledge that Westinghouse never did things by halves, and although his association with the natural gas industry was comparatively brief, it was notable for the considerable zeal and enthusiasm he displayed. Almost his first act was to arrange for boring operations to be commenced in the backyard of his house at Pittsburg, and in late February the drilling penetrated a shallow vein of gaseous sand. Boring was continued, however, and at a depth of 1,500 ft. a more substantial vein was tapped. The contractors were now in favour of ceasing drilling operations lest, tempting Providence too far, the well should become ruined owing to the boring reaching salt water. Westinghouse, however, with his characteristic optimism and increasing enthusiasm, requested that drilling be continued.

The climax came shortly after, when the boring met gas of such volume and pressure that the tools were blown up out of the well, and the shaft head demolished. The noise was terrific and the escaping gas, catching fire, produced a flame that towered 100 ft. high. It was weeks before the roaring flame was quelled, but when the well was finally mastered and capped, this prolific source of illumination was taken over by the Philadelphia Company, founded by Westinghouse.

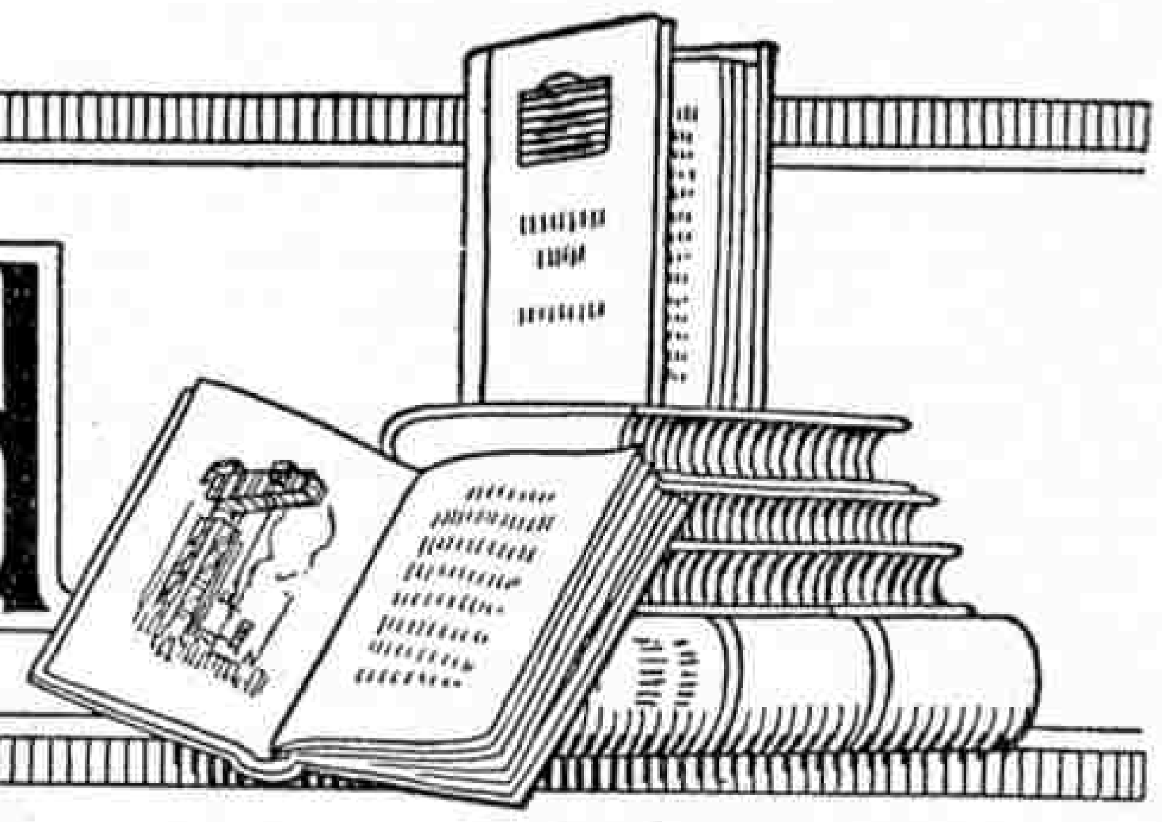
The adventure served as a background for the patenting on 4th November, 1884, of an oil " Well-Drilling Apparatus," which comprised rotary cutting tools actuated by a fluid-pressure motor, the excavated material to be forced up out of the boring. Westinghouse also found time to perfect and patent various methods of and devices for " Detecting and Preventing Leakages " in gas mains. His intensive industry may be gauged from the fact that between 1st October, 1884, and 30th June, 1886, he took out twenty patents dealing solely with this matter.

Westinghouse also introduced a gas main of increasing diameter to reduce friction and pressure and improve distribution.

In 1893 the Westinghouse Electric Co. Ltd. (of America) obtained the contract for the first electric generators to be made and erected at Niagara Falls.

The inventor's intense activity was maintained up to 1913, when he was attacked by heart trouble to which he slowly succumbed. He died on 12th March, 1914, at the age of 68 years.

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.

"Microscopic Fresh Water Life"

By F. J. W. Plaskitt. (Chapman & Hall. 13/6)

That our readers are keenly interested in the aquarium and its inhabitants is evident from the correspondence that resulted, following the series of articles on this subject that appeared in the "*M.M.*" last year. Such readers will be interested in this book—the more so if they are the fortunate possessors of microscopes. The study of microscopic fresh-water life is a never-failing source of fascinating entertainment, and the search for specimens affords the opportunity of healthy exercise in the country. At night, or on wet days, there is the delight of viewing them beneath the microscope, and of admiring the beauty and wealth of brilliant detail in the miniature wonders of nature that have been collected.

There are so many forms of microscopic life even in a few drops of stagnant water that it is very necessary to have some good book as a guide. This volume, one of the best we have ever seen of its kind, embodies the experience and observations of the author over a period of 30 years and will prove a reliable and interesting companion. It covers the whole subject, from the methods of collection to the detailed classification of fresh-water micro-organisms. In a very helpful fashion the reader is told exactly how and where any particular species are most likely to be found. This information, together with details of the best appliances for collecting (with suggestions for home-made substitutes) and the best ways of using each, will be found most useful.

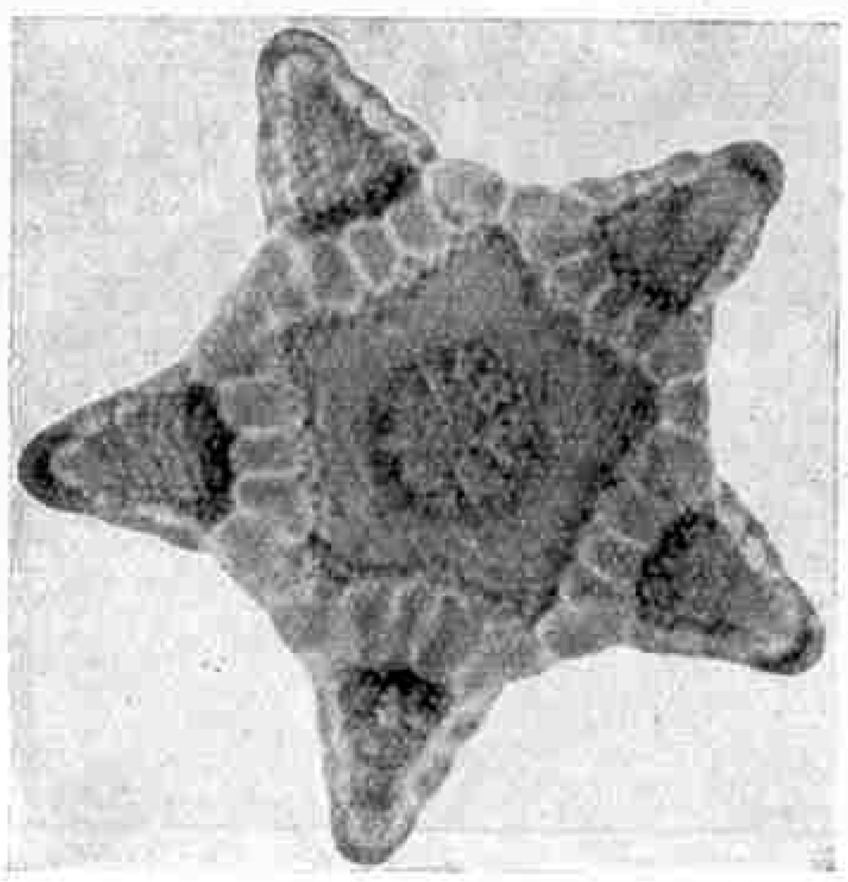
There are 286 illustrations and each represents the object as it is seen alive under the microscope. These carefully-prepared line drawings and photographs render identification of specimens comparatively easy, and the lucid descriptions that accompany them enable the reader to become familiar with an astonishing number of microscopic forms without any of the usual drudgery.

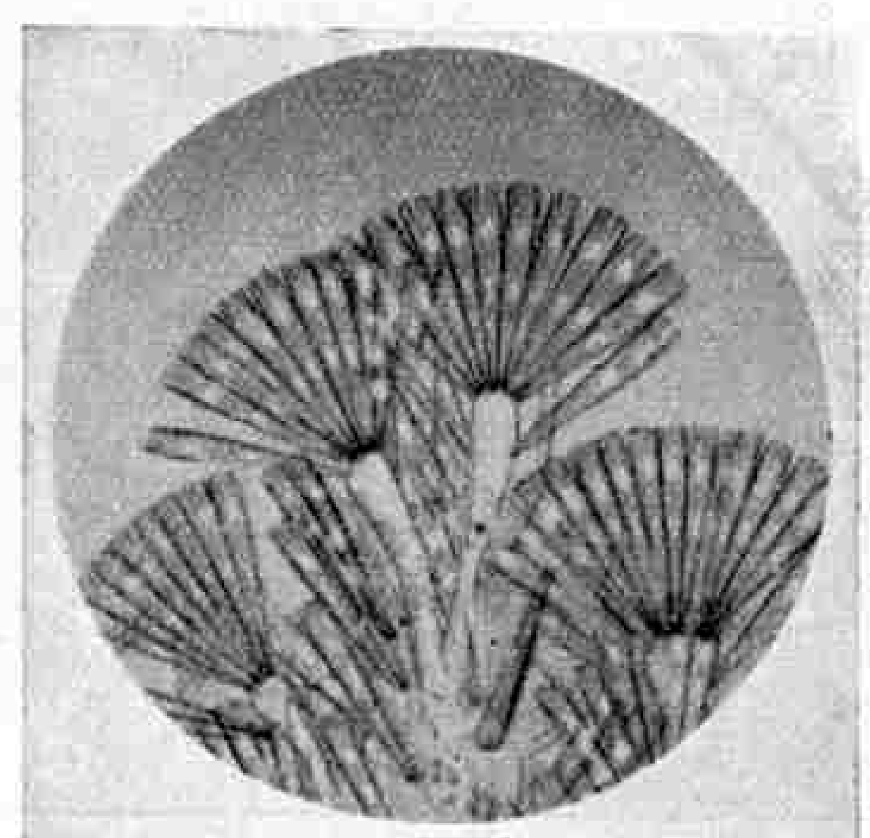
* * * *

"Three Men Discuss Relativity"

By J. W. N. Sullivan.
(W. Collins, Sons & Co. 7/6 net)

This book is a plain straightforward account of Einstein's theory and the developments that may be expected from it. It appears in the form of a dialogue between a Relativist, a Philosopher and an Ordinary Intelligent Person. The use of dialogue for a discussion of this kind is not easy and while the Philosopher and the Ordinary Intelligent Person occasionally have flashes of intelligence, in general they act somewhat mechanically in raising difficulties. They ask the questions that the Relativist wishes to answer and as a consequence the latter gets in some good long lecturing runs. Another danger of the method adopted is illustrated by the fact that the O.I.P. asks what is meant by "axes of reference" on page 23, although he has taken part in a discussion on the same subject 18 pages earlier! Anyway he certainly should have read the second paragraph of Mr. Sullivan's introduction, which was specially written to explain these things beforehand. Leaving details of this kind aside, the book is most interesting to read although it will appeal chiefly to older readers.





(Left) A salt water diatom, Amphitetras Ornata, showing "balloon cells" around base of apices. (Right) Another diatom, Licmophora flabellata, with wedge-shaped frustules spreading fan-like. (From "Microscopic Fresh Water Life" reviewed on this page)

There seems no doubt that the new ideas have come to stay. They give us a more accurate picture of the universe and if there is not much difference in practical results between the new and the old theories, there are great differences between the ideas themselves. These differences are made clear by Mr. Sullivan, who takes the reader step by step from Newtonian ideas to those grouped under the term "relativity." The last two chapters, on the size and boundaries of the universe and on world-building will leave some readers breathless, but luckily they are not called upon to decide such momentous questions as whether the stars that they see are real or only the ghosts of the stars that were there 1,000 or 2,000 million years ago.

* * * *

"Edible and Poisonous Fungi"

(H.M. Stationery Office. 2/6 Post Free)

Contrary to general belief, the number of kinds of fungi that are really poisonous is comparatively few, and although there are many species that may be easily recognised and that are quite safe and good to eat, at the present time only the common mushroom and the horse mushroom are used in this country.

It cannot be too strongly emphasised, however, that the only safe method of ascertaining whether a fungus is edible or is poisonous, is to know its botanical character and to be able to distinguish and recognise it just as other plants are recognised. This is a much safer method than the superstitious beliefs—some of which have survived since classical times—as, for example, that poisonous fungi when cooking will turn a silver spoon black, but edible fungi will not; or that only edible fungi have a skin that will peel off, which is not the case.

The present booklet, which is published with a view to enabling interested persons to distinguish between edible and poisonous fungi, is really a new edition of a similar handbook published in 1910, but the text has been brought up to date and new illustrations are inserted. The majority of species described in the book belong to the mushroom tribe—that is fungi on which the spores are borne on plates or gills on the underside of a circular cap. In the descriptions, technical terms have been avoided as far as possible, but where they have had to be used, a glossary assists beginners to follow the meaning.

There are 25 plates beautifully printed in colour, by which means identification should be easy and the descriptions of the various fungi should remove all difficulties in this direction.

As a reference book the publication will be exceedingly useful, more particularly to botanists.

* * * *

"Our Early Ancestors"

By M. C. Burkitt (Cambridge University Press. 7/6)

This book introduces the study of prehistoric people up to the time of the copper age and with some outline of the civilisations immediately preceding and following the period dealt with, namely that of the palæolithic and bronze ages.

The history of mankind may be said to be divided into several imaginary volumes, each of which comprises a number of separate parts. The third, and still unfinished, volume of this history is concerned with the so-called "iron age," which begins when this metal came into common use for tool-making and other general purposes. The second imaginary volume contains the history of an early epoch dealing with the period before the smelting of iron ore had been properly discovered, and when copper and its alloy with tin—that is bronze—were the only metals usually employed for tool-making. The history of the conditions of human existence in this, the earliest age of metal, is one of great interest, when there were wonderful palaces and towns in Crete and Greece, with a wealth of gold objects and wonderful paintings.

The history of mankind in the first imaginary volume is very different, and it is this period that is dealt with in the present book. At that time there was no knowledge of metals manifested, and all tools used were made of wood, bone or stone. Animals had not been domesticated and mankind was still in the hunting stage. The hunters and their families lived on the sunny side of the valleys under overhanging rocks or in the mouths of caves. They did not actually live in the depth of the caves themselves, for the cinders of their fires are never found in these places. This is only what we should expect, for the interiors of caves are not only generally absolutely dark and require continual artificial light, but also they are often very damp and even in those remote days rheumatism was not unknown. In the period dealt with the hunters pursued the mammoth and the woolly rhinoceros and other animals—such as the reindeer and the bison—that no longer exist in the warmer zones of Europe. The objects found in the caves include engraving awls, harpoons, lances and needles, the latter—small and often beautifully made and eyed—being used, no doubt, for sewing small skins for the purpose of making clothes.

All this makes a fascinating story and one that is of particular interest to all those who are anxious to know something of our ancestors.

* * * *

"Popular Mechanics" Handbooks

("Popular Mechanics" Press, Chicago)

These handbooks are issued by the publishers of the well known American periodical "*Popular Mechanics.*" Two of the three before us deal with the lathe, and with drilling and thread cutting, while the third contains a miscellaneous collection of shop notes of all kinds. Amateur craftsmen will find them full of practical hints and methods.

* * * *

"Blackie's Boys' Annual"

(Price 5/-)

This Annual certainly seems to improve every year, and the present edition contains one of the jolliest collections of yarns one could wish to read. There are 31 tales of adventure and daring—humorous tales and nature stories; yarns of historic interest; episodes of romance and heroism in the far east and the far west. The subjects covered are wide and range from University "Rags" to the Crusades of the Knights, so there are stories to suit all tastes.

There are also nine instructive articles, most interestingly written, and dealing with such varied subjects as a Hiking Camp; The Story of the Salmon; the Tank Corps in France and Flanders;

Examples of the paintings of men who lived during the Copper Age. In these curious drawings the primitive artists depict animals and human beings often in an extraordinarily expressive manner. (From "Our Early Ancestors")

Motor Engine Points; and the Truth about the Buccaneers. With such a splendid variety—and illustrated by many black and white sketches, whole page half-tones and four coloured plates—the volume is one that will afford any boy many hours of pleasurable reading.

* * * *

"Amusing Reminiscences of Victorian Times"

By (and obtainable from) J. H. Masters, Tenterden. 4/6

This little volume of reminiscences is one of the most entertaining that it has been our pleasure to read for many years. The style of the narrative and its racy humour seem to take one immediately into close personal contact with the author, and whilst the volume will make only a small appeal to our younger readers, older subscribers will find it a novel change from orthodox biography.

* * * *

"Metal Work"

By Adam & Evans. (Arnold. 6/6)

Metal-work now takes its place along with wood-work in many handicraft sections of schools and clubs, and its devotees will find this book a useful and authoritative guide.

Divided into two parts, the first deals with the metals used in the handicrafts and the methods of their manufacture. These include pig iron, wrought iron, mild and cast steel, and special chapters deal with the non-ferrous metals—copper, lead, tin, zinc, aluminium, antimony and nickel, and the alloys. The second section includes such matters as vices, files and small hand-tools; chapters on measuring, testing and marking out; sheet metal work; forge work; lathe work; etching and motive power required for machine tools, etc.

The book is well illustrated with diagrams and illustrations from photographs, and whilst it is essentially a technical manual and will appeal more particularly to the metal-worker as such, it contains a remarkable amount of interesting information.

* * * *

"Beyond the Milky Way"

By George Ellery Hale, D.Sc. (Scribner. 7/6)

In this book Dr. Hale, who is the Director of the famous Mount Wilson Observatory and is well known for his pioneer work in Astronomy, summarises the suppositions in regard to another Universe. He outlines some of the latest discoveries, both in Astronomy—dealing with the infinitely big—and in Physics—dealing with the infinitely little. He describes how the late Ernest Fox Nichols was the first to measure the heat radiation of the stars, and points the way to future great developments. In an interesting chapter on "The Oriental Ancestry of the Telescope," Dr. Hale outlines the devices used by the Egyptians, Chaldeans, Chinese and Hindus before the discovery of the telescope. The book will be a welcome addition to all interested in the latest advances in astronomical discovery.

* * * *

"How to go to Sea in the Merchant Service"

By F. H. Stafford

(James Brown & Son (Glasgow) Ltd. 3/6)

This little book claims to be a complete and practical guide for parents and guardians of boys who wish to go to sea, and this claim is certainly justified. The various means of entering upon a seafaring life are dealt with in full detail and there is little doubt that the information will go far towards solving the problems of many a harassed parent. Apart from its value in this respect, however, the book is full of interest to all lovers of ships and the sea. The illustrations are really remarkable both in number and quality and they alone would justify the addition of this book to any library.

Interesting New Books

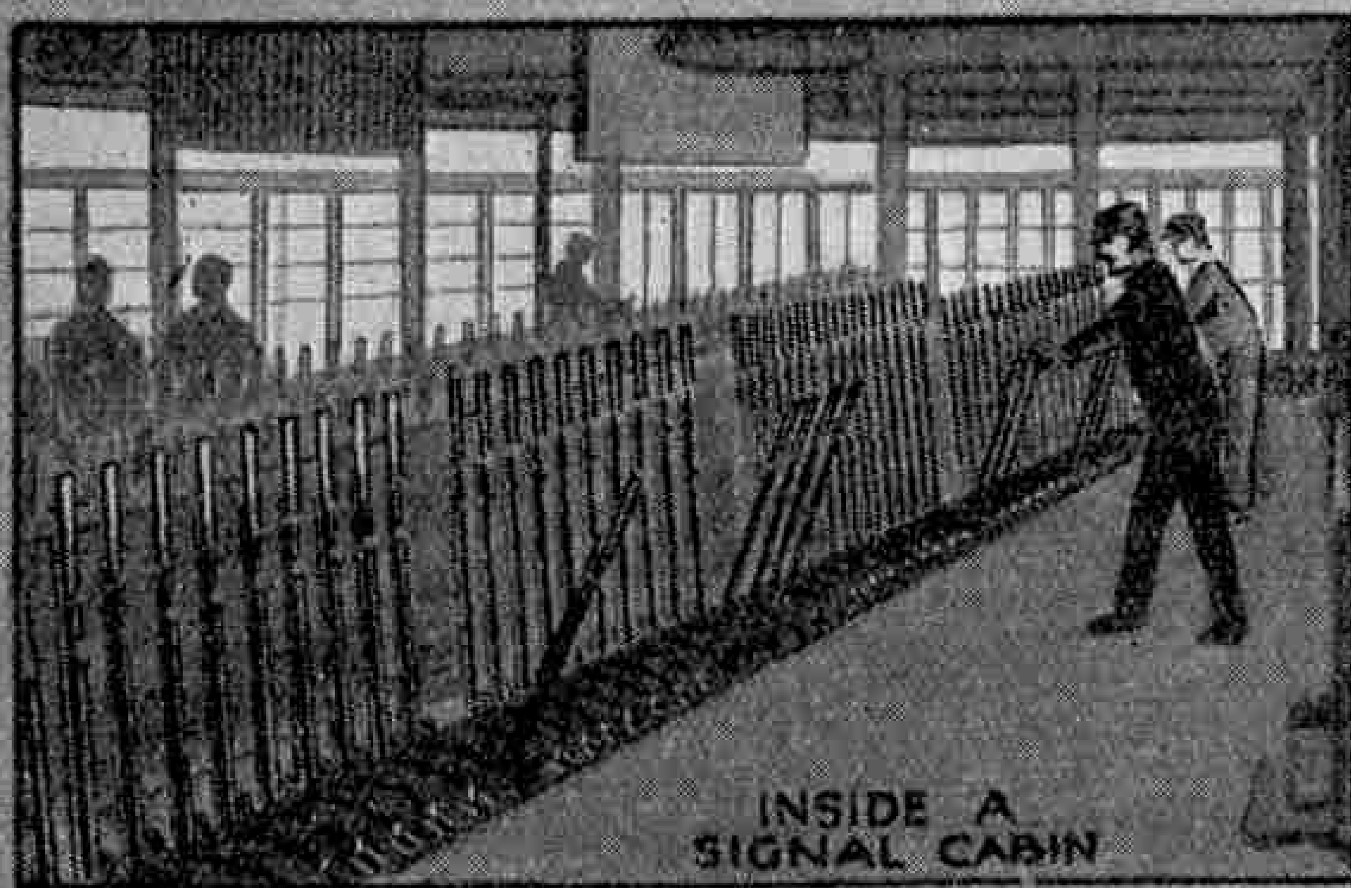
We hope to deal with the undermentioned books in an early issue.

"The Last Cruise of the Shanghai" *by* F. de Witt Wells (Hurst & Blackett), 15/-

"Romance of Excavation" *by* Masters (The Bodley Head), 6/6

"The Boy Slaves" *by* Mayne Reid (Dent & Sons), 2/-

"My Travel Book, by Land, Sea and Air" *by* G. G. Jackson (Warne), 3/-



Railway News of the Month

New Russian Locomotives

The Soviet authorities are now making a serious effort to improve the locomotive stock operating the Russian State railways and recently the first of a series of " Mastodon " type engines (4–8–0) was assembled at the Krasmy Putilovetz works. A programme including 230 engines of this type, 10 of which are to be completed this year, is being laid down.

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Locomotives' Home Addresses

Much interest is added to an hour spent at a busy station if one knows how to ascertain the centres at which the various locomotives are shedded. On the London and North Western section of the L.M.S., a series of numbers are marked on small tablets attached to the cab roof of the engines, and it is necessary to know the code. The Great Western locomotives, however, and those of the Midland Section of the L.M.S. generally can be traced by the home shed being indicated on the headlamps. The North Eastern section engines of the L.N.E.R. have their " address " painted in abbreviated form in white letters on the inside of the cab panelling. In this connection it is interesting to recall that on certain lines in the past, for example the Caledonian and the London, Brighton, and South Coast, not only the home shed, but also the driver's name was painted permanently inside the cab, while on the former Midland line a small tablet on the outside of the footplate bore this information.

From time to time we have received many enquiries from readers for details of shed codes and we give below the principal particulars relating to the sheds of the G.W.R. Details concerning the L.M.S.R., L.N.E.R. and S.R. will be given in future issues.

PDN, Old Oak Common; RDG, Reading; SHL, Southall; SDN, Swindon; OXF, Oxford; DID, Didcot; BAN, Banbury; GLO, Gloucester; WES, Westbury; BL, Bristol (Bath Road and S.P.M.); TN, Taunton; WEY, Weymouth; NA, Newton Abbot; PLY, Plymouth (Mill Bay and Laira); EXE, Exeter; SBLZ, St. Blazey; TR, Truro; PZ, Penzance; NPT, Newport (Dock Street and Ebbw Junction); PILL, Pill; BSG, Bassaleg; CDF, Cardiff; PPL, Pontypool Road; ABDR, Aberdare; STJ, Severn Tunnel Junction; NEA, Neath; SED, Swansea; LLy, Llanelly; LDR, Landore; CAR, Carmarthen; WPN, Wolverhampton; BHD, Birkenhead; CHR, Chester; TYS, Tyseley; SALOP, Shrewsbury; WPN, Oxley; STB, Stourbridge; CNYD, Croes Newydd; WOS, Worcester; HFD, Hereford; CHEL, Cheltenham; TBG, Trowbridge; TDU, Tondu; LTS, Llantrisant; FGD, Fishguard; WTD, Whitland; CRW, Crewe; LMTN, Leamington; WLN, Wellington (Salop); PT, Port Talbot-Duffryn; DNG, Rhondda and Swansea Bay; NEY, Neyland; SAL, Salisbury; OSW, Cambrian Section; BCN, Brecon; MCH, Machynlleth; CV, Cardiff Valleys.

Relics of the Past

Very few items of early railway equipment still survive outside museums, and fewer still remain in the positions occupied in the days of service. Special interest attaches therefore to an old square stone that is still to be seen in the goods yard at Forest Hill. This old stone is the sole survivor of the stone sleepers on which the track of the old London and Croydon line was laid, and probably dates back to 1829. A piece of metal protrudes from the stone's surface and this probably is a fragment of a rail or rail support.

* * * *

Quick Work on the S.R.

On a recent occasion a Southern Railway train picked up 367 passengers at Southfields Station and was away again with all on board in 22 seconds. A few mornings later even this " hustle " was beaten, for a train entered Addiscombe Station, took aboard 364 passengers and was away again in less than 20 seconds! Throughout March the steam trains of the Southern section averaged only 40 seconds per train in lost time.

* * * *

New West Australian Locomotives

The introduction of the first of 10 new express passenger engines marks the inauguration of a new policy by the West Australian State Railways. Previous to the construction of this engine, which is a " Pacific," all locomotives had been imported, but it is now intended to construct them whenever possible at the State Railway's own workshops at Midland Junction.

The new locomotives are similar in design to 10 " Pacifics " built by the North British Locomotive Co., to the design of the State Railway's Chief Mechanical Engineer, Mr. E. A. Evans. These engines were briefly mentioned in the " *M.M.*" for May 1925.

The engines will be used on passenger services and each exerts a tractive effort of 22,248 lb. They are fitted with superheaters and other modern appliances for economical working, including an automatic coal-trimming arrangement. The fire grates are specially designed for burning coal, known as " collie," and have an area of 35 sq. ft.

* * * *

South African Coal Wagons

The South African Railways have placed in service recently a number of 67-ton coal wagons. The tare weight of each wagon is 69,000 lb. and the wagons are carried on two six-wheeled bogies. The discharge doors are fitted in the wagon bottoms, three on each side, and so arranged that the coal can be discharged either at the track sides or between the rails.

It is interesting to contrast these wagons with coal wagons as used in America and Britain, where the largest in use are of 140 tons and 40 tons respectively. The latter, by the way, are owned by the L.N.E.R., who also own the highest capacity goods wagons of any type in this country, 50-ton brick wagons, and the largest trolley wagons, 81-ton capacity.

* * * *

" *Tiny* " to be Preserved

The broad gauge shunting engine known as " *Tiny* " of the old South Devon Railway has recently been assembled on the platform at the newly reconstructed Newton Abbot station, where it is to be preserved as a relic of early days. This old engine was built in 1868 and has been out of service for over 30 years, although it has been employed in the meantime as a spare pumping machine at Newton Abbot. " *Tiny* " is a four-wheeled broad gauge coupled engine with an upright boiler and a cog wheel drive. Two hundredweights of coal would completely fill its bunker and the water tank will hold no more than 500 gallons!

* * * *

A Reader's Station Tour

Those of our readers who followed our recent notes on veteran locomotives will regret to learn that four 0–6–0's of the DX Class, numbers 3106, 3130, 3309 and 3553, have been scrapped. Another interesting scrapping is that of No. 1944, " *Victoria and Albert*," this being the last but one of Mr. F. Webb's 4–4–0 compound passenger engines left on the L.M.S.

Mr. G. F. Fox, Leicester, who sends the above information, also writes that he was recently on a train hauled from Leicester to London by Midland single No. 638 and Class 3, 4–4–0, No. 730, and it is interesting to learn that No. 638 is one of only 10 of the famous Midland " singles " remaining in service. The other nine singles are Nos. 600, 633, 640, 641, 645, 649, 669, 673 and 679.

While in London Mr. Fox visited the principal stations. Among the engines observed at the Southern Railway termini were 454 " *Queen Guinivere* "; 752 "*Linette* "; 781, "*Sir Aglovale*"; 772, "*Sir Percivale* "; 788, " *Sir Urre of the Mount* "; 791, " *Sir Uwaine* "; 803, " *Sir Harry le Fise Lake* "; 793, " *Sir Blamor de Ganis* " of the " King Arthur " class, and Nos. 801 and 804 of the 2–6–4 " River " tank class, named respectively " *Darenth* " and " *Tamar*."

At Paddington, Nos. 4085 and 4090, " *Berkeley Castle* " and " *Dorchester Castle*," were on view, while of the " Stars," 4019 " *Knight Templar* "; 4022, " *King William* "; and 4030, " *King Harold* " were seen. The " Saint " class was represented by 2395, " *Caynham Court*," and 2986, " *Robin Hood* "; and 3809, " *County Wexford*," of the 4–4–0 " County " class was also seen.

The final visit of the day was to King's Cross and among the Gresley " Pacifics " seen were 2546, "*Donovan* "; 2547, " *Doncaster* "; 2552, " *Sansovino* "; 4474, " *Victor Wild* "; and 4476, " *Royal Lancer*."

Electric Rail Car

Electromobile Ltd., of Otley, have recently constructed an electric railcar for use by the War Office on a branch line at Shoeburyness to carry artillerymen to the gun ranges. The car carries electric batteries beneath the seats and runs for 40 miles before a recharge is necessary. Accommodation is afforded for 16 passengers and the operating costs are slightly more than 1d. per mile.

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The Great Western Railway Company's wage bill is £40 for every minute of the day and night. The company employs 110,000 men and it will not need an expert mathematician to arrive at the approximate annual total disbursed.

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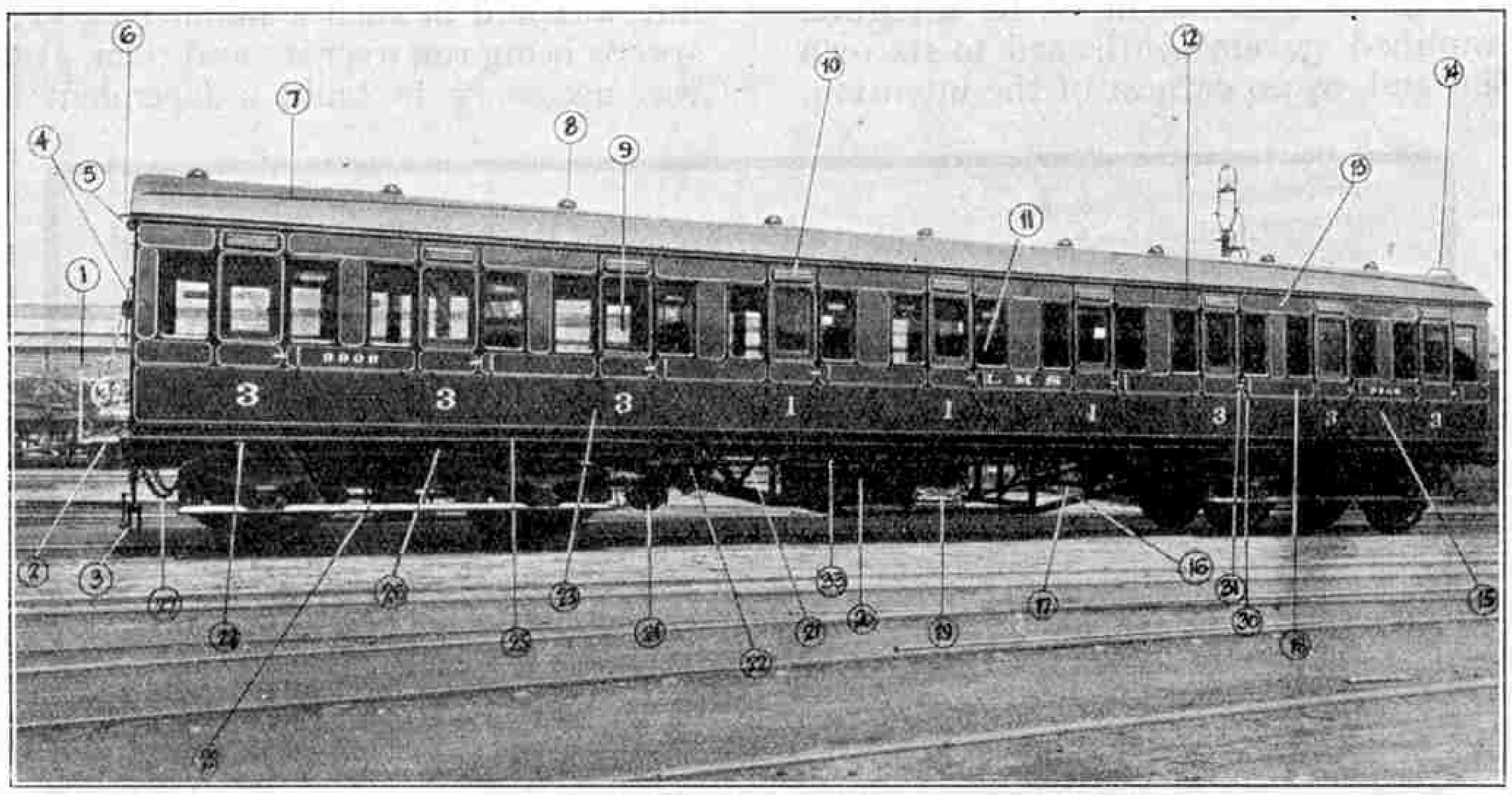
The first of the new 2–6–0—0–6–2 Garratt type locomotives for the L. M. S. is now in service and, we understand, is achieving excellent results.

L.M.S. STANDARD 57-FT. BOGIE COMPOSITE CARRIAGE



1 Buffer; 2 Buffer Guide; 3 Screw Coupling; 4 End Commode Handle; 5 Passenger Communication; 6 Cornice Spout; 7 Weather Strip; 8 Roof Ventilator; 9 Door Light; 10 Door Bonnet; 11 Quarter Light; 12 Outside Cornice; 13 Top Panel; 14 Roof Commode Handle; 15 Bottom Quarter Panel; 16 Truss Bar; 17 Rocking Shaft; 18 Waist Panel; 19 Electric Light Regulator; 20 Cell Box; 21 Vee Hanger; 22 Automatic Vacuum Brake Cylinder; 23 Door Hinge; 24 Dynamo; 25 Top Stepboard; 26 Solebar; 27 Check Chain; 28 Step Iron; 29 Bottom Stepboard; 30 Door Commode Handle; 31 Door Handle; 32 Electric Light Sub-Controller; 33 Electric Light Two-Pin Socket

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Re-Allocation of "Claughton" Class Locos

Under a new scheme that has recently been introduced on the L.M.S. Railway, engines of the "*Claughton*" Class are being re-allocated to various sheds. Numbers 5900-5954 are to be stationed at Crewe; 5955-5972 at Rugby; 5973-5991 at Camden; 5992-6009 at Edgehill; 6010-6020 at Longsight; 6021 and 6022 at Preston; 6023-6025 at Carlisle, and 6026-6029 at Bangor.

It will be observed that the engines are allocated to various sheds in groups and it is probable that a similar scheme will be put into operation to cover other classes, although at present there is no evidence of a move in this direction.

* * * *

The historic railway saloon in which the Armistice was signed on 11th November, 1918, is to be taken from its present resting place in the Invalides Museum, Paris, and placed in a special building that is to be erected at the cross roads in the forest of Compiegne, the point at which the preliminary negotiations were conducted.

* * * *

The L.M.S., following the example of the Southern Railway, have decided to introduce compartment-type rolling stock on their electric services in London and on the Liverpool-Southport and Manchester-Bury services of the old L. & Y. line.

Locomotive Veterans in Odd Corners

Although the majority of locomotives are scrapped at the company's works on becoming worn-out or obsolete, some are sold, and a systematic search round the odd corners of the country, particularly in industrial regions, would bring to light many old favourites of the past. Thus, at various coalmines in the North Eastern area, former tank engines of the old North London and the now electrified Mersey Railway are still at work, or were until very recently. The Mersey Railway steam locomotives were particularly sturdy six-coupled tanks, and their small wheels and unusually large outside cylinders made them very suitable for heavy colliery work.

Other old locomotives may sometimes be observed amidst an assortment of rusty scrap iron and machinery. Adjoining a brickworks near Leeds, for instance, there is a dump of scrap metal, and among it a local enthusiast recently discovered in fairly good condition a tiny engine of the type which at the end of last century was used for propelling the ungainly steam trams in the City of Leeds. A more interesting instance may have come to the notice of "*M.M.*" readers travelling south from Darlington on the main line of the L.N.E.R. The largest and finest "Pacifics" in the country pass close to an engineering yard where stand two veterans of the old Great Northern Railway. These are a domeless 0–4–4 tank engine, of the Stirling type once so common around London, and an even earlier tender engine of the 2–4–0 class, probably of Sturrock's design.

* * * *

Atlantic 9904, "*Holyrood,*" fitted with speedometer, was observed working from Edinburgh to Glasgow recently, but she subsequently returned to the Waverley route.

Cammell Laird & Company Ltd., of Sheffield, have recently received an order from the Central Argentine Railway Company for 800 25-ton all-steel bogie low-sided wagons, and the Midland Railway Carriage and Wagon Company have received an order from the same railway for seven first-class bogie dining cars.

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Since our recent note on the 24-hour clock was penned, the Dutch railway and postal authorities have adopted the system, thus following the example set by the famous K.L.M. (the Royal Air Company) several years ago.

* *

As an experiment, first class coaches have been introduced on most of the principal routes of the Swedish State Railways. These are intended for the convenience of foreign tourists, as there is practically no native demand for first class accommodation.

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New Locomotives for Queensland

Twenty-five new 4–8–0 locomotives with double bogie tenders have recently been completed and despatched to Queensland, Australia, by Sir W. G. Armstrong-Whitworth & Co. The locomotives are for the State Railway's 3 ft. 6 in. gauge and each has cylinders 17 in. in diameter by 22 in. stroke. The driving wheels are 3 ft. 9 in. in diameter, the leading bogie wheels 2 ft. 4 in. in diameter and those of the tender 2 ft. 9 in. in diameter. The total wheelbase of engine and tender is 45 ft., and the tender has a capacity for 4½ tons of coal and 3,000 gallons of water. The engines are designed to work at a boiler pressure of 160 lb. per sq. in. and possess a total heating surface of 798 sq. ft. On the usual basis of 85 per cent. of the boiler pressure the tractive effort is 19,200 lb.

Locomotives and tenders have been shipped fully assembled and on arrival in Queensland it will only be necessary to lift them on to the quay, when they will be ready for immediate service.

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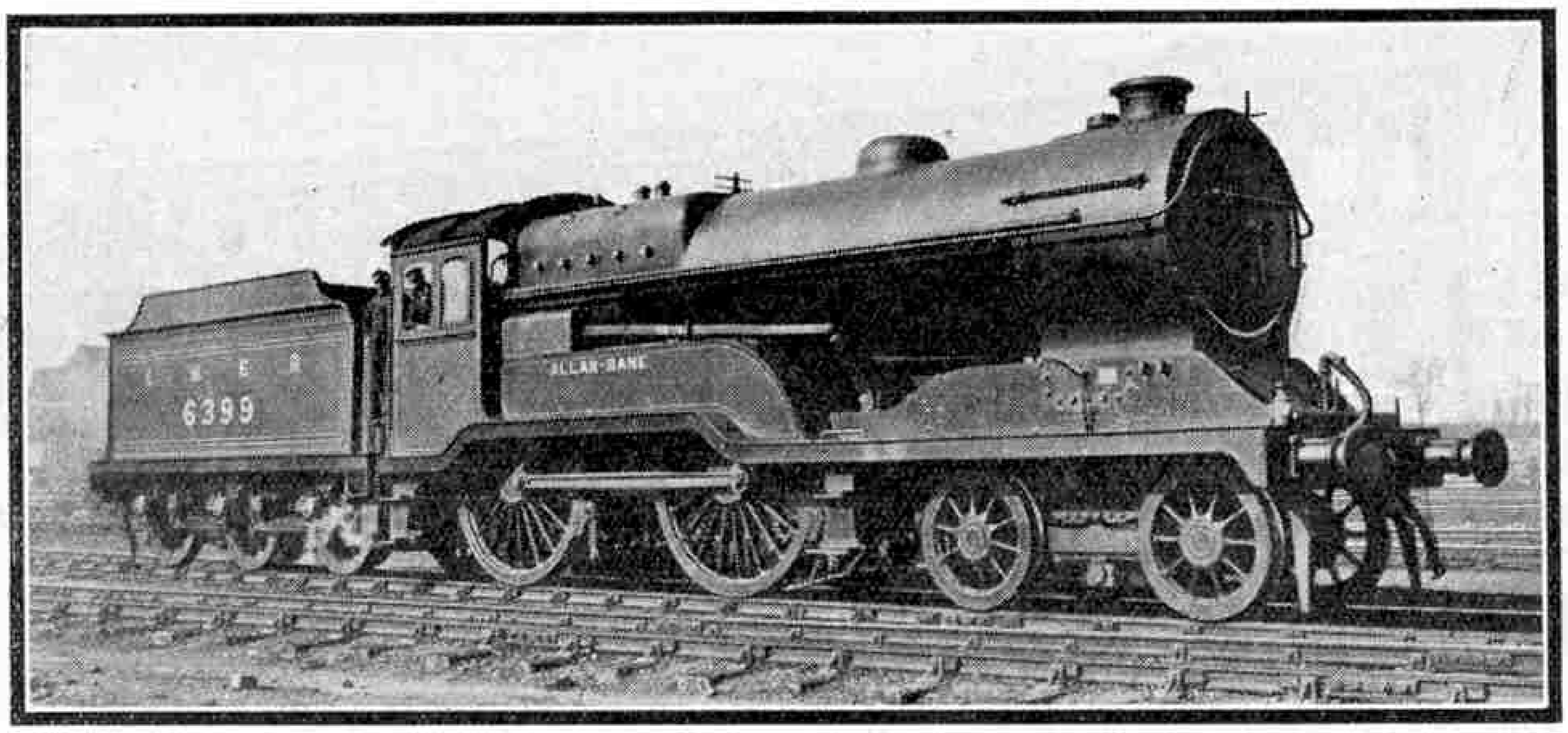
£100,000 is to be spent by the Southern Railway on the Brighton section in converting the existing Westinghouse brake system to the Vacuum system, so that the engines and coaches of all its three sections may be interchangeable.

FAMOUS TRAINS: IX.

The "3.20 Down Manchester," L.N.E.R.

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

IT was something of a shock to the well-established London and North Western and Great Northern Railways when the Midland signified its intention of extending its ramified system southward to its own terminus in London and, as an earnest of the intention, ran a line through Bedford to Hitchin and monopolised a large share of the Great Northern main line into King's Cross until its own St. Pancras Station was ready in 1868. Still more of a surprise, perhaps, was given to all these three companies when, nearly at the close of last century, in the face of determined opposition, the Manchester, Sheffield and Lincolnshire Railway obtained Parliamentary powers to do exactly the same thing.



Photo] [R. D. Stephen

L.N.E.R. "Director" Class 4-4-0 Engine No. 6399, "*Allan-Bane*." This is one of a batch of 24 engines built in 1924 and placed on the North British section of the L.N.E.R.

Prior to the opening of the "London Extension" in 1899, the Manchester, Sheffield and Lincolnshire was an important system crossing the country from Cleethorpes and Grimsby in the east, through Sheffield and Barnsley to Manchester in the west, with a share in the large joint railway known as the Cheshire Lines Committee, and important interests in North Wales. Its southernmost tentacle extended to Annesley, near Nottingham. The powers obtained enabled the M.S. and L. Company to prolong this line southward through Nottingham, Leicester and Rugby to a junction with the London Metropolitan Railway, which had advanced northward to a point beyond Aylesbury.

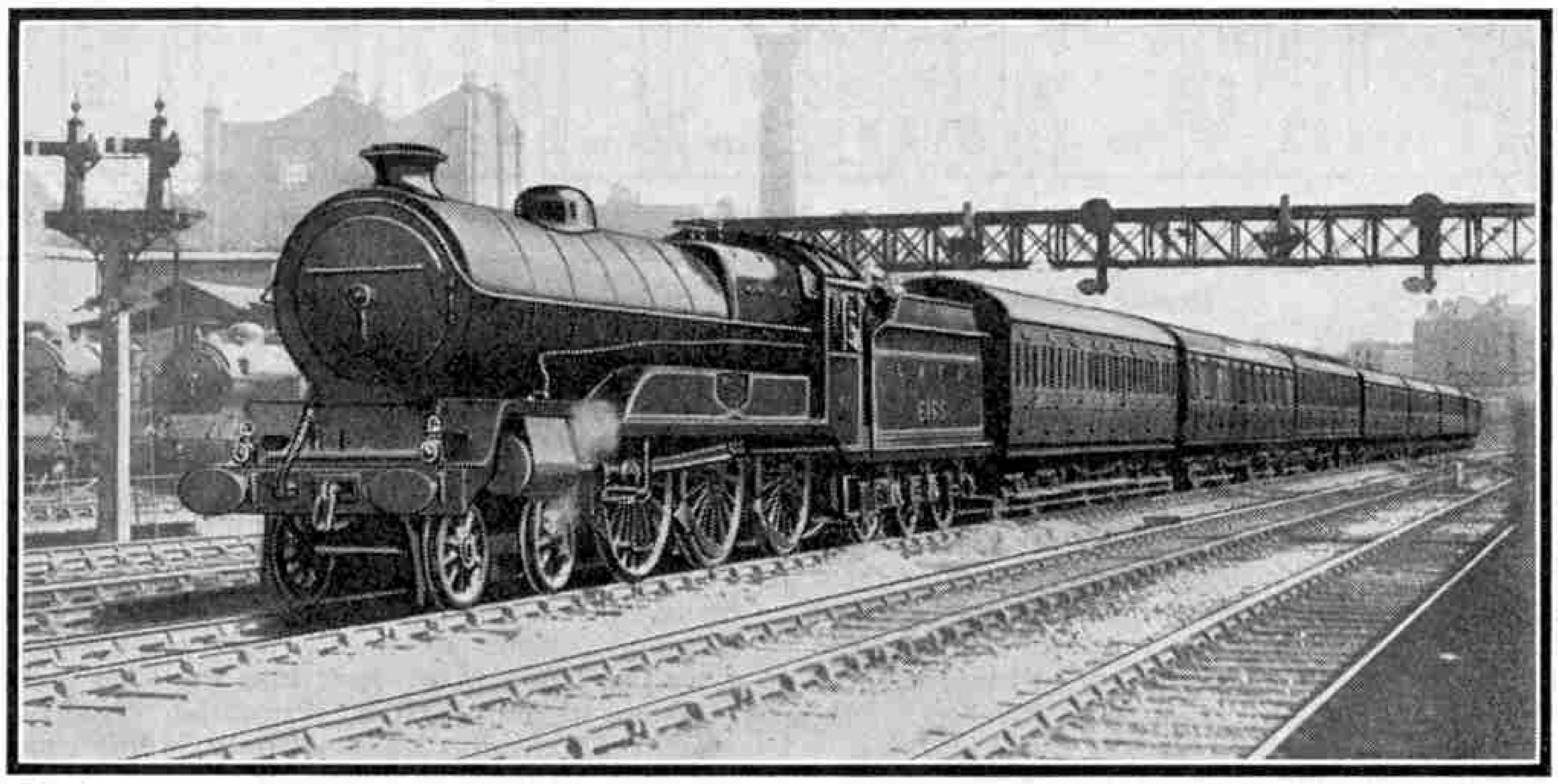
Leading Dimensions of "Director" Class 4-4-0 Express Engines, L.N.E.R.

Cylinders (2) diameter	**20 in.**
" stroke	**...26 in.**
Driving Wheels, diameter	**6 ft. 9 in.**
Heating Surface, tubes	**972 sq. ft.**
" " flues	**416 "**
" " firebox	**155 "**
" " superheater ...	**209 "**
" " total	**1,752 "**
Firegrate Area	**26½ "**
Working Steam Pressure ...	**180 lb. per sq. in.**
Tractive Effort (at 85 per cent. working pressure)	**19,650 lb.**
Adhesion Weight	**39·8 tons**
Weight of Engine in working order	**61 "**
Water Capacity of Tender ...	**...4,000 gallons**
Coal " "	**6 tons**
Total Weight of Engine and Tender (full)	**109½ tons**

As a result of this vastly important development the provincial railway required a new name, and included in the Parliamentary powers was the authority to change its name from Manchester, Sheffield and Lincolnshire to the imposing title of "Great Central" Railway. In due course the hundred miles of vastly expensive new line were completed. The Great Northern took the opportunity of combining with the Great Central in the building of the magnificent Victoria Station at Nottingham, while another big station had to be erected at Leicester. Regardless of expense, the main line was laid in such a manner as to invite the highest speeds being run over it; and then, at the London end, it was necessary to build independent lines inward from Harrow and a new terminus and a big goods station at Marylebone. This last section involved some engineering problems, not the least of which was the tunnelling under the corner of the famous Lord's cricket ground, which involved temporarily opening up the ground and, of course, the payment of a heavy sum of money by way of compensation to the Marylebone Cricket Club.

Whether the Great Central Extension to London would ever have been built and opened if the grouping of the railways had been foreseen is very difficult to determine. It has hardly attracted a through passenger traffic between London and the Midlands and the North sufficient to justify the enormous expense of its construction, although valuable suburban traffic has been built up in the outskirts of London, Leicester and Nottingham. But a very important link was opened shortly afterwards, between the Great Central Railway at Woodford Junction and the Great Western at Banbury, over which there now pass several well-known through expresses between the North East Coast of England and the South Wales ports and South Coast watering places. Another valuable use to which the Great Central main line is put is the carriage of vast quantities of coal from the Yorkshire and Nottinghamshire coalfields to London and also to various parts of the West of England.

The failure to attract much traffic to its express trains has not been for want of inducements. As soon as the line had "consolidated"—that is, the embankments and cuttings had properly settled down so that high speed running could safely be permitted—some very fast train services were instituted. As the last-comer to London, and therefore in the position of having to take the best route left, the Great Central has the most difficult of all the main lines going out of London northward, so far as gradients are concerned, but these have never been allowed to stand in the way of the speed of its express trains. Quite early the 103 miles between London and Leicester were scheduled to be covered in 105 minutes, at an average speed of all but 60 miles an hour. The next step was to institute the "*Sheffield Special*," making the 164¾ miles from Marylebone to Sheffield without any intermediate stop in 170 minutes. It is the present-day development of the "*Sheffield Special*," now extended to Manchester, that forms the subject of our consideration this month.



Photo] [F. E. Mackay

3.20 p.m. Marylebone-Manchester, leaving Marylebone. 4-6-0 Locomotive 6165 "*Valour*"

When it first ran, the "*Sheffield Special*" was made up to a total of three coaches. The rear one was a slip coach for Nottingham, the remaining two being vestibuled together and constituting the main portion of the train. It was quite a modest problem of haulage, therefore, that was set to the fine 4–2–2 engines of the "967" class that were then in use on the London Extension. One of the two Sheffield coaches, by the way, was a "buffet car," the Great Central having, from its opening, adopted as a "slogan" for its services: "Every express train vestibuled, with buffet car attached." The Great Central has probably done more than any other British railway—with the possible exception of the Great Eastern—to popularise the "Restaurant Car," or real travelling restaurant, rather than the more exclusive "Dining Saloon," and gradually all the railways of the country have come into line with this progressive policy.

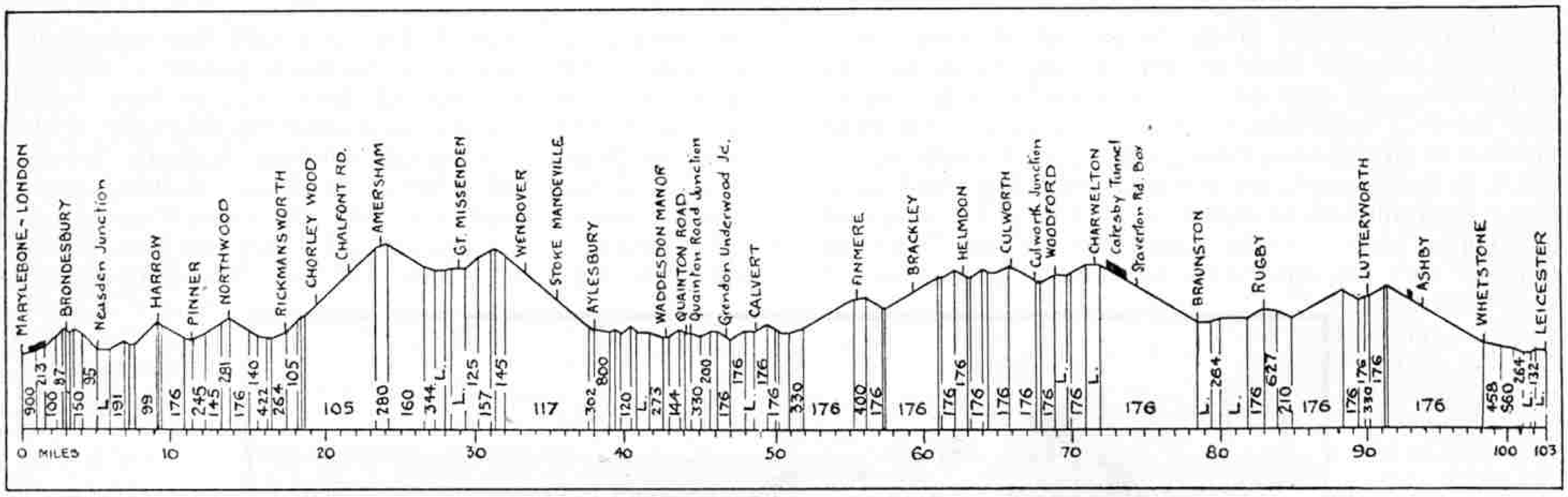
As time went on the "*Sheffield Special*" grew more popular, and its weight correspondingly increased. The slip coach was altered to serve Leicester as well as Nottingham, being run forward to Loughborough and Nottingham by a following train which proceeded to Grimsby and Cleethorpes. In the years before the war the formation consisted generally of five or six coaches of the latest and heaviest Great Central stock, making a total weight behind the engine tender of 180 to 215 tons, and 35 tons less than this from Leicester onward. Meanwhile the "Atlantics" had been built, and after them the first of the famous "Director" class of 4–4–0 engines, to which the working of this famous train is still entrusted. By now, of course, the main train was running through to Manchester, the Central station being the objective instead of the more usual London Road terminus.

Throughout the war the "*Sheffield Special*" survived, but with stops at both Leicester and Nottingham interrupting the non-stop Sheffield journey. Despite these additions to running time it was only found necessary to slow down the overall running time of the train to Manchester by 20 minutes, from its present time of 4 hours 25 minutes, with the startling result that for some considerable time the Great Central had the fastest of all trains between London and Manchester, although over a route nearly 30 miles longer and vastly harder in grading than the shortest route of its competitors. During the war period, of course, all British express trains were considerably slowed down, in order to reduce the number of trains operating and also the coal consumed.

Since the war the non-stop run to Sheffield has not, unfortunately, been reinstated, and the total time from Marylebone to Manchester Central is maintained at 4 hours 25 minutes, in place of the one-time 4 hours 10 minutes. Another addition to the stops has been made at Penistone, which, with Guide Bridge, makes altogether five stops between Marylebone and Manchester. One of the most remarkable features of the working is that the same engine works right through, in the hands of the same crew, for the complete distance of 212¼ miles—for the major part of the year—the second longest continuous engine and crew working in Great Britain. It is no light task, either, the 3.20 p.m. now generally taking out of London seven vehicles of the latest and heaviest L.N.E.R. stock, making a gross load of some 255 tons behind the tender for the bulk of the journey. Further, this load has to be worked at high speeds over very heavy grades, as we shall see in a moment.

The make-up of the train varies a little, but is generally somewhat as follows. On the back is a composite corridor coach for Halifax, which is now provided by the L.M.S. Company and is the only "stranger" in the formation. The Manchester portion of the train consists of a third-class brake, an open third-class car, a composite restaurant car of the type favoured by the late Great Central Railway (with kitchen in centre flanked by a couple of compartments of each class), a first-class open saloon, a composite first and third-class corridor coach, and a third-class brake next the engine.

And now a word about the engine before we start. Very occasionally one of the 2-cylinder or 4-cylinder 4–6–0 engines makes its appearance on this turn of duty, but the chances are overwhelmingly that our locomotive is of the Great Central 4–4–0 "Director" type. Amongst the handsomest engines running over any part of the London and North Eastern system, simple and straightforward in design and efficient in performance, the "Directors" have proved their worth to the extent of being adopted as one of the standard London and



Profile of Gradients, Marylebone to Leicester, L.N.E.R.

North Eastern express passenger designs for other than the heaviest main line duties, which fall to the "Pacifics." It is, indeed, a feather in the cap of the Gorton Works staff and of Mr. J. G. Robinson, the designer of the "Directors," that this has been the only 4–4–0 type of engine built by the L.N.E.R. since the grouping became effective. Most "*M.M.*" readers know that several "Directors" have been introduced into Scotland for working the heavy Edinburgh-Glasgow and Edinburgh-Perth services of the late North British Railway, and that another recent innovation has been the use of "Directors" on the West Riding and Harrogate Pullman services of the Great Northern section of the line.

Smartness has always been the keynote of Great Central working, and punctual to the second we move out of the terminus—in strict confidence I may tell you that I have occasionally known the 3.20 down leave a shade *in front* of time, though it ought not to do so! Whether or not the Metropolitan Railway had any conception when laying its lines, of the speeds that its powerful ally would desire to maintain, it is difficult to say, but the former has certainly provided some terribly steep gradients for the first 40 miles of our journey. The first of them begins at the platform end and takes us up for nearly three miles to a "summit" at the point where we cross over the "Outer Circle" of the L.M.S. at West Hampstead. For the second and third miles this gradually steepens from 1 in 213 to 1 in 87—a stiff start, indeed! Then there is a smart little drop to Neasden Junction for over a mile at 1 in 95, on which we may attain anything up to 70 miles an hour, at no more than five miles from the start—a feat that could not be paralleled on any other main line out of London.

At Neasden there diverges to the left the alternative Great Central main line to the North, *via* Northolt Junction and the Great Western and Great Central line through High Wycombe. This route, being easier in grading, is used by heavy excursion and freight trains, but its increased journey of 4½ miles rules it out for the fastest expresses which, with one exception, unless calling at Wycombe, take the original and shorter Aylesbury route.

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.

From Neasden we climb through Wembley to Harrow, and shall breast the last 1½ miles at 1 in 94-105, to the slopes of the famous "Hill," at about 40 m.p.h. or slightly over. Then comes a swift drop at 1 in 176 to a maximum of 60 an hour through Pinner; a rise, partly at 1 in 145, to Northwood, which we top at about 50, and falling grades, at 1 in 176-140, to the neighbourhood of Rickmansworth, where again we may expect a maximum of round about 70 an hour. Now, just when we are most needing our momentum, for the tremendous climb through the Chilterns that follows, it becomes necessary for our driver drastically to slacken his train round the sharp curve at Rickmansworth, to a speed of 15 miles an hour. Here the electrically-worked section of the Metropolitan line comes to an end, and with it the "colour-light" signals that have governed our progress most of the way from Marylebone to this point. We have travelled 17¼ miles and have taken about 22 minutes to do it.

Now comes the gruelling rise to Amersham. Through Chorley Wood and Chalfont Road we mount, all the way at 1 in 105, until we have had no less than six miles of it right off. The speed averages 35 miles an hour or slightly over—good work, too, in view of the train-load and the speed at which the ascent was begun. But the crew doubtless heave a sigh of relief when we breast Amersham and have some easier travelling ahead. Down to Missenden we cross the "seventy" line; past Wendover and Stoke Mandeville the rate is 75 an hour and upward, and we ease down slightly to pass through the new station at Aylesbury. We have now covered 38 miles from the start, in 45 or 46 minutes. Six-and-a-half miles later we reduce speed to branch to the left off the old Metropolitan on to the Great Central proper at Quainton Road Junction, and in less than three minutes more we join, at Grendon Underwood Junction, the loop line that has come from Neasden through High Wycombe. Nearly 47 miles from the start in 55 minutes leaves us only 54 minutes in which to complete the next 56 miles to Leicester.

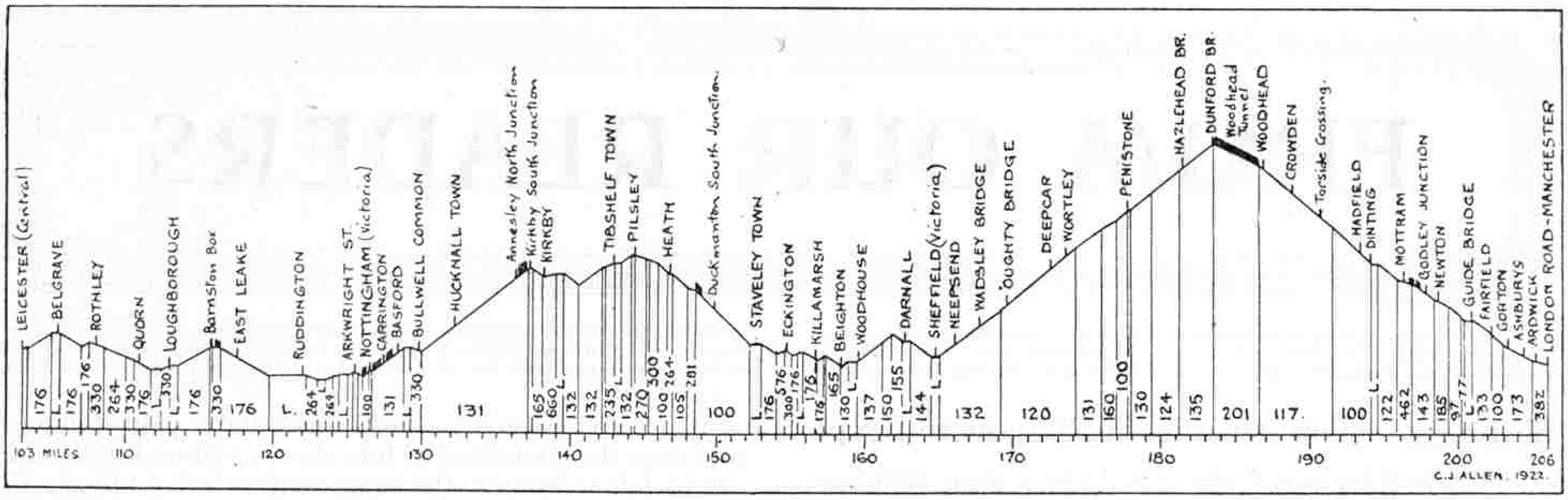
From here to Nottingham the steepest grade has been kept down to 1 in 176 by careful engineering, but there are some long stretches at this inclination, calling for hard work on the part of the engine. As the gradient profile shows, the bulk of the next 15 miles is adverse to the engine, largely at 1 in 176; but we shall find that our "Director" sails cheerfully up the banks at over 50 miles an hour, the speed seldom falling below about 52 and rising to just over 65 or so in the short intervening dips. Then we hurry over a sort of switchback "tableland," past Culworth Junction, where the Banbury "spur" from the Great Western comes in on the left, and Woodford and Hinton, an important junction and locomotive depot. Thirty-four miles to Leicester, and only just about 32 minutes in which to cover them!

Scooping up a fresh supply of water from Charwelton troughs, we dash into Catesby Tunnel—the longest of all south of Sheffield, measuring from end to end 1¾ miles—and, bowling down 6½ miles at the 1 in 176 grade, probably touch 80 miles an hour by the time we pass Braunston. We notice, by the way, that all the stations on this stretch of the line, from Calvert onward, are of the "island platform" type. That is to say, one platform serves both up and down lines, which are "looped" round both sides of it. The curves round the platforms are in no case of less than a mile radius, so that we are barely aware of their presence, even at the highest speeds.

Breasting Rugby in about 91 minutes from London, we swing over the great girder bridge carrying our route across the whole width of the approach lines and sidings to Rugby Station on the L.M.S. Shortly after passing Lutterworth we reach the top of the second long downhill stretch and, accelerating gloriously, we probably just reach or even exceed another 80 an hour, prolonged through Whetstone right into the suburbs of Leicester, before drawing up smartly at Leicester platform. We have neatly covered the 103 miles in exactly the allotted span of 109 minutes.

Only two minutes are allowed for the stop, but they are sufficient to enable us to see that even so big a station as Leicester has been built on the island principle. The main up and down platform is one of the longest in the country.

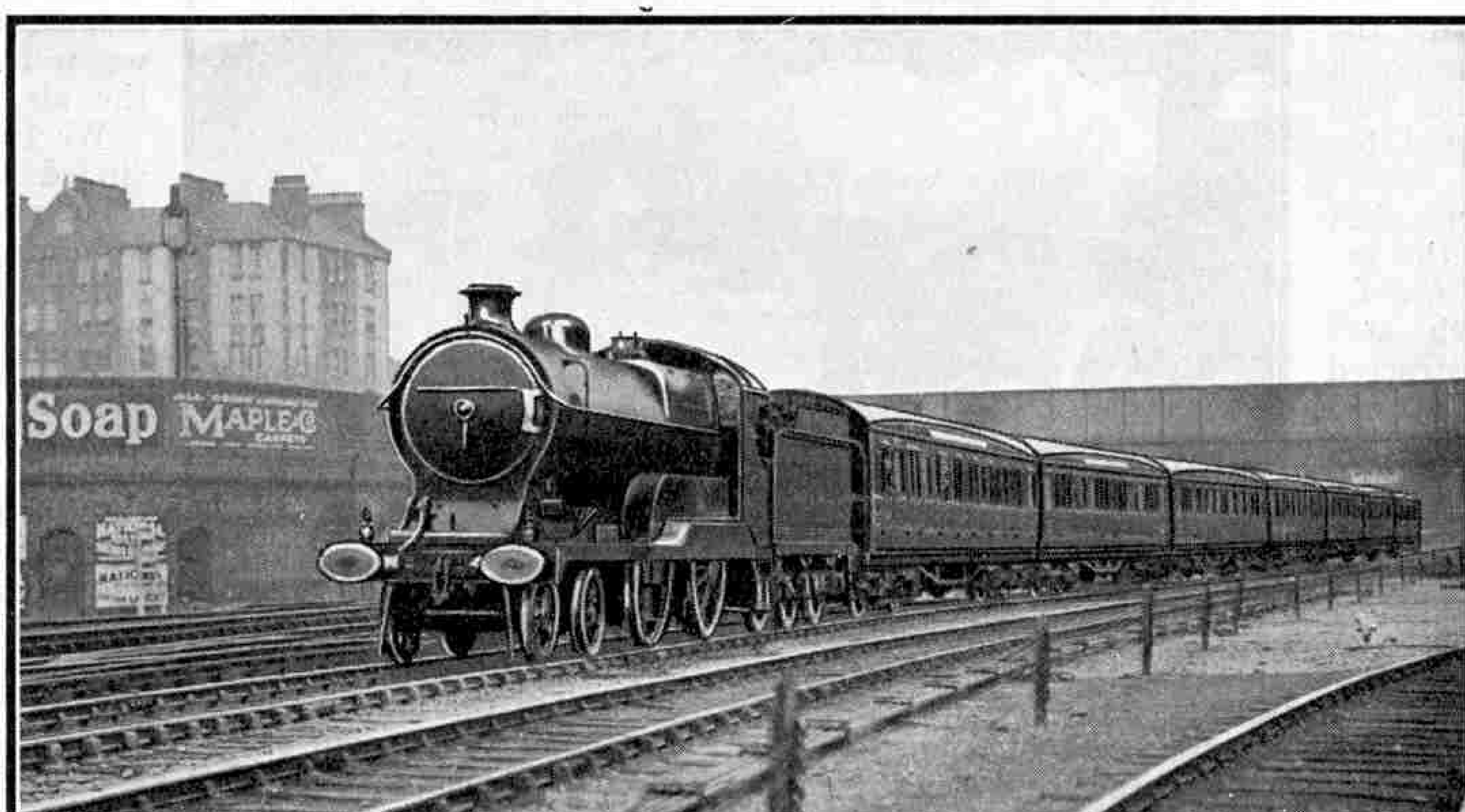
Away again, we have but 25 minutes allowed in which to cover the 23½ miles into Nottingham, and that despite a slow finish round the sharp curves from "Weekday Cross" Junction into the Victoria Station. It is over this stretch that the fastest Great Central run of the day is made, the early morning newspaper



Profile of Gradients, Leicester to Manchester, L.N.E.R.

express having to cover the 22½ miles to the Arkwright Street Station at Nottingham in no more than 22 minutes, start to stop. Such times involve dashing down to Loughborough at a speed reaching up to 78 miles an hour or so; then swinging over Barnston Summit at a minimum of 60, and perhaps touching 80 yet again near Ruddington before we begin to slow for Nottingham. These are tight timings indeed; there is not a single minute to spare anywhere!

Off from Nottingham again after a halt of two minutes, once more we have some tough climbing. The profile shows how the major part of the next 11 miles, to Kirkby South Junction, is as steeply ascending as 1 in 131. If we get up this ascent in no more than 17 minutes we shall do well. We are now on to the original Manchester, Sheffield and Lincolnshire line, and henceforward are well into the coalfield area on to Sheffield. Broken grades to Pilsley herald the long descent from there to Staveley, on which we shall achieve our last really high speed of the journey, probably at least 75 miles an hour, but possibly higher still. Then we negotiate a very curved section of the line, taking water for the second time at Eckington troughs, and so manage, again with no margin of time, to come to a halt in the grimy city of Sheffield at the Victoria Station, 48 minutes after leaving Nottingham (38¼ miles) at 6.26 p.m.



Photo] [F. E. Mackay

The 3.20 down Manchester Express leaving Marylebone hauled by a "Director" class locomotive

Here we are saddled with the addition of a through coach from Bournemouth to Bradford, attached in rear, which, fortunately, we have not to take further than Penistone. For this journey has "the sting in its tail." Look at the gradients west of Sheffield! One in 132-120-131-160-100-130-124-135—18½ miles of it without a break—what a task for an engine to face after having been continuously at work at high speeds for 3¼ hours! Yet up we soar, loudly vocal but without apparent difficulty. Gradually the speed creeps up through the "thirties," until possibly we just top the "forty" mark before slowing down for Penistone. Here we leave our through Halifax coach, as well as the Bournemouth-Bradford coach that was attached at Sheffield, so that the load is lightened to six vehicles for the last stage of the climb—from Penistone to Dunford Bridge.

We are now well up into the Pennines—the "Backbone of England"—and see the hills closing in on every hand. Directly we are through Dunford we make straight for the mountain face and enter Woodhead Tunnel. Space does not permit any detailed description of this remarkable bore; suffice it to say that its total length of 13 yards over three miles makes it the longest tunnel, by a handsome margin, on the whole of the L.N.E.R. system. Actually there are two tunnels, one for the down line and one for the up, falling in our direction at 1 in 200. A considerable amount of money was spent recently in improving the ventilation of Woodhead Tunnel, which was particularly bad on the up road, owing to the lower speed and harder working of the engines on the up gradient. Once through the tunnel and past Woodhead, we hurry down the long descent to Manchester. Full speed downhill is inadvisable, owing to the constant succession of reverse curves in the line, as we skirt the margin of the picturesque string of lakes on the right which is as a matter of fact, a series of reservoirs supplying water to towns on the east side of Manchester. We are not likely to exceed 65 miles an hour; if we should touch 70 for a moment, we shall find it quite fast enough to be pleasant.

Approaching Dinting, we are slowed to 40 miles an hour for the sharp curve leading on to Dinting Viaduct. This structure, in its magnitude, is a fit companion to Woodhead Tunnel; it is 1,200 ft. long, and reaches a maximum height of 130 ft. above the valley that it spans. A few minutes later we draw up at Guide Bridge, where important connections are made to Oldham, Ashton, Stockport and other towns fringing Manchester on the east. A final run of 11¼ miles, right round the southern suburbs of Manchester, such as Belle Vue and Levenshulme, brings us into the Central Station from a south-westerly direction. This belongs to the Cheshire Lines Committee, in which the L.N.E.R. is the predominant partner. We roll in at 7.45 p.m., on the stroke of time. We may have taken longer to get there than the trains of our competitors—it is only to be expected, with the longer distance and the heavier grades—but none of them, probably, would have given us such exhilerating bursts of high speed as we have enjoyed to-day on the "*3.20 Down Manchester.*"

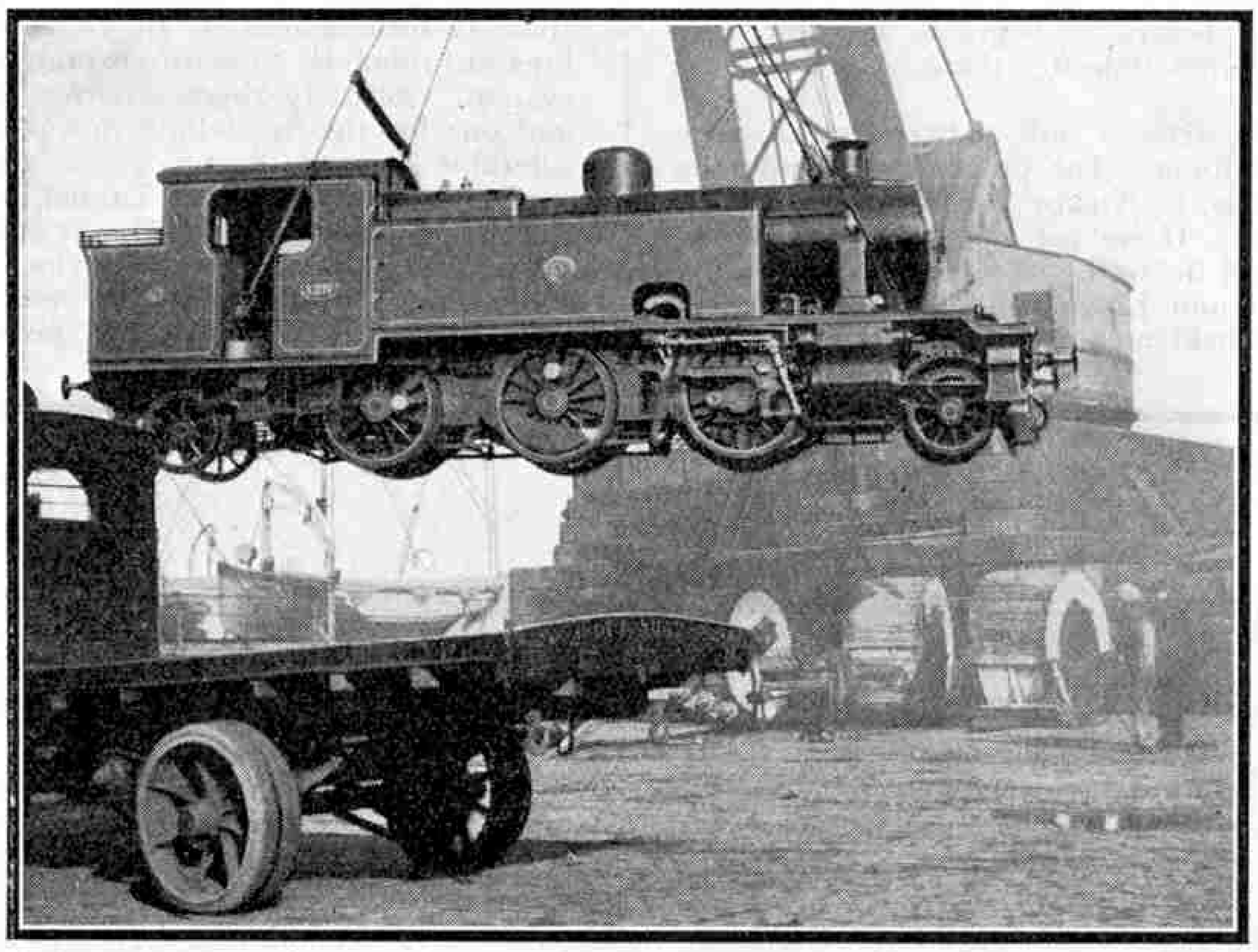
FROM OUR READERS

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

Shipping Locomotives from Glasgow to Egypt

While walking round Glasgow docks a short time ago I watched a shipment of tank locomotives for the Egyptian State Railways, their destination being Port Said. The engines were built by the North British Locomotive Company, Hydepark, Glasgow. They are all of 2–6–2 T type and are of Stephenson's standard gauge, Egypt being the only part of Africa in which this gauge is used. They are two-cylinder engines using superheated steam and having Walschaerts valve gear. The connecting rods and the coupling rods were the only parts that were not fitted, the journals of the crank pins and coupling pins being protected by wood.

The steamer that was conveying the engines was the "*Belfri,*" of Oslo, which was specially constructed for locomotive transportation. Several of the engines were stowed in the hold and the remainder were placed athwartship on special rails that rested on the hatch tops and gunwales. Wooden wedges, assisted by wire ropes passed through the spokes of the wheels and fixed to special long bolts on deck, kept the engines secure.



A Locomotive being hoisted on board on Glasgow Docks

Each engine weighed 66½ tons and was hoisted on board by a steam crane built in 1874 and still "going strong"—a remarkable tribute to the durability of British-made machinery. The engine I photographed was the first to be stowed on the top of the forward hatch and, as preparations to receive it were not quite complete, it hung suspended from the crane for two hours. When lowering this engine into position the old crane showed great flexibility in operation and compared favourably with a modern crane.

H. S. MacKinnon (Glasgow).

First Impressions of Flying

My first flight in an aeroplane took place at Brooklands Aerodrome. The machine, a Vickers Vimy bomber, was waiting on the grass outside the hangars and mechanics were completing their examination of it. I was given a leather helmet and a pair of gloves and then the pilot climbed into the cockpit and beckoned me to follow him, at the same time warning me not to get too near the whirring propellers. When all was ready the pilot gave a signal and two men took away the chocks—large wedges that are placed in front of the wheels to hold back the machine—and then the pilot opened out the engine and the great machine moved forward. We "taxied" along the ground to the other side of the aerodrome and then, turning round so as to face the wind, the pilot gave her "more juice" and we tore along at a high speed until the ground seemed to fall away and we were really up in the air.

We banked over and circled the track and then passed out over Weybridge. I glanced at the speedometer and was surprised to see that we were doing 80 miles per hour. This does not seem at all fast in the air because there is nothing to pass, but on looking down the earth seemed to be running away from us! After circling Weybridge we banked and struck across country that I did not recognise. The queer thing about banking is that the machine does not seem to tip up at all, but the earth slips out of its place and comes up either on the right-hand or the left as the case may be!

Again glancing at the instruments on the dashboard I saw that we were 1,000 ft. up and travelling at 100 miles per hour. Now and then we passed through clouds, which made it rather cold. We flew over Guildford and then turned and made tracks for home. As we neared Brooklands we began to come down, and this sensation is not so bad as some people imagine. At last we touched ground with hardly a bump and taxied to the hangars. My first flight lasted three-quarters of an hour and I am longing to go up again.

I came away from the aerodrome convinced that flying was destined to become a favourite sport in the not very distant future. Perhaps some day I may be fortunate enough to own a machine of my own, and then, Mr. Editor, you may expect me to "drop in" and see you at the first opportunity!

T. H. Luxford (Weybridge).

Down a Coal Mine

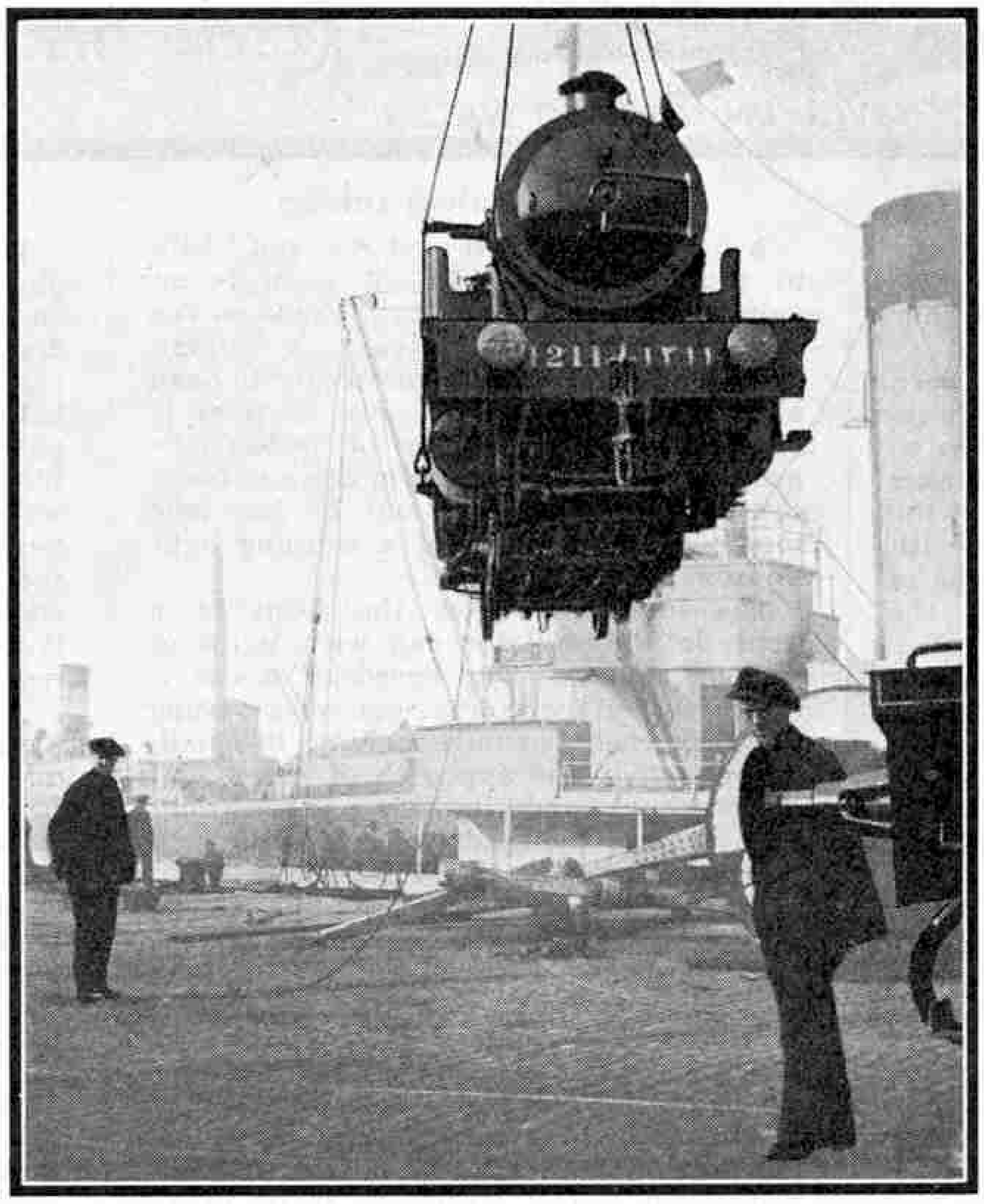
A short time ago I had the good fortune to be one of a party from a school scientific society that had arranged to visit a coal mine.

On arrival at the mine, and before we descended into the depths, the various seams and workings were explained to us by means of a map. We were shown also about twenty books that had to be filled in daily with details regarding the state of the mine and duly signed. The most interesting thing "on top" was, of course, the engine, which is fitted with brakes that operate automatically if the cage should descend too fast. We were then given acetylene lamps—for there are no inflammable gases in this mine—and we descended 275 yards at what seemed an incredible rate. It was a queer sensation when the cage was retarded, for then we appeared to be ascending!

Having arrived at the bottom of the shaft we lit our lamps and walked along a double tramway track to the main "station" of the mine. This was lighted up with electric lamps and one could hardly believe it to be underground. We were shown the pit ponies, twelve in number. Their stables were whitewashed and lighted by electricity, and altogether the conditions were very good. At this station also was an electric motor that hauled ropes to which the coal trucks could be attached. The actual mining is done by hand and the position of the diggers is not one to be envied.

Many other interesting things were shown and explained to us and then we retraced our steps to the bottom of the shaft, visiting on the way two electric water pumps. Finally we ascended in the cage, and it was with a slight feeling of relief that we stepped out at the surface with the blue sky above us!

F. H. Beasant (Bishopston, Bristol).



On the way to Egypt (*see previous page*)

A Visit to a Cycle Works

One of my most interesting experiences was a visit to a great cycle and motor-cycle works at Nottingham. This visit was arranged by our school scientific society.

We were conducted first into a great room where machines driven by overhead pulleys and shafts cut gear cases, crests and other small articles for the cycles. Next we passed through shops where flat steel sheets was formed into the well-known cross-bar and other tubular components by means of the oxy-acetylene flame. It was quite thrilling to see a long flat plate transformed in so short a time. I was greatly interested in the sand-blasting and it seemed to me that the sand-blaster's job was not very desirable. He sits inside a steel chamber wearing a mask and a breast plate and he handles a large pipe from which sand is projected on to the cycle frame with enormous force, filling the chamber with choking dust.

Passing on, we entered an automatic room where wonderful machines carried out on their own accord many interesting operations. Nuts, bolts, threaded pins and cotter pins were seen in the making, all processes being carried out in spacious, airy shops.

After viewing these and many other operations with keen interest we were taken to the enamelling and finishing shop, where the cycles were coated with enamel, dried and lined with green or gold. The machines are then assembled and placed in storage.

W. F. Henson (Derby).

Chain Making

Among the many things that interested me in the "Black Country" is chain-making by hand. This work is done practically in the open and therefore anyone can easily watch the making of chains of all sizes and shapes.

The operations are carried out in large sheds consisting of corrugated iron roofs supported by stout metal posts. In these sheds there are perhaps a dozen men at work, each having his own furnace which he can blow with a pair of foot-bellows. The piece of metal to be used is placed in the furnace and left there until red hot. It is then taken out by means of long tongs, one end is fastened into a slot in a stone bench and the metal is bent roughly to the required shape, one end being left open so that it may be joined to another link. The unfinished link is heated again and, after having been fitted to another link, hammered up. In order to get the links more evenly shaped, a little foot hammer, which can be worked very quickly, is employed. At the end of the day the chain is polished and finished off.

I noticed that the men who are employed upon this work are not young but usually middle-aged and they are fine muscular specimens. They often make as much as 20 ft. of chain per day and in order to work at such a speed and in such heat they must, of course, be very physically fit.

Those readers who have visited the Meccano factory will contrast this method of chain making with that by which the Meccano sprocket chain is produced. In the Meccano machine-shop a long coil of steel wire is fed into one end of a small but very complicated machine, from the other end of which the completed sprocket chain emerges at the rate of something like 2 ft. per minute, each separate link being cut, shaped, and connected to the next automatically.

G. Coombes (Blackheath).

A MOTOR THAT WILL TRAVEL ON LAND OR WATER

Plough that Works by Itself

Ploughing the fields is going to be the easiest operation in farming, for an American inventor has made it unnecessary even to watch the plough at work!

The latest automatic plough has been designed for use with a tractor. When its inventor, an American farmer, wishes to plough a field of any size he merely makes one furrow along the outside border of the field and commences a second one with the outside front wheel of the tractor in the furrow just ploughed. Then the automatic guide is lowered into place and the machine started again. The guide is a heavy curved piece of metal on the front of the tractor that keeps the front wheel pressed up against the edge of the furrow in which it travels by means of a strong spring. With this aid the plough follows the correct course round and round the field, ploughing in narrowing circles until the centre is reached, and in the meantime the farmer is free to see to other business while the ploughing proceeds.

If any unexpected obstacle stops the progress of the machine, or if the guide is lifted out of the furrow as the result of any accident, a switch on the front axle is opened and cuts off the engine. This results in the stoppage of the tractor before any damage can result.

* * * *

To Protect Oil Engines from Overheating

A positive prevention for the overheating of the bearings of oil and petrol engines has been discovered. This is known as a thermo-stop and it not only gives a warning of trouble by ringing a bell but also acts as a safety valve by stopping the engine.

The principle of it is quite simple. In a small dome-shaped vessel is an open switch that is closed automatically when the temperature rises, by the melting of a link of easily fusible metal. The circuit thus completed rings a bell and actuates a relay that cuts off the ignition current of the motor.

In use several of these domes are screwed into various parts of the engine to give warning of abnormal heating. In some experiments made by the inventor the supply of oil to the bearings of a motor was cut off temporarily to produce overheating, but the thermo-stop prevented any damage from being done by stopping the engine. This test was made repeatedly with success and there seems little doubt that the device will find many uses, particularly for protecting the large Diesel engines that are now built for ship propulsion. It may also help to solve the problem of providing fool-proof engines for motor-cars.

Check on Furious Driving

A motor-car invention that is not likely to prove popular with all users is an indicator that reveals to onlookers the speed of an approaching car. A German engineer decided that it was absurd to have a red light behind a car only, as there is at least as much danger of pedestrians being run over by cars as of one car being overtaken by another, and he has now repaired the omission of a warning light in front.

His invention takes the form of a light on the radiator cap with bulbs of various colours. The speed of a car is indicated by the colour, one shade being fixed for each ten mile increase in speed. For example, the approach of a car with a green light would indicate to pedestrians that it was being driven steadily at a speed of from 10 to 20 miles per hour, while the appearance of a red light would be a signal to seek safety for it would mark the approach of a 60 miles per hour "speed merchant."

Naturally the police are interested in the invention and a suggestion has been put forward in Germany that it should be made compulsory on all cars and that the red light should be made to glow, not when a car attains a speed of 60 miles per hour, but as soon as the legal limit is exceeded.

* * * *

Spring Wheel to Supersede Pneumatic Tyre

A Chicago inventor proposes to substitute flat spiral springs for the pneumatic tyres ordinarily used for motor car wheels. He claims that his invention not only abolishes tyre trouble, but actually makes motoring cheaper, as the solid rubber tyres used on spring-fitted wheels are very easy to manufacture and use comparatively little material.

Eight of these springs are provided on each wheel, and they are attached to the arms of a metal spider that turns on the hub, a cushioning effect being provided by an intervening rubber pad built into the wheel. The springs act between the spider and the rim of the wheel with its solid tyre, and it is claimed that the rubber pad and the springs between them prevent the transmission of road shocks to the body itself better than pneumatic tyres, especially at high speeds. Similar flat spiral springs have also been used in the construction of front and rear buffers for motor cars.

This invention is of great interest in view of the efforts made by the Germans towards the end of the Great War to produce spring wheels that would make them independent of rubber. The substitutes were abandoned as soon as supplies of this commodity became available.

To Avoid Roadbreaking

When a new water main or large gas pipe is to be carried under a main road an army of workmen spend a day or two digging up a trench over one half of the road while traffic is restricted to the other half. The hole is filled in when the pipe has been laid, and the same procedure then takes place on the other side. For some time afterwards there is a nasty bump or possibly a shallow trench across the entire road, for a certain period must elapse before the earth has settled sufficiently to allow the surface of the road to be remade.

A Texan inventor considered this method of procedure unnecessary. The disturbance in his country was aggravated by the existence of concrete roads, tne surfaces of which had to stand for several days after remaking before they became strong enough to carry the weight of traffic. It seemed to him to be possible to bore the necessary hole from the side without disturbing the surface of the road or interrupting the traffic in any way. His boring tool took the form of a shaft as long as the pipe to be installed and driven by a petrol motor. This was firmly fixed in the centre of the pipe and carried cutting blades at the forward end, while a spiral conveyor was fixed under the shaft to carry the loosened earth backward. A trench of the required depth as long as the outfit was dug at the side of the road to accommodate the machine and boring operations commenced, a small jack being used to keep the cutting edge pressed up to its work. The first trial was quite successful, a 2 ft. pipe being carried under the road without any damage being done to it.

Experience led to improvements, such as the use of gearing between the motor and the main shaft, and the mounting of a flywheel. It was also found advisable to use a second set of cutting blades to bore a pilot hole of smaller diameter in front of the main opening. When the invention is in full working order and handled by experienced men a considerable saving in time is expected, and in any case the immunity of traffic from disturbance is a great gain.

This invention will be of most value in the case of country roads or of those commonly met with in the suburbs of American cities, where the side-walks are very extensive. In the centres of crowded cities, where his absence would be most appreciated, the road breaker apparently must be left to continue his depredations. It is possible, however, that it may prove useful in laying pipes running in the same direction as a road by reducing the amount of excavation necessary.

A New Ticket Issuer

The ticket punch that rings a bell and perforates a ticket at the same time was invented as long ago as 1891 and it is not until now that a more comprehensive instrument has been produced to supersede it. The new ticket issuer shown in our illustration has been described as "a cross between a pocket cash register and a young gas meter!" Omnibus conductors in London have already christened it the "concertina," because it has a kind of keyboard resembling the keys of that remarkable musical instrument.

Inside the punch is a bundle of printed tickets. The operations of the conductor on the keys and on discs on the side imprint on each ticket the stage at which the journey began, the fare paid and the class of ticket. In addition the numbers and prices of all tickets issued are automatically registered. This is a great improvement on the old system from the conductor's point of view, as it does away with the necessity for making out a record of the tickets sold during each journey.

The new punch has been devised mainly with the object of enabling one form of ticket to be used over the whole of the system of the London General Omnibus Company Ltd., instead of the 30 or so at present in use. The ticket rack now carried by conductors would thus be rendered unnecessary and there would be no necessity for the elaborate arrangements in vogue for sorting and despatching tickets of various prices and colours to the different depots.

Trials of the "concertina" are now being carried out by the L.G.O.C. and if these are successful it will be adopted generally.

* * * *

Ideal Microscope Lamp

As an example of careful adaptation of light to its immediate purpose, a lamp introduced by an electric company in America is quite noteworthy. An object on the plate of a microscope is illuminated on one side only by ordinary lamps, with the result that the perspective view is so flattened out that its true general appearance cannot be seen. The design of the new lamp enables efficient illumination to be obtained on all sides, for it is shaped like a horse shoe and when in use rests on the glass plate of the microscope around the object to be examined.

The glass portion, or "bulb," is a tube silvered over on the inside except for a narrow strip running along its whole length on the inside of the curve, while the outside is painted black except the portion of clear glass just mentioned. The filament is stretched along the length of the tube and the light from it, both direct and that reflected from the silvered portion, emerges in a thin beam. The purpose of the silvering is to intensify this beam as far as possible by reflection, while the escape of light is prevented by the blackening of the exterior of the tube.

As the glass of the plate allows light to penetrate through from below, a specimen examined under a microscope with the aid of this lamp is thoroughly illuminated, and it has been found possible to examine with it many objects that would otherwise have been practically invisible.

An Electric Hole Saw

In applying electric power to small hand drills a method has been developed of sawing a hole through it instead of drilling or boring it. The instrument made for this purpose is particularly valuable for cutting the comparatively large holes often necessary in metal pipes. It is also adapted for cutting holes in wood.

Courtesy] [*London General Omnibus Co. Ltd.*

How the new ticket punch referred to on this page is used. Pressing the keys on top imprints the stage, class and fare paid on each ticket before it is removed from the box

An ordinary twist drill is mounted on the end of an electric drill. This first makes a small depression in the centre of the portion of the metal or wood to be cut out and then the special device comes into play. This is a steel cup on the rim of which saw teeth are cut that make it into a kind of circular saw. The twist drill on the centre projects slightly beyond the rim of the saw and is thus able to act as a guide for the saw.

Many instances of work for which this invention is suitable could be given. Plumbers would find it useful for cutting large pipes in making connections, while the holes for clocks and speedometers in the instrument boards of motor cars could be made with it easily and exactly.

* * * *

Guy Rope Holder

A very simple idea that has been suggested for anchoring the guy ropes of tents, flag staffs, or aerial poles is to use a bar with an augur head instead of the usual wooden peg. Such a bar can be screwed obliquely into the ground to a greater depth, when the weight of a considerable quantity of earth is made available to hold it in position. This holder can be sunk into almost any kind of soil without digging a hole, nor is the soil disturbed in the process, so that reduction in holding power is avoided.

Gasholder with a Constant Pressure

The design of gasholders has advanced a great step with the invention of an improved method of sealing the gas in the holder. Until now this has been accomplished by allowing the sides of the holders to dip in water, a method that gives rise to trouble of various kinds. For instance, the water is liable to freeze in northern countries, where it is sometimes necessary to enclose the holder in a building, while the pressure of the gas contained varies with the number of sections of the holder in operation. In one large holder the pressure is sufficient to support a column of water 12 in. in height when the holder is full, but this is reduced to 5 in. when there is only sufficient gas in the holder to fill one section. Another drawback is that the sides of an ordinary gasholder are constantly wetted and dried as they rise and fall in the water tank and this results in rapid corrosion on the inside, where attention cannot be given. The excavation and lining of the tank into which the sides of the holder sink is also very costly.

The latest gasholder takes the form of a large vessel with a floating diaphragm or top that rises and falls in the holder with variations in the quantity of gas in exactly the same manner as a piston moves in the cylinder of a petrol engine. The weight of the diaphragm on the contained gas forces it through the mains, and as this is fixed, the pressure of the gas supply from the holder does not vary.

The most interesting feature is the method adopted for sealing the gas. On the outer edge of the diaphragm is a trough about 2 ft. in depth containing thin tar. The outer side of this trough slides on the inner surface of the holder and the overflow of tar from the trough effectually seals the very narrow space between. The tar solves another problem also, for it covers the internal surface of the holder down which it flows and protects it from possible corrosion.

There is no doubt that this new type of gasholder will eventually become standard. Sufficient experience has now been gained in Germany and the United States to enable initial difficulties to be overcome. Trouble was at first experienced, for instance, with the tendency of the diaphragm to tilt instead of remaining horizontal, which led to a serious fire in an early gasholder of this type erected at Posen, in Poland. This is now prevented by the use of guide rollers that maintain a perfect balance, and tests made recently have shown that the variation from the horizontal of the diaphragm of a holder of this kind did not amount to more than half an inch during a very severe gale.

* * * *

Invention by Substitution

An American recently invented an improved frame for dynamo-electric machines. The improvement simply consisted of the use of concrete in place of metal and the original application for a patent was rejected. The inventor appealed and was finally granted a patent on the ground that his idea was not an obvious one since nobody else had tried to patent it.

"Catching the Express"—with a Camera

Secrets of Train Photography

By F. E. Mackay

AT this time of the year we receive very many enquiries from photographic readers regarding the photography of trains in motion, and we have asked Mr. F. E. Mackay to disclose some of the secrets of his art for the benefit of our readers. Mr. Mackay is a "past master" in railway photography and not only are his pictures familiar as illustrations in the "*M.M.*" but they are well known throughout the railway world, both at home and abroad.
—EDITOR.

* * *

During the past few years the popularity of this interesting branch of photography has grown by leaps and bounds, and now practically all railway enthusiasts who own cameras turn their attention from time to time to train photography.

The apparatus chosen by photographers for this work varies greatly, and to a large extent depends upon the amount of money that can be afforded for this purpose. In railway photography, as in all other branches of the art, skill in operating is of more importance than expensive apparatus. At the same time, although a skilled worker will produce better results with a cheap camera than a bungler will with the most elaborate apparatus, one thing is essential if the best work is to be done, and that is an efficient focal plane shutter. The type of camera may vary within wide limits, but it must be fitted with a focal plane shutter if it is intended to photograph trains travelling at high speeds and at the same time to secure as large an image as is possible with the size of plate in use.

Photo] [F. E. Mackay

Southern Railway. Brighton Express leaving Victoria (Engine : King Arthur Class (4–6–0) No. 796, "*Sir Dodinas de la Savage*")

What has just been said does not mean that train photography is impossible if one does not own a focal plane shutter. All it means is that without such a shutter certain limitations make themselves felt, and must be accepted as inevitable. There are on the market to-day several "between-lens" shutters giving fairly accurate speeds up to 1–300th of a second, and such shutters will give excellent results provided their limitations are borne in mind. It is merely necessary to remember that with such a shutter main line expresses tearing along at 60 to 70 miles an hour are beyond our scope, and to be content with trains travelling at moderate speeds. As a matter of fact it appears to be forgotten too often that even "*The Flying Scotsman*" and the "*Cornish Riviera Express*" are not always at top speed, and that by being at the right spot at the right time they may be caught before they have got into their stride.

Even the owner of an ordinary between-lens shutter having its highest speed marked at 1–100th of a second—in reality more likely to be 1–25th of a second—need not despair. His limitations are still greater, and he must be content with trains at still lower speeds or, alternatively, with working at a considerable distance from the line so that the image of the train he secures is very small. A small image is not much use in itself, but if it is sharp it can be enlarged so as to become of real interest.

We now come to the question of the lens. It may be said at once that a very rapid lens of the anastigmat type is the best for the purpose, but such a lens is very costly, and although, like the focal plane shutter, it is highly desirable, yet it is not absolutely necessary. The ultra-rapid plates of to-day are of such enormous speed that an ordinary rapid rectilinear lens working at F.8 will produce excellent results with shutter speeds as high as 1–500th of a second, provided the light conditions are favourable. The writer commenced train photography somewhere about 1899. At that time he had to be content with a Dallmeyer rapid rectilinear lens working at F.8, and what were considered fast plates in those days had a speed of only about 200–250 H. and D., as compared with to-day's plate speeds of 600–700 H. and D. In spite of these handicaps the results then obtained were quite as good as any turned out at the present day. To stress the point further, although the writer possesses an F.4.5 lens he only uses the full aperture when working in a poor light, the aperture in regular use being F.8.

In regard to plates or films, the best advice is to select a good brand of ultra-rapid plate, stick to it and master it. There is nothing gained by experimenting with one make after another in the hope of discovering some extraordinary plate. All British plate manufacturers turn out plates that can be thoroughly relied upon.

Orthochromatic plates have no advantage over ordinary plates unless a screen or light filter is used, and this is seldom possible on account of the considerable increase of exposure involved. Striking results may be obtained, however, by the use of panchromatic plates without a screen. It is probable that the extra care required in the use of panchromatic plates scares many a photographer away from them. These plates are easily manipulated after a little practice, however, and one soon becomes accustomed to carrying out the various operations in total darkness. The main thing is to make certain exactly where the various trays and solutions are placed before turning out the light, otherwise, while one is groping about on the dark-room table for an elusive bottle, all kinds of disasters may occur!

Readers frequently send in enquiries as to which is the best developer for very short exposures. Actually there is no "best" developer, and any standard formula will give a good result if treated properly. The writer's preference is for the well-known "Pyro-Soda," and this developer is recommended by many experts who specialise in high-speed photography. After many years of experience the writer is convinced that Pyro-Soda will do all that any other developer will do and do it equally well, and among its many valuable features is that of being easily used by beginners.

These who wish to make up their own Pyro-Soda developer are advised to try the following formula, which is used by the writer in all his work:—

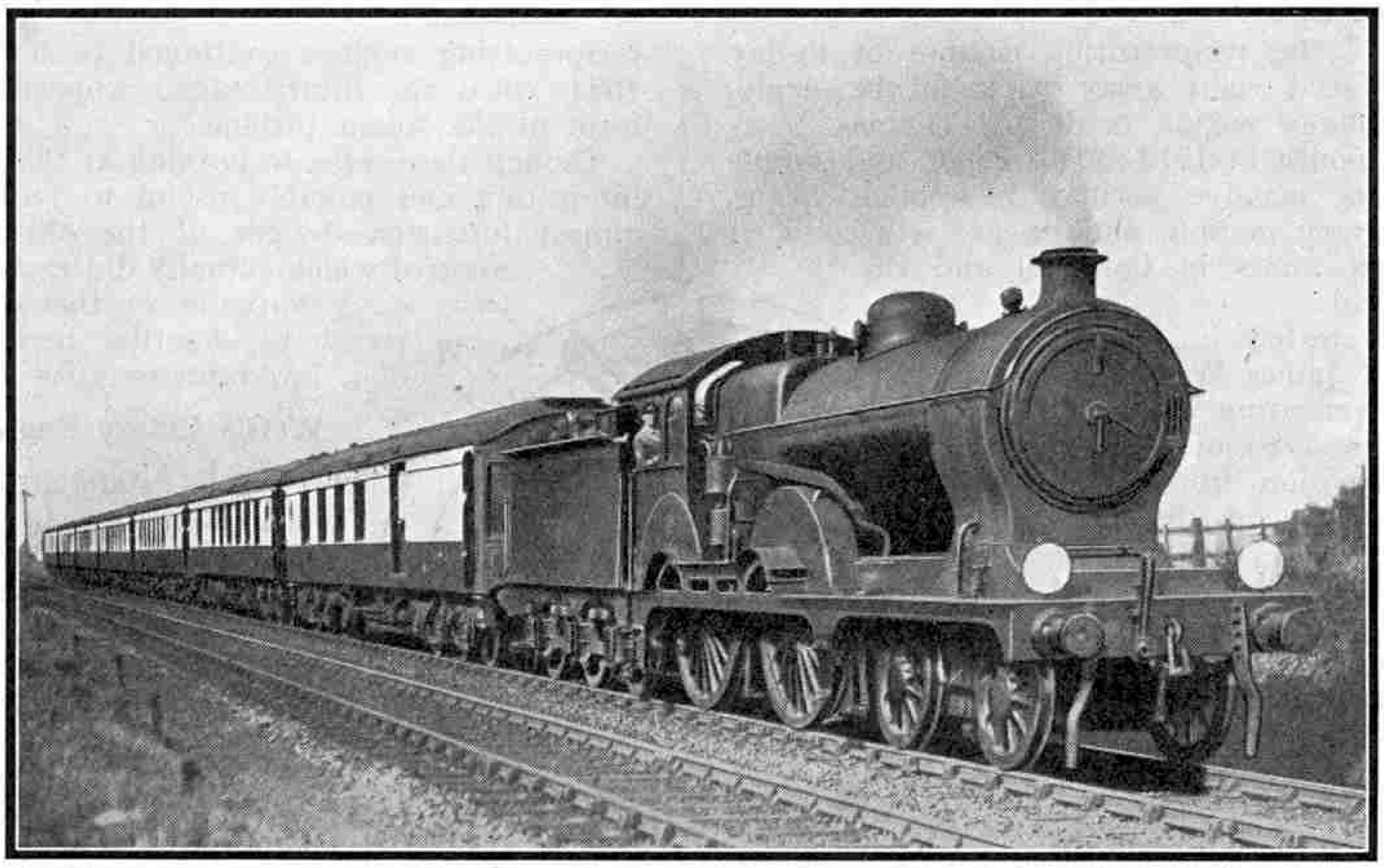
Solution A		Solution B	
Potassium Metabisulphite,	30 grns.	Soda Carbonate,	2 ozs.
Water	20 ozs.	Soda Sulphite,	2 „
Pyro	100 grns.	Water to	20 „

For use take equal parts A and B.

This formula gives beautifully clear negatives that print to perfection on bromide paper and enlarge successfully up to 30 in. by 40 in.

Photographs taken against the sun or in circumstances where the sun does not shine on the side of the train should be developed with a dilute solution in order to avoid harsh results. The use of a lens hood is strongly advised to shield the lens from direct sunshine, and incidentally the use of a lens hood in all photographic work will add considerably to the brilliance of the result.

Negatives that are thin, either from under-exposure or under-development, can be improved greatly by intensification. The chromium intensifier is perhaps the best of all for the purpose and gives surprisingly good results. It must be remembered, of course, that no amount of after-treatment will put into a negative what is not already there; intensification merely strengthens the negative so that it will give a better and stronger print. Chromium intensifier is prepared by Burroughs Wellcome and Co. in the well-known "Tabloid" form, which avoids the necessity of keeping a stock of chemicals.



Photo] [F. E. Mackay

L.N.E.R. Down Clacton Pullman (Sundays only) passing Giden Park. (Engine No. 8783) (4–4–0)

The use of a light tripod is advisable in train work. Generally speaking, the photographer takes up his position some time before the train is due to pass, and this enables the picture to be carefully composed and focussed beforehand. Beginners find some difficulty in making their exposure at the right moment, with the result that very often either the engine has passed out of the picture or the rear of the train has not come into it. The best method of ensuring accuracy in this respect is to select a sleeper, fishplate or other object in a suitable position near the rails, and to release the shutter when the engine reaches the object.

It should be realised that accuracy in "snapshooting" can be attained only after considerable practice, and therefore the beginner should not be disheartened if his first attempts are poor or even hopeless failures. By degrees the results will become better and better, and finally the releasing of the shutter at the exact moment will become almost a matter of instinct.

The train photographer should not overlook the importance of securing an impression of actual movement. Whenever possible smoke and steam should be included in the photograph in order to give this impression.

It is often a good plan to take one's stand at some suitable point on a rising gradient where the engine will, as it were, be breathing hard as the result of having to exert its full strength. Excellent smoke and steam effects may be obtained also as a train is emerging from a station.

The background against which the train will appear should have some consideration. If possible a natural background should be chosen, containing no houses or other buildings. It is still more important, however, to avoid telegraph poles or isolated trees, for very frequently such objects appear to be actually growing out of the train and produce a ludicrous effect!

There is one interesting branch of railway photography that is within the possibilities of even the cheapest camera, and that is the photography of individual locomotives when at rest, a collection of locomotive "portraits" becoming eventually of historic interest.

Ancestors of the Modern Turbine:

Some Interesting and Forgotten Rotary Engines of Years Ago

By D. Arnold-Forster

THE origin of the reciprocating engines of to-day can be traced right away back to the single-acting pumping engine made by Thomas Newcomen of Dartmouth in 1712. This crude and simple engine, with its massive oscillating wooden beam, produced no rotary motion, and its use was confined to pumping out mines in Cornwall and the North of England.

Everyone interested in such things is familiar with James Watt's improvements to reciprocating engines; the discovery in 1780 of how to obtain rotary motion from beam engines by means of flywheel, connecting rod, and crank; the introduction of double-acting and direct-acting engines, followed by their steady improvement down to the present day; and the recent remarkable development of internal combustion engines. What is not so well known is that, when the first practical engines were put to work, and for many years afterwards, a number of inventors, including James Watt himself, tried hard to obtain rotary motion without the assistance of any reciprocating parts.

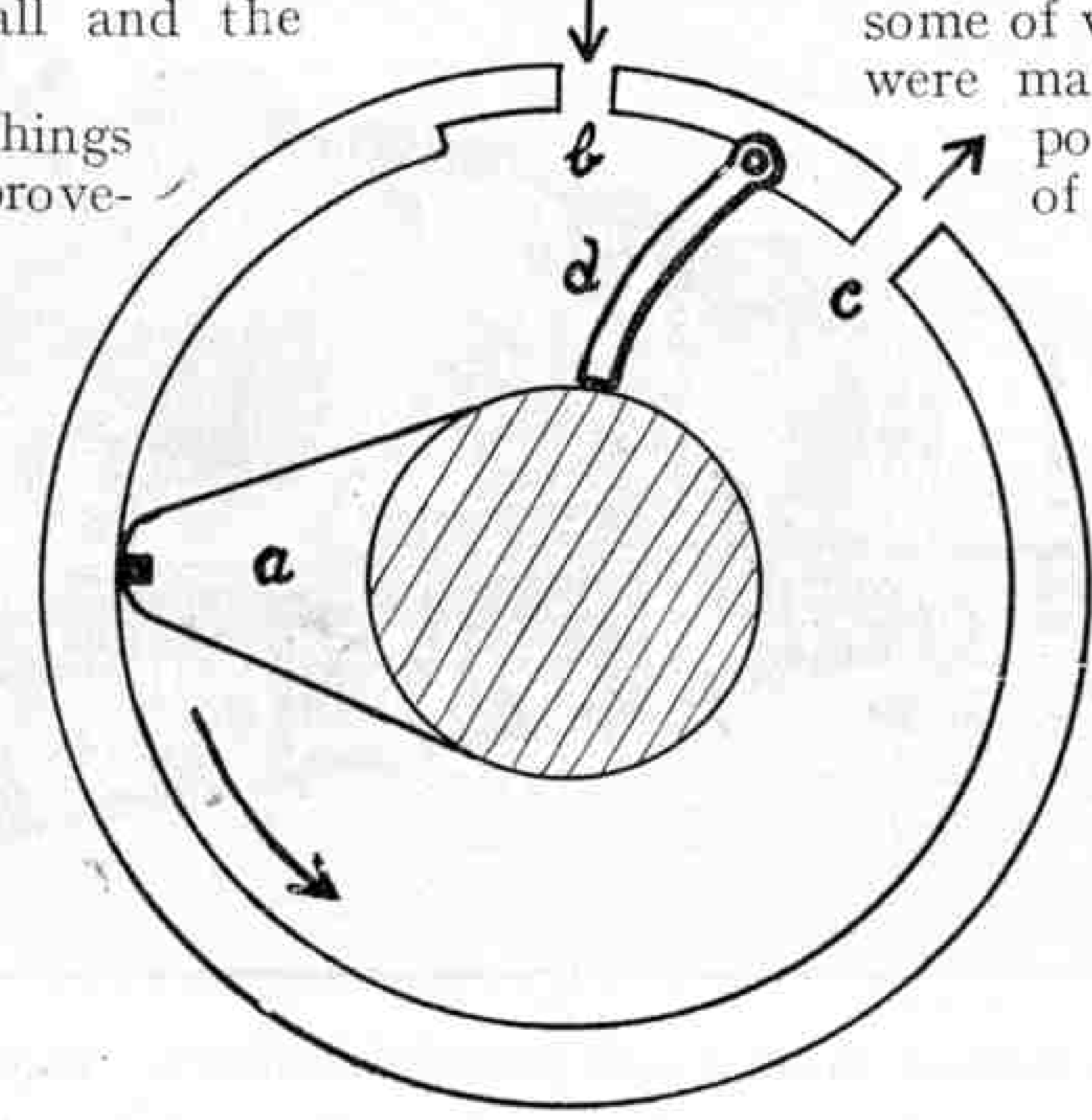


Fig. 1. Watt's Rotary Engine

Difficulties due to Crude Engineering Methods

The engines designed for this purpose were described generally as "Rotary" engines. Some of them required accurate fitting that was not easy to secure in those days, and though fairly simple and effective means were soon found to pack the pistons and cylinder glands of reciprocating engines, great difficulty was found in making working parts of some of the rotary engines properly steamtight.

It was quite possible at the time that some form of rotary engine might become standard for all ordinary purposes, and that the reciprocating engine would be confined chiefly to pumping work, for which it was originally intended. If Watt and his contemporaries had been able to employ less crude engineering methods of manufacture, and if better material had been available, the rotary engine might have come out on top. But as it was, the rotary engine dropped out of the running and reciprocating engines continued to hold the field till 1884, when the rotary engine appeared again in the form of the steam turbine.

Though they came to nothing at the time, it may be interesting and possibly useful to recall some of the almost forgotten designs of the old rotary engines, some of which actually did useful work. There were many varieties of them, and it is proposed to describe here the principles of a few representative types.

Watt's Rotary Engine Patent

Watt's rotary engine was patented in 1792, but so far as is known it was never constructed, as at that time he was concentrating on his reciprocating engines. However, Watt's idea was made use of by Joshua Routledge, who in 1818 made the simple rotary engine shown diagrammatically in Fig. 1.

This engine consists of a revolving radial piston "a," that works inside a cylinder and is forced round by steam entering at the port "b" and exhausting at "c." At each revolution the hinged flap "d" is pushed up to allow the piston to pass. The admission of steam is controlled by a slide valve worked off the shaft and adjusted to cut off early and allow expansive working. An attempt to stop leakage was made by cutting grooves in the piston and filling them with soft packing. Running at slow speeds with low pressure steam, the "knock" on the hinged flap would not perhaps be serious, but at high speeds it probably would lead to trouble.

Fig. 2 represents a type taking a continuous flow of steam but not suitable for expansive working. It consists of a vertical circular disc "a" revolving on a horizontal axis. The lower half of the disc is encased in a trunk "b" of circular section, one end of which is closed by a diaphragm with a slit in it, and the other end left open to the atmosphere. The disc carries three circular plates "c," which are turned by suitable gearing so as to be at right angles to the plane of the disc when within the trunk (shown dotted), and flat in its plane when passing through the slit in the

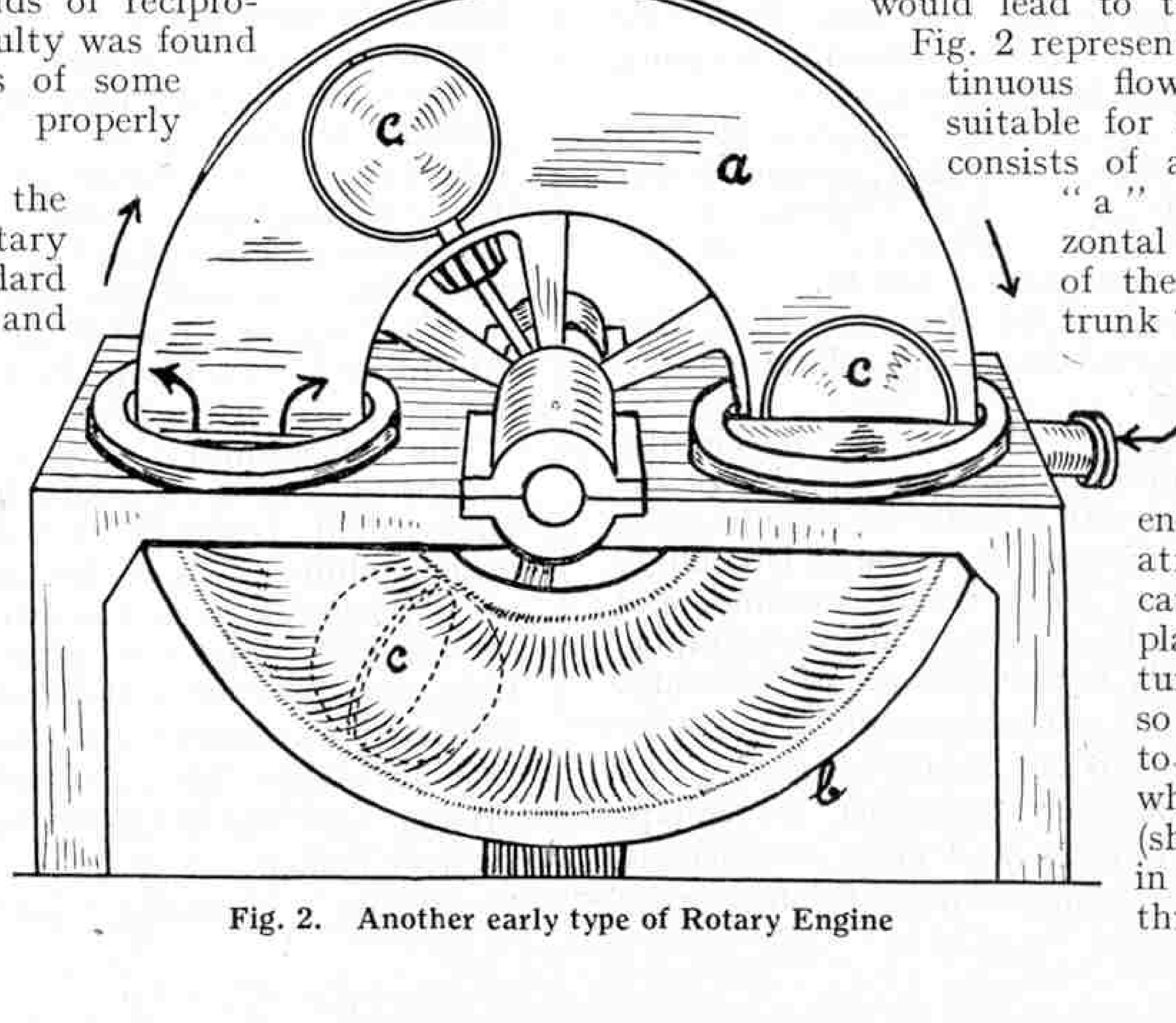


Fig. 2. Another early type of Rotary Engine

diaphragm. Steam enters through a pipe at the closed end of the trunk and exhausts at the open end. Unless the disc and circular plates make a good fit in the trunk there must be considerable loss from leakage, and the provision of packing to stand the wear and tear is not easy to arrange.

The engine shown in Fig. 3 was patented by Mr. Hick in 1843. Two blades " a " revolve independently on the axis of the cylinder " b." The blades pass through guiding slots in an internal drum " c " that revolves on the driving shaft " d," placed eccentrically to the axis of the cylinder so that the drum and cylinder just touch at the top. The guiding slots in the drum are made steam-tight by cylindrical metal packing pieces which allow them free movement. Steam enters on one side of the point of contact on top and exhausts on the other side, the result being to rotate the drum " c " with its shaft. Here again a very good fit is necessary to avoid leakage, unless modern methods of packing are introduced.

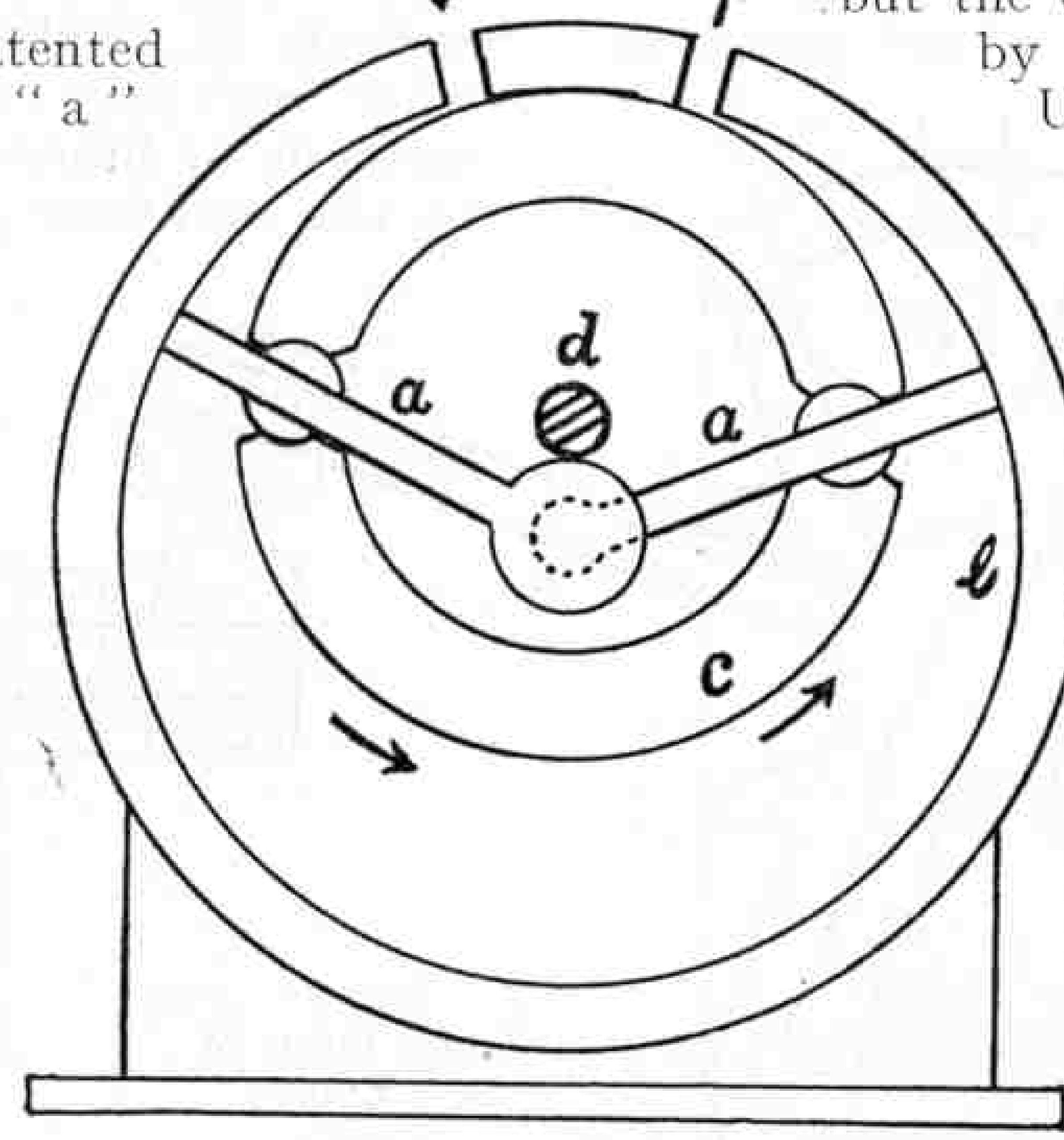


Fig. 3. Hick's Patent Engine

" Universal Joint " Engines

There is a distinct family of rotary engines depending on the peculiar movements of the three parts of a " universal joint." In the diagram to explain the principle, Fig. 4, two shafts " a " and " b " at an angle of 135° are connected by a joint formed of a circular piece "c" to which are pivoted the two semicircular pieces " d " and " e," the axes of these being at right-angles to one another. During each revolution of the shafts the piece " c " will swing through a considerable angle in two different planes. Now imagine the pieces " c," " d " and " e " to be filled in solid so as to form circular and semi-circular discs, and the whole joint to be enclosed in a spherical casing. Four separate chambers will be formed between the discs and casing, two of which will be always expanding and two contracting in volume as the shafts revolve. It is clear that, if steam is admitted to each chamber and exhausted at the proper time by suitable valves in the casing, the shafts will be forced to revolve. A small model made of cardboard discs with paper hinges will show the action more clearly than a diagram.

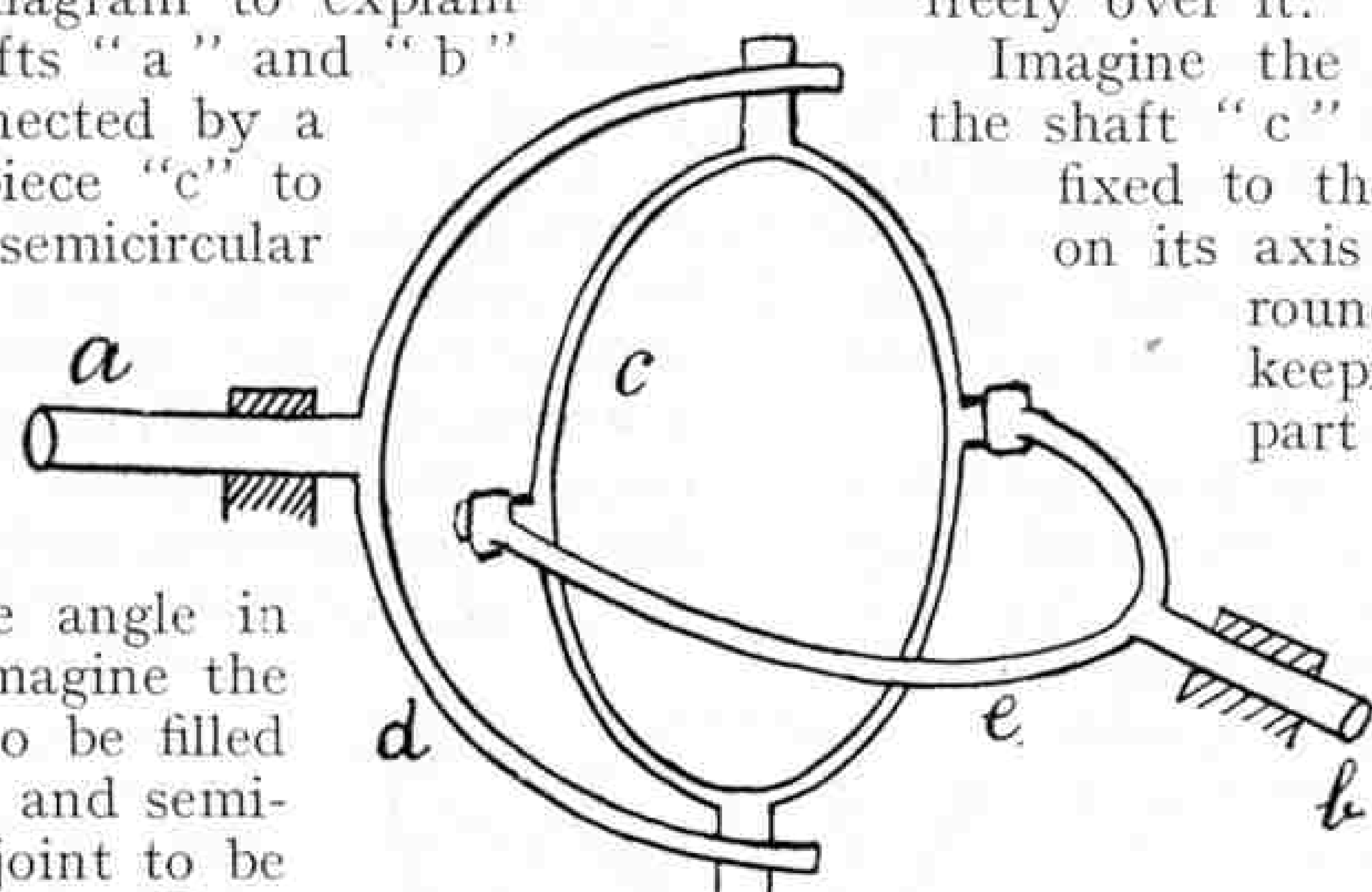


Fig. 4. Use of the Universal Joint

In 1879 Mr. Beauchamp Tower made an engine of the universal-joint type that became known as the spherical engine. The three hinged parts of the joint enclosed in a spherical casing can be recognised in the diagram, Fig. 5, but it will be noticed that the two outer parts, instead of being plane discs, are in the form of solid segments of a sphere. Four chambers are formed inside the spherical casing between the disc segments, two of which will expand while the other two contract. Steam is admitted and exhausted by ports in the spherical segments, whose backs serve as revolving slide valves, and expansive working is used. The steamtightness of the segments depends on a good working fit, but the edge of the central disc is made tight by spring packing.

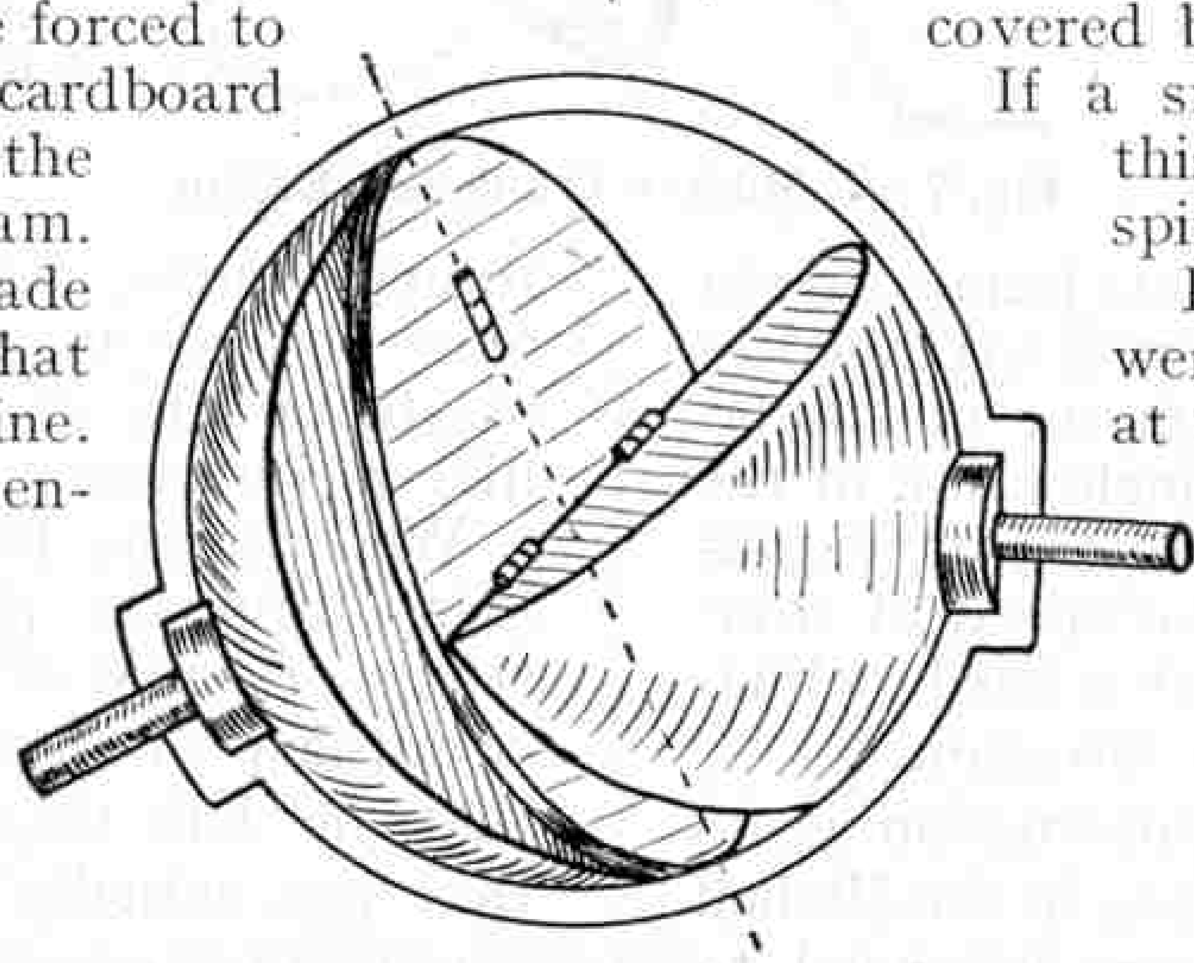


Fig. 5. Beauchamp Tower's " Spherical Engine "

Uniform motion for the drive is obtained from one shaft by adding a flywheel. The other shaft then revolves with non-uniform motion and, as in all engines of this type, is a dummy.

" Disc " Engines

The " Disc " engines form another family of rotary engines, the first of which was made by Messrs. Taylor and Davis in 1836, and improved later by Mr. G. D. Bishopp, Messrs. Rennie, and others. Fig. 6 shows one of the simplest forms of disc engine in section.

A circular disc working on a large single ball-bearing is enclosed in a chamber the side of which is spherical, and whose ends are formed of two conical surfaces with their points meeting in the centre. The upper half of the chamber is divided in two by a vertical partition " a," and a slot is cut through the upper half of the disc to enable it to slide freely over it.

Imagine the crank " b " to revolve, carrying the shaft " c " round with it. The disc, which is fixed to the shaft, is prevented from turning on its axis by the partition " a," but sweeps round the chamber, the outer edge keeping close contact with the spherical part of the chamber, and its flat surfaces rolling round the conical surfaces, making continuous new lines of contact as it passes.

The disc, partition, and chamber walls form four spiral-shaped spaces, two of which are always expanding and two contracting. (Momentarily there are only three spaces at top and bottom of the revolution of the crank). Steam is admitted to the expanding and exhausted from the contracting spaces through ports on either side of the partition (shown dotted). These ports are covered and uncovered by the motion of the disc itself.

If a small paper and cardboard model of this disc and chamber is made the peculiar spiral motion is easier to grasp.

In some engines spring packing plates were used to obtain steam tightness at the lines of contact between disc and cones; in others the cones and faces of the disc were made with radial teeth engaging in one another on the line of contact.

A 5 h.p. disc engine was used to work threshing machines in 1841, and between 1842 and 1849 they were tried with some degree of success for marine propulsion.

Though not quite obvious at first it is a fact that the disc and universal joint families of rotary engines are closely related.

Referring again to Fig. 6, suppose the crank to be done away with, the fixed casing to be made free to turn, and attached to a shaft at "d," 135° from the disc shaft. In this form, disc, casting, and partition act exactly like a universal joint, and direct rotary motion may be obtained as described in Fig. 5.

It is interesting to know that a rotary engine of this type worked the printing machinery in "*The Times*" office for many years, up to as late as 1857.

It is curious that one of the most enthusiastic believers in rotary engines was a sailor, Lord Cochrane. When seven years old, this fighting admiral of fireship fame happened to meet James Watt, who showed him his inventions, and that probably accounts for his lifelong interest in engines, unusual in those days of sailing ships.

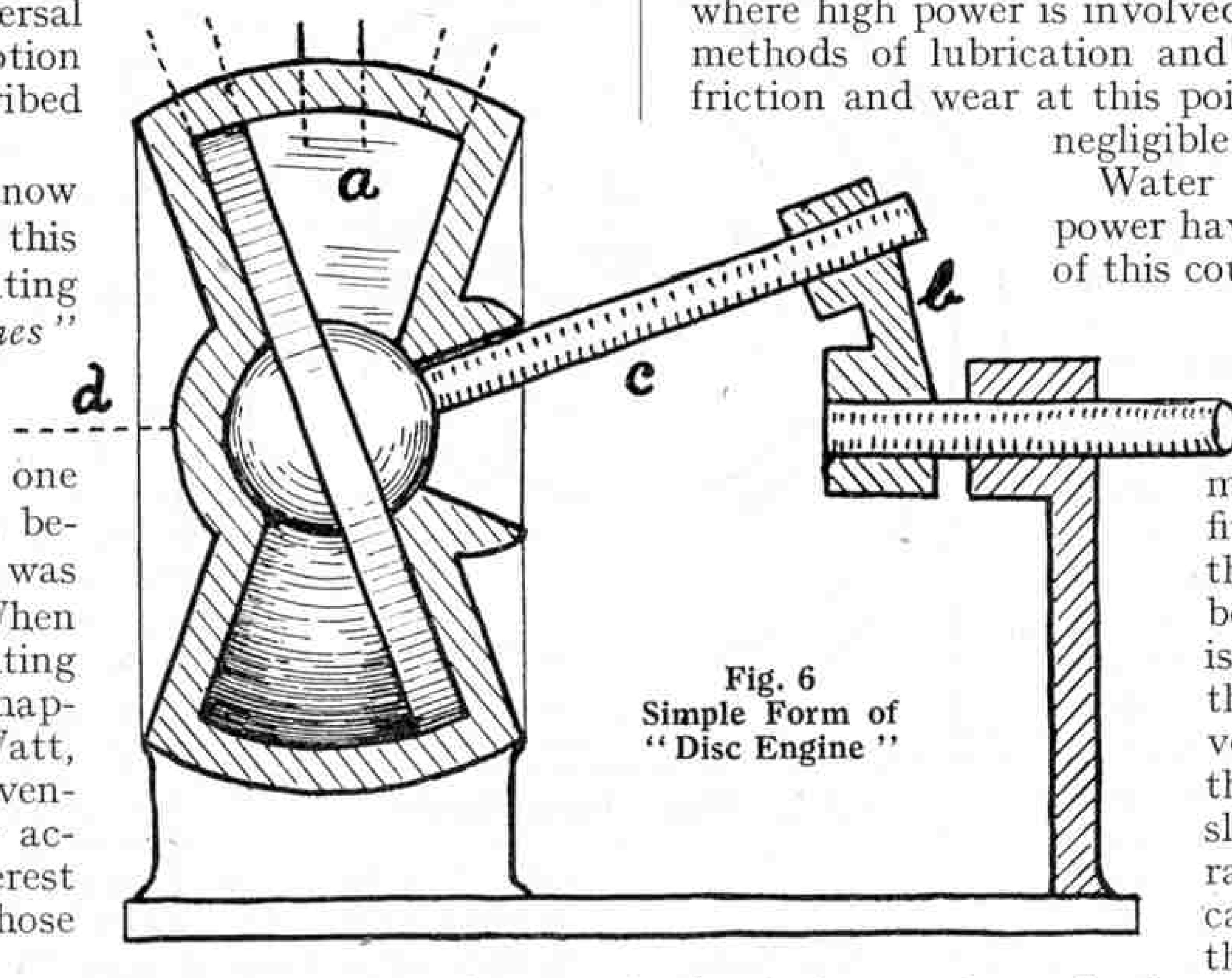


Fig. 6 Simple Form of "Disc Engine"

When unemployed on shore he tried to introduce a rotary engine for locomotives, and in 1834 he fitted it to a steamboat in which he navigated the Thames. After years of effort he persuaded the Admiralty to try it in one of their small steam vessels, and later in a frigate. It was successful, but marine engineers of that day were committed to reciprocating engines, and none of the old rotary engines was ever adopted for ships of war.

Fig. 7 shows the principle on which modern crank-less engines work. Though the crank is eliminated, they are not strictly speaking rotary engines, because reciprocating motion is retained. An oblique disc, called a "swashplate," fixed to a shaft, will wobble as shown by the dotted line when the shaft revolves. If three or more piston rods, worked by steam, hydraulic, or internal combustion cylinders, are made to press on the surface of the plate in succession as indicated by the arrows, the plate and shaft will be forced to revolve.

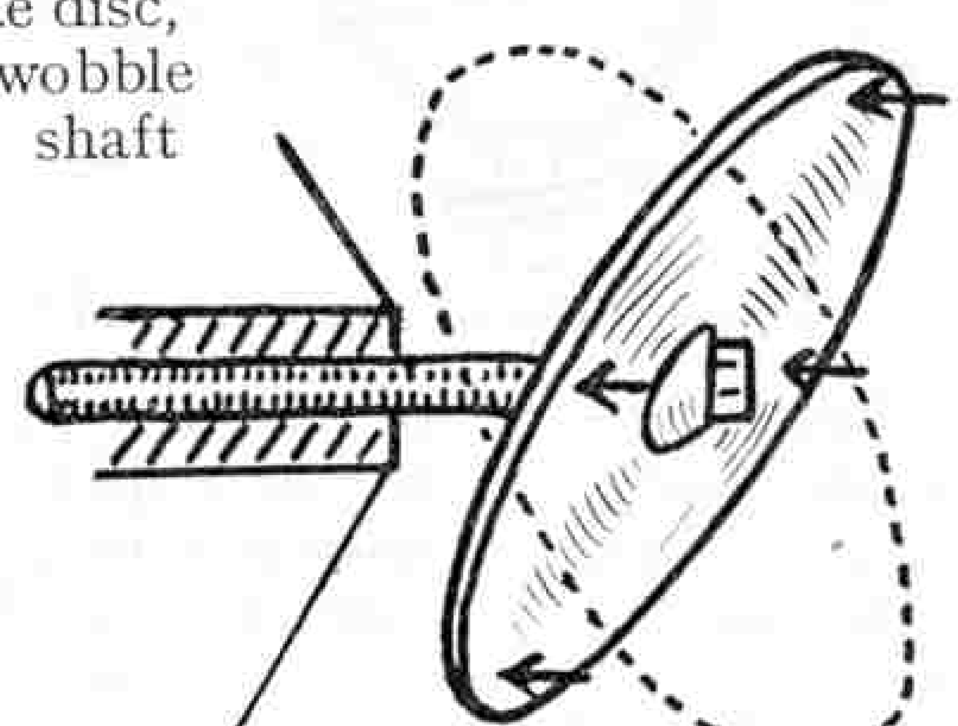


Fig. 7 A Modern Crank-less Engine

This wobble plate has been used for many years in the rotary pumps and rotary oil driven hydraulic motors of the Williams Janney type. In order to obtain a variable speed such as is required for a ship's cargo winch, a swashplate pump, driven at a constant speed by an electric motor, is arranged to deliver oil at pressure into a rotary motor of similar design to the pump. By varying the inclination of the plate in the pump unit the length of stroke of its pistons can be regulated, and by this means the speed of rotation of the motor unit, whose plate is at a fixed inclination, can be varied as desired in either direction.

The principle of these hydraulic transmission gears can be applied to a primary engine. Thus, in the Michell crankless gas engine, several pistons are arranged to press on both back and front of a heavy swashplate that takes the place of a fly wheel. By this means a compact and well-balanced engine is obtained, and the elimination of crankshafts and connecting rods reduces vibration to a minimum.

In mechanism of this nature, the revolution of the wobble plate is maintained by the thrust of the piston ends on its revolving surface, and this thrust is heavy where high power is involved. But, owing to improved methods of lubrication and design of thrust bearings, friction and wear at this point can be made practically negligible.

Water turbines of considerable power have been at work in the mills of this country for 50 years or so. A common form consists of a vertical shaft connected to a large bell-shaped wheel whose mouth faces downwards and fits over a fixed cylinder at the bottom of a deep chamber. The floor of this chamber is level with the "tail" of the mill race. Through the vertical sides of the cylinder there are curved horizontal slits pointing away from its radii, and through the outer casing are slits curving in the opposite direction. The head of water from the dam level is led down by a huge pipe into the lower end of the inner casing, and the sudden change of the direction of the water rushing through the slits causes the outer casing and shaft to revolve.

The steam turbine did not come into use until much later, when its first practical application was to drive some of the earlier dynamos fitted on board ship. It was not until about 1897, when the now historic experimental torpedo boat "*Turbinia,*" fitted with Sir Charles Parsons' first marine turbines, made her debut at a Naval review at Spithead, that it was realised that reciprocating engines had a serious rival in the turbine.

Since that time the steam turbine, greatly improved, has been gradually ousting the steam reciprocating engine from its hitherto established position both at sea and on shore. Readers of the July number of the "*M.M.*" will have noticed also that the steam turbine is now being tried for heavy locomotives. Thus Lord Cochrane's persistent idea of eliminating all reciprocating parts and slide valves from marine and locomotive engines has been revived again.

The modern steam turbine is a true rotary engine, but differs in principle from the old ones because it works by converting the momentum of steam into energy, whereas the old rotary engine, like reciprocating engines, worked by steam pressure.

Who can say that inventors may not pick up useful ideas from the old rotary engines? At any rate a study of some of the old ideas may save a modern enthusiast of inventive turn of mind from believing that he has discovered a new mechanical principle that was actually known and tried practically in the search for the best method of using steam pressure over a hundred years ago!

A Modern Velocipede

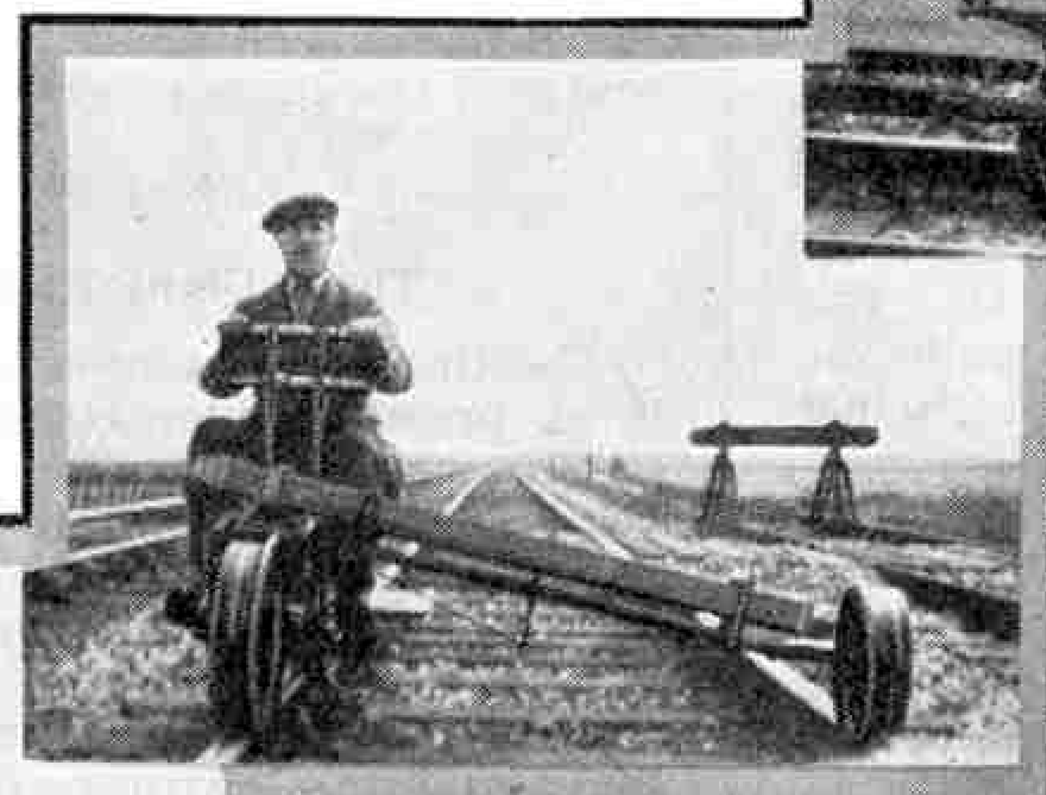
By R. D. Gauld, M.Eng., A.M.I.C.E.

THE early bicycles that were made in the days before chains and gear wheels, were dignified by the title of "velocipede," although the only chance they had of getting up much velocity was when running down hill! The accompanying photographs show a modern variety constructed for running, not on the road, but on the railway.

The full title of the machine is the "Fairbanks Morse Velocipede," so called from the name of the American firm that manufactures it. There are not many of them in use in this country, but on American railways this and similar machines, sometimes driven by a petrol engine, are largely employed. They are very useful to inspectors, signal linesmen and others in getting about their districts when trains are not very frequent and there are long distances between stations.

As will be seen from the photographs, the machine can carry two persons. The front one sits astride and supplies the motive power; the one in the rear sits side saddle, as in that position he can keep a better look-out for trains.

The upright wooden post in the front with a two-handed grip at the top is pulled and pushed and drives the back wheel by a crank, connecting rod and gearing. The feet rest on two iron cross-pieces, which are also connected to the back wheel through a connecting rod and gearing, and are so arranged that as the upright is pulled backward the feet are pushed forward. Considerable power therefore can be exerted, and on a calm day, on a level portion of the line, a speed of from 8 to 10 miles an hour can be maintained.



The velocipede is made as light as possible so that it can easily be lifted off the track out of the way of a train. It should be used in the same direction as the traffic, as this gives slightly longer time for getting it out of the way. If it is necessary to pass through a tunnel, or over some other piece of the line specially mentioned in the "Appendix to the Working Time Table" of the railway company, it has to be signalled as though it were a train.

In the photographs the machine is shown with an engineering assistant's levelling equipment attached to it. The level in its case is lying on the back seat, and the tripod and levelling staff are strapped to the outrigger that connects the outside wheel with the main carriage. This arrangement has the advantage of putting a little extra weight on the single wheel, which is otherwise somewhat liable to jump off the rail when passing through crossing work.

In order that it may be easily stored away in the guard's van of a train, the velocipede is made to detach into two portions, in a manner similar to that adopted for a motor-bicycle and side-car. The single outer wheel, with its outrigger and stay rod, is detachable from the main carriage. On arrival at the station nearest to the place where the machine is to be used, the two portions can be taken out of the van and assembled in a very few minutes.

The velocipede enables the railwayman to do a good deal more work in a day than if he had to walk the section concerned, and as it is only about a third the weight of a platelayer's trolley, it is much safer to use as it can be removed from the line more quickly.

The writer has known of instances where a permanent way inspector has travelled over the whole of his district of about 45 or 50 miles in an ordinary working day by the aid of this useful contrivance.

The accompanying photographs were taken when the velocipede was in use on a stretch of line in the Fen country where the fairly easy gradients and the good visibility of approaching traffic make the conditions almost ideal. There were one or two places, however, where bridges over the chief rivers and "drains," as the artificial waterways in the Fens are called, were constructed at such a height above water level as to allow sailing barges to pass beneath them. This meant that the railway approaches to the bridge on each side were graded fairly steeply to rise from the general level in the Fens, but it was never found to be particularly strenuous to work the velocipede over such "humps." A strong headwind would perhaps be a more severe trial, but possibly the writer was lucky in the choice of his days out for he never experienced much inconvenience from "atmospherics."

The mild thrill of travelling over the flat country in the Fens was far exceeded in the experiences of the engineers on a railway crossing the Andes in South America, who at one time travelled on a velocipede to which a mast and sail were fitted. On a downward track with a strong wind the speed attained was high enough to try the nerves of the most hardened "speed merchants!"

Largest Building in the British Empire

A block of offices that will constitute the largest building in the British Empire is at present under construction in Montreal. The general tendency in the large Canadian cities, both in the east and in British Columbia, seems to be to erect buildings on the model of the sky-scrapers of the United States, and the projected building will be an imposing pile, if not quite of the same size as the Woolworth building. When completed the block will have 24 floors with a total height of 450 ft. The frontage will be 400 ft. in length while the ground floor will have an area of 1,250,000 sq. ft.

* * * *

Poole Harbour Bridge

The recently completed bridge over Poole Harbour is about 330 ft. in length and carries a vehicular roadway 18 ft. in width with two footpaths each 5 ft. in width. A double leaf rolling lift span is incorporated in the centre of the bridge to permit the passage of ships underneath it. The two leaves lock together at the centre when closed and are operated by a 20 h.p. electric motor. The working of the bridge is controlled from the Poole side, 1½ minutes being required to open both leaves. Hand gear is provided in case the main drive fails.

* * * *

Rhine Navigation Schemes

Two schemes have been put forward with a view to improving the navigation of the Rhine between Strasburg and Bâle and both have their supporters. The German proposal consists essentially of anchoring to the bed of the river masses of stakes and brushwood, so that the river is diverted and a deep channel scoured out by its action. This method has already proved its efficiency on the Loire and other rivers. The French support an alternative scheme for constructing a canal parallel to the river between Kembs and Strasburg. This will involve the construction of seven locks and the same number of hydro-electric generating stations, which would produce a total of about 800,000 horse-power.

The undertaking of both schemes has been sanctioned by the Central Commission of the Rhine, and the French are starting the excavation of the canal. It appears probable that if the French scheme is started the German scheme will be abandoned.

Dutch Trolley Omnibuses

The first trolley bus system has been inaugurated in Holland, two single-decker Daimler vehicles forming the nucleus of a fleet of coaches to be organised if the first prove satisfactory. The buses at present in service each have seating accommodation for 24 passengers, the motor, carried in the centre of the chassis, being rated at 55 h.p.

* * * *

Three Giant Reservoirs

The third largest reservoir in the world is at present under construction on the Gatineau River, Quebec. The natural water area of 20 sq. miles is being increased to 115 sq. miles by the construction of a great dam that will impound 95 thousand million cu. ft. of water. The only reservoirs in the world larger are one at Gatun, Panama Canal, with a capacity of 183 thousand million cu. ft., and the Gouin Reservoir, Quebec, which is capable of holding 150 thousand million cu. ft.

* * * *

Diesel Engine Progress

Despite rumours of a reversal of the high opinion held regarding the efficiency of Diesel engines for ship propulsion, the number of vessels fitted with this type of engine continues to grow. The installation of Diesel motors developing 1,050 h.p. in the "*Disco*," a vessel built for use on the difficult Arctic service between Denmark and Greenland, inaugurates the use of motorships in still another field.

Little has been heard of the Scott-Still semi-Diesel type of engine that was installed in the "*Dolius*" about eighteen months ago, but the owners are apparently well satisfied, for they have now placed an order for a similarly driven vessel of twice the tonnage. The Still engine uses the exhaust heat for raising steam, which passes to the cylinder and acts on the underside of the pistons during the return stroke. In the "*Dolius*," operating on the Blue Funnel Line service to Java, each of the engines develops 1,250 shaft horse power at 120 r.p.m., whereas the new ship will be propelled by engines each developing 2,500 s.h.p. at 105 r.p.m.

The passenger motor-ship "*Itape*" recently launched at Dalmuir is of peculiar interest as it is propelled by the first supercharged Diesel engines constructed in this country.

Oil-Fire Extinguishing Plant

A most interesting plant has been erected at an oil-storage depot in New Zealand, in order to guard against fire. After experiment it was decided that the most effective material for dealing with oil fires was a foam-generating composition, containing sodium bicarbonate and aluminium sulphate, which generates carbon dioxide, a non-inflammable gas in which ordinary combustibles will not burn, when treated with water. The chief problem in the use of this method lies in the fact that the chemicals must be mixed as near to the flames as possible, while it is undesirable to introduce the water to either chemical until necessary. The plant that has been erected consists essentially of two circular tanks, each divided into three compartments and having a revolving agitator. The larger tank, with a total capacity of 1,125 gallons, is to hold the aluminium sulphate while the sodium bicarbonate solution is mixed in the smaller tank, which has a capacity of 375 gallons. A 50 h.p. engine operates the agitators and drives the pumps required to supply the water necessary for mixing.

The dry ingredients of "Fire Suds," as the mixture is called, are stored in sealed tins. If a fire breaks out, the chemicals are dumped into one compartment of each of the two tanks and the pumps are started up. Only three to four minutes are required to generate 160 gallons of "Fire Suds" per minute. A float depth indicator shows when the tanks are becoming empty and other compartments are brought into use. Twin delivery pipes lead from the tanks to convenient hydrants, from which the liquids are led through canvas delivery hose to unite at the nozzle, forming a heavy flame-killing foam that spreads over the surface of the liquid. In this manner the foam effectually "blankets" the flames and extinguishes them by excluding air.

* * * *

Huge Boring Machine

An immense boring machine has been constructed by a German firm of manufacturers for use in the work of boring cylinders for turbines. This machine is capable of boring to a diameter of 13 ft. 1½ in., and has a total weight of 236 tons, an engine developing 50 to 55 h.p. being required to drive it.

The castings for a 160,000 kw. turbine at present under construction are being bored on this machine.

Durability of Engineering Structures in Sea Water

Very interesting results have been obtained in the course of an investigation into the effects of sea water and marine life on engineering structures. Whether these are made of wood, iron and steel, or concrete, corrosion or damage of some kind seems to be unavoidable at the present moment.

A museum has been assembled in London in connection with this enquiry and among the specimens is a piece of teak from Rangoon that was honeycombed by teredos in eight months. Another sample shows that even the famous Jarrah wood from Australia is not free from the attack of this pest, as is made evident by the bad condition of piles brought from Perth in West Australia. The portions of these piles that were not immersed in the sea are absolutely sound.

In general the average life of wood in sea water cannot be reckoned at more than 10 to 15 years, and in tropical waters it may be as low as two years only. Its life in fresh water, on the contrary, seems to be indefinite, for piles that are still sound have been removed from fresh water in which they have stood for considerably more than 1,000 years. For the protection of wood from destruction in sea water creosote has not been as satisfactory as on land, and experiments are now being made on the effect of adding to creosote various compounds containing arsenic with a view to poisoning the teredos and other destructive marine organisms.

Even concrete is not immune from the attack of the living creatures of the sea. It is interesting to note, however, that there is at least one case on record where these creatures actually protected building material. An iron girder removed from the sea at Rangoon was entirely covered with oysters and when this living covering was removed the girder was found to be absolutely free from rust.

No steel alloy yet tried seems to be perfectly resistant to rusting and attempts have been made to find a satisfactory protective paint. The most promising results so far have been obtained with tar. One curious exhibit in the museum is an iron bolt that was originally embedded partly in oak and partly in wood of another kind. After a long period under sea water the portion of the bolt in the oak has been reduced in diameter by about 50 per cent. while the remainder of it is still of its original dimensions, an effect that is very difficult and indeed almost impossible to explain.

The study of problems connected with corrosion is of most importance. Forests are rapidly disappearing and wood seems to decay and require replacement far too soon for the comfort of those who foresee the day when supplies will be hopelessly inadequate. With iron also the position may become serious. Sir Robert Hadfield has estimated the loss of iron by rusting to be 20,000,000 tons annually, so that an iron famine seems unavoidable at some future date in spite of our supposed ample supplies of iron ore. What materials will engineers employ when wood and steel are no longer obtainable? Concrete, of course, is available, and it is possible that non-rusting steels will become practicable on a large scale, or that it will become commercially feasible to use new alloys, such as solium, that are not easily corroded by moisture.

Bridge Removed in One Hour

A remarkably quick and efficient piece of work was accomplished recently at Carbaroit, near Rochefort, France, where a railway bridge known as the Pont de la Boutonne was replaced by a new structure. In order not to interrupt the service, temporary lines were laid near the old bridge and the latter was then removed sideways to link them up. The transference was made by sliding the bridge along greased rails and the work was made easier by the use of four cranes that relieved the rails of a portion of the weight of the bridge. The operation was carried out so expeditiously that the Bordeaux express was able to pass over the bridge less than one hour after the removal commenced.

* * * *

AN INGENIOUS DEVICE

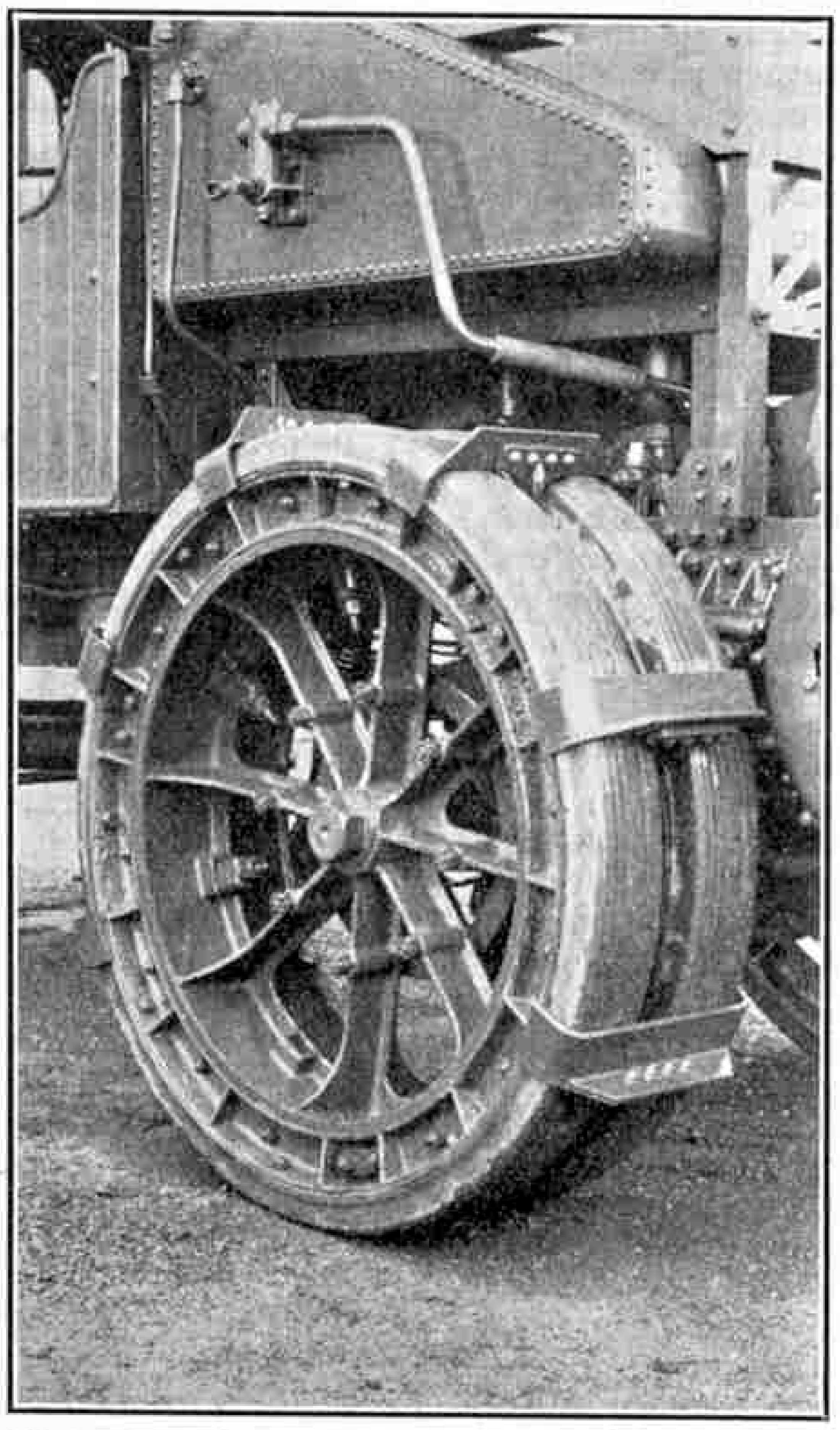


Photo courtesy] [*Sentinel Wagon Works Ltd.*

Our photograph shows an ingenious device called a "spud," used on "Super-Sentinel" rubber-tyred tractors. These "spuds," which enable the tractors to be used over rough country, are made so as to be easily fixed and taken off

The Mersey Tunnel

About 18 months have passed since the Mersey tunnel was commenced and during this time nearly a quarter of a mile has been bored from each end. The width of the river between the banks where the tunnel is being bored is 3,750 ft., while the average distance between the top of the tunnel and the river bed will be about 30 ft. The tunnel is being lined with cast iron plates bolted together to be perfectly watertight, and cement will be forced by powerful pumps into all crevices and fissures. About 1,000,000 tons of rock will be excavated and 137,000 tons of iron will be used in completing the tunnel. The total cost is estimated at £5,000,000.

Mail Conveyor at Plymouth

Ocean mails are landed at Plymouth in order to enable them to reach London and other parts of the country at the earliest possible moment, and with a view to facilitating transport between mail boat tenders and the shore the Great Western Railway have introduced a power conveyor that is speedy in operation and calls for the employment of only one-third of the number of men formally necessary.

The conveyor is a mild steel braced structure carrying a travelling belt 3 ft. in width and is driven at a speed of 160 ft. per minute by an electric motor. It is supported above its centre of gravity by a bridle, so that when held in mid-air it hangs practically in the position in which it is operated, while it is balanced by a weight of about 5 cwt. on the opposite side of the supporting tower. A very small force is thus required to move it into any working position, and when not in use it can be raised by a hand winch through the medium of a wire rope attached to the bridle. In operation this rope is kept slack so that the end of the conveyor is not lifted from the deck of the tender as this rises and falls.

The capacity of the conveyor is six tons of mail per hour, and the bags are carried from the tender right into the mail vans standing on the quay.

* * * *

Europe's Largest Turbo-Generators

An interesting power station was opened a short time ago at Rummelsburg, near Berlin, in which the necessary steam is raised by the combustion of powdered coal. Three works are incorporated in the organisation, the complete power house comprising a coal pulverising mill, a steam generating plant and a current generating station. A special canal has been cut to connect the power station to the River Spree and along it the coal is transported in barges carrying 1,000 tons. After being dried the coal is ground to dust and driven by compressed air through a sieve to the boiler house. Steam at a pressure of 37 atmospheres is produced by the boilers, only three men being required to attend this part of the installation.

In the power house itself are three turbo-generators. Each of these has an output of 80,000 kw., and they are the largest in Europe. The total of 240,000 kw. supplied by them can be raised in case of emergency to a maximum of 270,000 kw., and this maximum will be increased to 500,000 kw. by the installation of further generators.

* * * *

New East Indian Railway Bridge

It has been decided that the present East Indian Railway bridge over the river Jumna, near Allahabad, is too light for the heavier class of traffic now being carried, and a new steel bridge is to be erected alongside. Ultimately the existing bridge will be demolished. The river is wide at this point and will be crossed by 14 main spans each 213 ft. 9 in. in length, and there will be two approach spans of approximately 46 ft. in length, making a total length for the bridge of well over half a mile. Altogether 6,250 tons of steel will be used in the constructional work of the bridge, which is designed to carry a single line of 5 ft. 6 in. gauge, with a roadway beneath.

White Men See Red Indian

The following account of this interesting ceremony, which probably will be abandoned in
It was written from a report of an eye-witness, Corporal E. E. Harper, of the Royal Ca
***"MacLean's Magazine,"* the 1**

OLD as Indian mythology itself, the picturesque sun dance of the Red Indians of Western Canada will soon be quite as much a thing of the past as the secret of fashioning arrow-heads and spear-heads from flint. The sun dance has always been a mystery to white men, held as it has been within close-packed walls built of the boughs of the sacred spruce tree, and its devotees pledged to a secrecy that has seldom been violated.

Only the older members of present-day tribes continue to be sun-worshippers. The modern generation, for the most part, refuse to have anything to do with the pagan customs of their fore-fathers. In a very few years at the most, the sun dance will be nothing more than a memory. This is to be regretted because it has been a ceremony performed by the Redskins during at least the last five hundred years, for the purpose of invoking the God of the Sun to dispense prosperity to the participants and ward off sickness and bad luck. It is true that in various anniversary pageants old Indian fêtes are impressively enacted, but such exemplifications are at best but feeble representations of the actual customs of the warriors who once were lords of all they surveyed from the Gulf of Mexico to Hudson's Bay.

A Dance Never Seen by White Men

No doubt a few white men have been successful in gaining admittance to a sun dance camp, but even those who have been permitted to see what takes place in the open have not been allowed the opportunity to witness the secret work behind the outer and the inner screens of spruce boughs. There the dance leaders and the medicine men invoke the good will of the sun spirit by fasting, dancing and praying.

It was to this " holy of holies " that two members of the Canadian Mounted Police gained access last June. The white men in this instance gained admittance to the sacred ceremonies because the Indians feared that all future sun dance camps might be banned by the police for the reason that the Indians waste their substance in making useless gifts to one another, as well as waste valuable time from their farms and ranches at their favourite pastime of " doing nothing." The chiefs in this instance wanted to prove before the eyes of the " young men of the white chiefs " that nothing took place anywhere at the sun dance camp that could prove an injury to the Indian morally, physically or financially.

The sun dance camp in question was held at one of the Blackfoot reserves, and many of the Indians left their farms to attend this dance, at a time when their crops needed attention. The Indian agent desired to know if it was the wish of the authorities at the head of Indian affairs to have the sun dance banned by the police, as had been suggested at a previous time. In order to find out officially just what was the character of the dance, Corporal E. E. Harper and Constable Banks, were despatched to the reserve.

The investigators were met by Chief Weasel Calf, the only Blackfoot now alive who took part in the signing of the famous treaty of 1877. Chief Weasel Calf and his associates were more than considerate of their guests' comfort and insisted that they should view all the rites, the Indians being very much perturbed at the possiblility of their ancient dance being broken up and banned for the future.

Chief Weasel Calf did the policemen the signal honour of hoping they would live to be as old as himself, and they were introduced to a " reserved seat " of a portable nature that had been commandeered for their use—it was the back seat from a broken-up " buggy " or prairie cart !

" Teddy Yellow Fly," Interpreter

A North Camp Indian, an intelligent young man about twenty-two years of age, who exists under the picturesque name of Teddy Yellow Fly, acted as interpreter. Teddy Yellow Fly took no part in the ceremonies and he told the policemen that the Indians of his generation evinced little interest in the affair, except as spectators. Young Yellow Fly, who had done remarkably well in his school studies, hoped to be in a position to soon get through college, his ambition being to be a doctor.

The following extract from the official report of the corporal in charge of the investigation has its own dry meaning, though couched in the staid language of a policeman's report: " We arrived at the camp at 3 p.m., Friday, July 15, and found everything quiet and the Indians doing nothing. In fact, that was the most noticeable thing of all during the week—the Indians' love of doing absolutely nothing." Further on, the report emphasises that the sun dance appeared to be " an excuse for all camping together and having a good time—chiefly doing nothing." The sun dance itself, from which the camp derives its name, was only one of many dances that took place during the ceremonies, one of the first witnessed being the tobacco dance.

A squaw was leader of the sun dance festivities. This woman commenced to fast as soon as the camp was settled, abstaining from food for five days in succession. All she was given was a very little water at noon each day. The visitors were told that should it happen to rain at any time before the squaw leader's five-day fast was completed, the Indians would take it for granted that the sun god was displeased with her presence and that therefore all the religious ceremonies connected with the sun dance would be discontinued. Every day during the five days the squaw leader fasted there were four to five hours of prayer, prayers commencing at four o'clock in the afternoon and continuing without stopping until the sun went down.

These prayers, of a very weird nature, were held in the holy-of-holies in the central sun dance teppee. Only the woman-leader of the sun dance, past leaders of sun dances, the husbands of these women and the sun-priest (a solemn-visaged medicine man named " Fat Horse's Son,") were allowed to attend these meetings. No other Indians, and certainly no white man, could be allowed to desecrate those intense ceremonies. " As a special privilege," Corporal Harper's report proceeds, " we were allowed in during one session, but as this was so obviously against their wishes, I did not press the matter again, especially as I did not see any lasting good that could be gained by doing so."

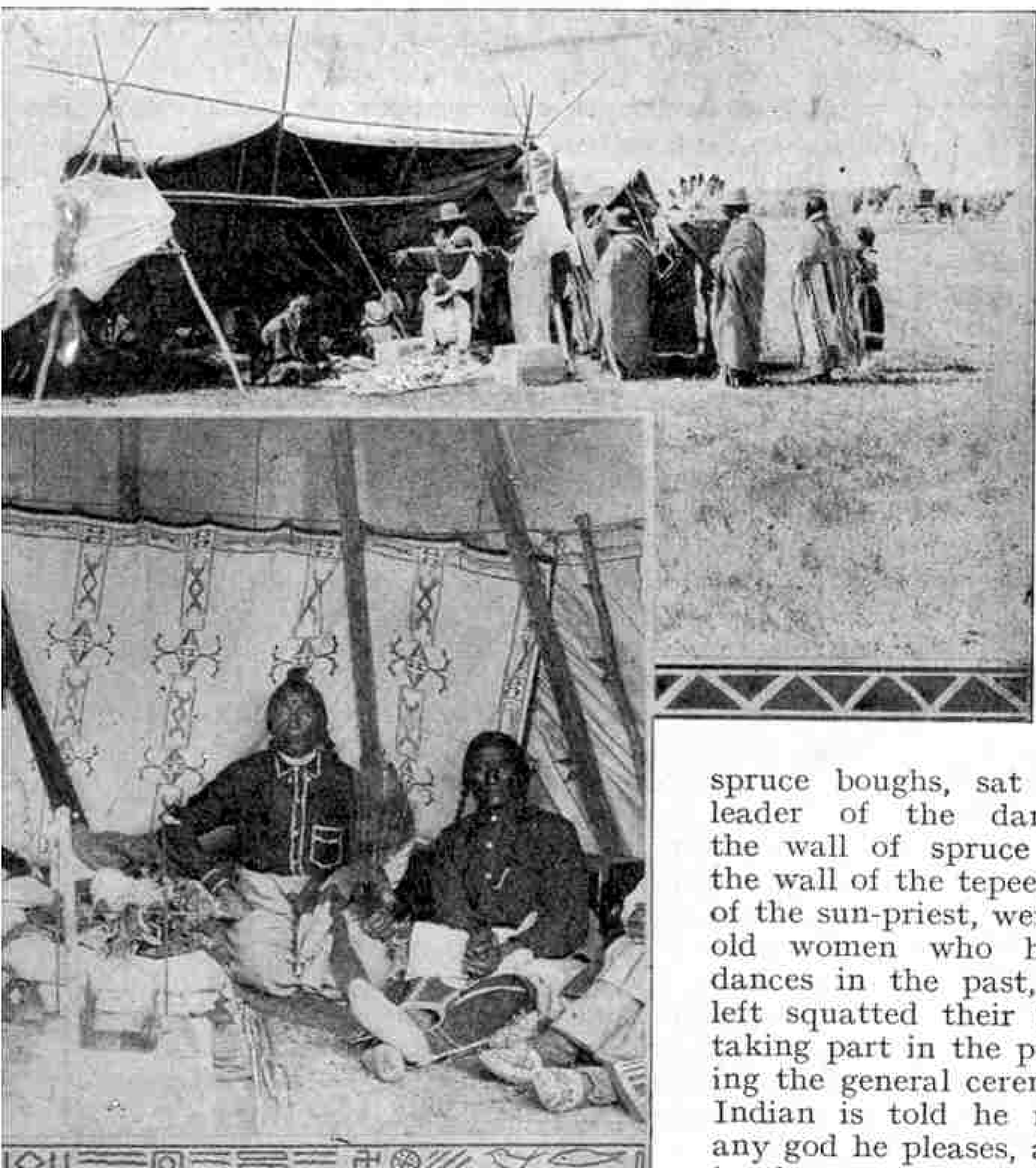
The Sacred Spruce

The sun dance tepee was a large enclosure, with a circle of spruce built around the outside on the ground to prevent the uninitiated from hearing or seeing what took place inside. It was pitched in the centre of the camp near what is known as the sun dance circle on the north side. On the inside of the sun dance tepee was another ring of spruce, woven and bound into a substantial wall about five feet from the walls of the tepee. Spruce is sacred wood among the Indians because of its being so favoured by the sun god as to be

ABOVE :
to the Pries
will be
Interior o
spread on
Medicine

n Sun Dance for First Time

**ned in the near future after having been performed for at least 500 years, is by Nicholas North.
'yal Canadian Mounted Police, and is printed here by special permission of the Editor of
' the leading Canadian publication**



**BOVE : Blessing the offerings. Indians bring gifts
the Priest. The food is being cut up and subsequently
ill be distributed among the tribe. CENTRE :
nterior of a Medicine Pipe tepee ; in the centre,
read on blankets, may be seen the contents of the
ledicine Pipe being sold. BELOW : Calf Child,
garbed in full ceremonial dress**

green all year round. Inside and immediately opposite the main entrance to the tepee, squatted the sun-priest or chief medicine man and in front of his dais, on a square built of spruce boughs, sat the woman-leader of the dance. Outside the wall of spruce and against the wall of the tepee, to the right of the sun-priest, were ranged the old women who had led sun dances in the past, and to the left squatted their husbands all taking part in the prayers. During the general ceremonies, every Indian is told he may worship any god he pleases, and it is only in the central tepee that special devotions are held in honour of the sun god. The Indians who did not attach themselves to any particular deity simply loitered about having a good time " doing nothing."

One of the principal ceremonies was the medicine pipe dance, which preceded the disposal of the medicine pipe on which the blessings of the sun god were invoked. Though called a dance, it is really a sale at which the buyer is supposed to gain magical cures for sick relatives through the purchase of the pipe.

This ceremony was begun by the sun-priest calling at the tepee of the buyer whence he and an assistant carried the buyer in a blanket over to the scene of the sale, which is called the seller's tepee. The buyer's squaw followed this procession carrying a shawl specially designed to wrap the medicine pipe up in before taking it home. The sale of the pipe was held in a smaller tepee attached to the sun dance tepee, and in the roof of this a large opening is left for the sun to shine through upon the proceedings, so that the priests and devotees may lift their eyes to the fiery face of the orb of day during their invocations.

On a couch of blankets in the medicine pipe tepee, were laid the pelts of every wild animal and bird known to exist in that part of the world where the dance was held. Among other curious items was a small bag of moleskins which the visitors discovered was used to wipe the perspiration from the face of the buyer of the pipe. This was very necessary, for should any moisture whatsoever fall upon the articles on the couch, there is a belief that it would immediately rain and the ceremony must be stopped before this sign of the sun god's displeasure.

The medicine pipe itself is made of a reed about three feet in length, hollowed through the centre, with a whistle at one end. It is covered at one end with weasel tails and small red feathers, while attached to the other end are several feathers about six inches in length hung parallel to the pipe with beads. At the bottom of these feathers several small bells are fastened. The pipe that was used on this occasion was said to be 150 years old, but the pipe itself is only part of the parcel designated as the medicine pipe. Included with it are the animal pelts mentioned, a large wooden bowl and other articles that are afterwards wrapped up with it.

Blessing the White Visitors

The buyer of the pipe and his squaw, who had commenced to fast the previous midnight, took their places on the right of the couch, while the chief medicine man sat on the left. All the time a dolorous singing and chanting was kept up.

Immediately in front of the medicine pipe couch there was painted on the ground a small square about twelve inches each way. This square was divided in half, one half being painted red to represent Day and the other black to represent Night. From each corner of the square a forked line shot down depicting lightning. Feathers stuck in the ground at the four corners represented trees.

The visitors were taken to seats near the entrance and on their right sat five old men who offered a prayer for the dance, asking for a blessing also on the Great White Chief and the Mounted Police. There were prayers for peace and then other prayers for themselves and the general community. After one very long prayer, one old man paused, pointed to the visitors, to the Sun and then to himself. The interpreter explained that he was asking that the visitors might live to be as old as he was and have no trouble or sickness.

The " Sale " of the Medicine Pipe

Each of these old men took the medicine pipe in turn, praying that the sun-god would endow it with magical powers. Prayers over for the time being the tom-toms commenced and dancing began in dead earnest.

The first dancer crouched close to the ground, and, with his arms stretched out horizontally, hopped around like a frog. Completing the circle of the tepee in this manner, the dancer leaped to a point under the opening in the roof, and, facing the glare of the Sun, offered up a short invocation. He then returned to his place among the worshippers and passed the pipe on to the next dancer.

When the dance was concluded the pipe was again rolled up and the chief medicine man led the procession over to what is called the " buyer's tent." This was the temporary abode of the person procuring the pipe for the cure of a sick relative.

In the buyer's tent the guests sat down in a circle with the buyer and his squaw in the centre. The medicine man then went through the ceremony of invoking the sun-god's blessing on food which was brought to him, at the same time painting the faces of the buyer and his wife. Next he smeared paint on the wooden bowl in the parcel with the pipe and asked both the buyer and his wife to rub their fingers in this. The ceremony was supposed to be emblematical of cleansing their hands before their first meal.

The priest and the old squaw dance leader gave the buyer and his wife a drink of water and a very small piece of bread and meat. After the ceremony had progressed for an hour, they were again fed, after which they were told they could eat as much as they pleased. The dance leader then showed the buyer and his wife how to fasten the medicine pipe over their fence entrance at the outside. The pipe, she told them, must be put up every day before sunrise and taken down before sunset.

These pipes are usually sold at the time of the sun dance, but if an Indian is ill, a relative goes to the last buyer of the pipe and says : " I want you to pray for my sick relative, and I will buy your medicine pipe." The Indian is by custom bound to sell and he forthwith calls a prayer-meeting of his household to intercede for the ailing one.

The Final Ceremony

On the afternoon of the same day the " dance " took place. At noon the leader was brought from the sun dance tepee, and the procession proceeded with much singing, dancing and beating on the tom-toms. The leader was placed under an awning provided for her facing the sun dance circle from the west. Immediately afterwards the sacred circle was marked out with forked posts with rider poles laid from fork to fork. This circle or lodge as it is commonly called was about 30 ft. in diameter.

After the leader and the chief medicine man had taken their seats under the awning, those taking part in the exercises filed past with offerings to the sun-god. These consisted of feather fans, head-dresses and other fancy things. As each worshipper came before the medicine man he knelt to have his face painted, the medicine man drawing a ring around his face and wrists with brown grease paint.

Chanting continued all the time accompanied by the demoniacal din of tom-toms. Dried beef tongue, specially provided for the occasion by the leader of the dance and blessed by the medicine man, was then served in small portions to the elect of the dance. No one else was permitted to touch the tongue. By this time the leader of the dance, who, as previously stated, had been fasting for five days, was so weak she could no longer sit up without assistance.

At the conclusion of the beef tongue feast, five groups of six men each took their allotted positions around the sun dance circle, about 50 yards distant, each man holding a pole about 15 feet long. These poles were tied together in pairs at the top. At given intervals the men bearing the poles would advance nearer and nearer the sun dance circle, a chorus of chanting being kept up all the time.

The medicine man, the dance leader and their retinue then started for the circle walking around it once and entering it by the east side. The sun dance pole, a large poplar tree with forked branches at the top, lay in the centre of the circle. The chief sun-priest and his helpers approached the pole, then after covering themselves with a blanket so that other human eyes might not see the operation, they wrapped the offering they brought with them up in poplar brush and fastened the bundle so made to the head of the pole. At the moment this ceremony was completed, a shot was fired and the head-dress of the almost fainting woman leader was removed, signifying that her long fast was over.

The sun dance pole with the offerings to the sun-god attached was then raised to a vertical position by the men with the smaller poles, these being used much the same as pike-poles are used by farmers at " barn-raisings " in eastern Canada. No one dare lay a bare hand on the sacred central pole, which when raised was fastened in place with poles reaching to the rails on the outer edge of the circle. The whole assembly then paraded to the river and returned, each individual bringing back a branch of poplar brush and placing it against the framework of the sun dance circle until the whole wall was closed in with the exception of the entrance at the east side.

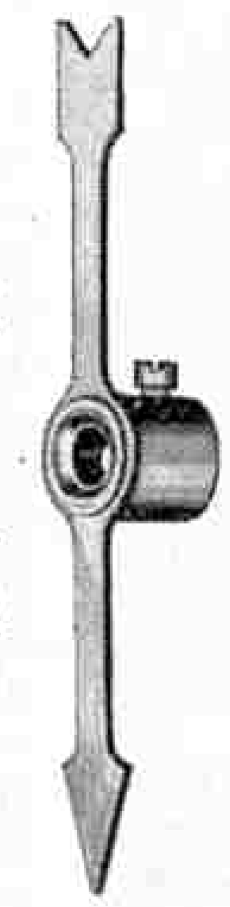
This completed the main ceremonies of the sun dance, after which a great feast was held, the sun-priest presiding. There were speeches and then stories by the older men who told of fights with other tribes and with white men—or of some thrilling horse-stealing escapade.

Corporal Harper concludes his report: "There was absolutely nothing that I could see that was contrary to the law unless it might happen to be the sale of the medicine pipe that 'Lit-the-Light' sold to 'David Bull Bear,' receiving in payment two horses. At night all that took place was the beating of tom-toms, which was kept up from sunset to sunrise. Just before the centre pole or sun dance pole was raised, a pile of clothing was made by the Indians in the camp and distributed among the old and destitute by the medicine men . . . It was a large camp. There were forty to forty-eight tents, holding in the neighbourhood of four hundred Indians. The young men took no active part and all, young and old, look upon it as an affair rapidly losing ground. I do not think there is any question that, even if they are left to themselves, the Indians will cease to celebrate the sun dance in a very few years."

New Meccano Parts

Left :—
Part No. 150 : Crane Grab, enamelled black, price 6d.

Right :—
Part No. 156 : Pointer, $2\frac{1}{4}''$ overall, with boss and set-screw, price 3d.



The above illustrations show the latest additions to the Meccano system. We believe Meccano boys will find the new parts very helpful in obtaining still greater realism in their models and in this connection we shall be pleased to receive particulars of the various ways in which the parts are used. The most ingenious ideas submitted will be suitably rewarded.

The Crane Grab is intended primarily, of course, for use in place of the ordinary crane hook. Miniature stone blocks, boxes, etc., may be gripped in its jaws and lifted without other aid. The Pointer is adaptable for all indicating appliances, revolution counters, etc.

Compression Springs

In response to numerous requests, we have arranged to supply separately the small compression spring at present embodied in the Meccano Spring Buffer. It is about $\frac{1}{2}''$ long (extended) and has proved extremely useful in many Meccano movements. It will be described in Meccano parts lists as follows :—

Part No. 120b, Spring for Spring Buffer, price 1d. each.

Exploring the Arctic—(*continued from page* 763)

Melville Island. On approaching Winter Harbour, Parkes saw strange sledge tracks and heard the distant barking of dogs. He took these indications to point to the presence of Eskimos and as he had no weapons he decided not to run the risk of encountering them and therefore turned back. As a matter of fact the sledges and the dogs belonged to M'Clure of the "*Investigator*," the ship that had set out from England with the "*Enterprise*," but had become separated from her.

When free from the ice in August 1852 the "*Enterprise*" sailed through Coronation Gulf and along the coast of Canada as far as Cambridge Bay, where no ship had previously been. There a second Arctic winter was spent, and sledge parties searching the shores of Victoria Land discovered a piece of a companion-door that might have been a relic of Franklin, but did not find any definite traces. At one time, had they but known it, they were actually within a few miles of the place where Franklin's fate would have been ascertained. The last winter was passed in Camden Bay and in 1854 Collinson brought the "*Enterprise*" safely home. Although the voyage had failed in the object for which it was undertaken—the discovery of Franklin's fate—it had accomplished a great amount of work and made many valuable discoveries.

Collinson's voyage had been perhaps too well managed to be adventurous, but it was noteworthy in this respect at least, that, in conjunction with the discoveries of the Franklin expedition, it pointed out the way to be traversed years later by Amundsen in the only vessel that has made the long sought north-west passage.

Using up the Bits

What Becomes of Scrapped Railway Material

Every year hundreds of thousands of tons of metal—rails, chairs, fishplates, wheels, axles, tyres—are scrapped by the railways. This does not involve waste, however, for railway scrap is of stable quality and is readily sold for various purposes.

Steel rails go back to the mills to be re-rolled for colliery railways, while cast iron chairs, brake-blocks and fire-bars are melted down at the foundries.

The old wagons are often sold intact and used by contractors in extensive building operations. Some of the covered vans form rope, sack and sheet stores at wayside stations, and the old carriage bodies, stripped of their furnishings and taken off the wheels, find a last resting place on allotments or small holdings, and in various places as contractors' offices and workmen's shelters. The upholstery of railway carriages is disposed of by contract to rag merchants and finds its way to the paper mills. Signal wires and fence wires are sent to the Continent in large quantities together with tin plate scrap, where the zinc and tin are melted off and made up into toys for the following Christmas.

Even used electric batteries from telegraph and telephone instruments are sold, spent oxide and zinc oxide finding a ready market. Battery terminals are disposed of as scrap brass and under this heading come the brass ends of electric light globes. Incandescent gas mantle rings are sent back to the manufacturers for new mantles to be welded to them, while gas mantle ash is disposed of by the pound.

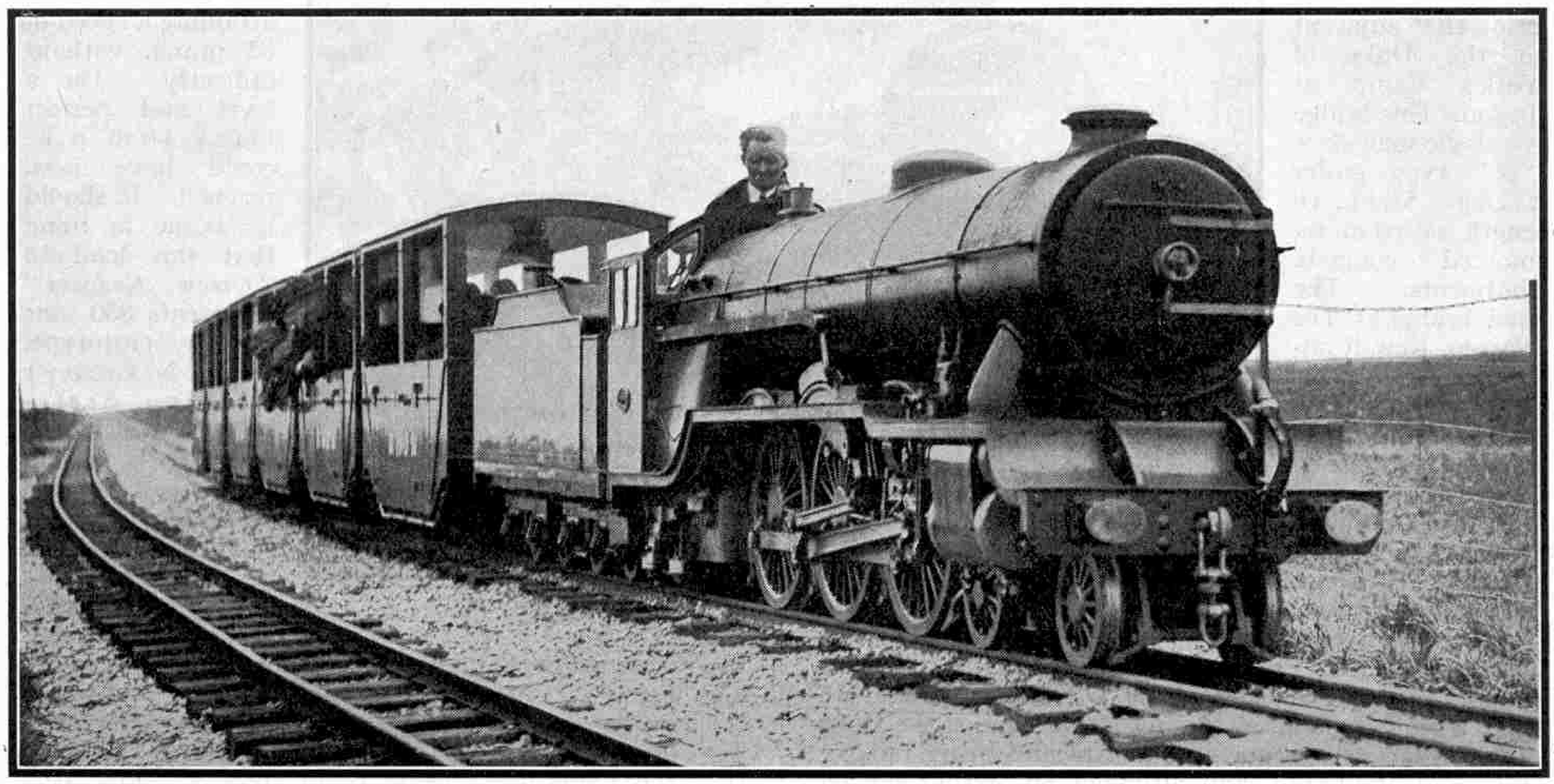
Scrap glass, which the railways accumulate in large quantities, is sold regularly under the trade term of "cullett," and carriage windows, glass from station roofs lenses of signal lamps, etc., come under this category. The mirrors from carriages are re-silvered wherever possible, and may outlive two or three carriages. Locomotives, when they can be worked no longer, are usually broken down in the railway locomotive shops; but every engine wears out at least two boilers before its career comes to an end.

From the different kinds of wood that are used in the locomotive workshops inflammable fire-lighters are made with creosote and tar to light the fires in the fire-boxes of the engine, and from the engineers' oily rags is manufactured thick grease for freight wagons.

J. R. Hind.

A New Miniature Railway

Famous Motorist's Life Ambition Realised



On the way to Dymchurch. The top of the cab on the loco has been removed in this photograph

NEARLY every boy feels at some stage in his early days that the crowning experience of his life would be that of donning overalls and taking charge of a really big locomotive, but few ever realise that ambition. Nearly 40 years ago was born a boy whose ambition went beyond this, for he resolved that one day he would actually control a real railway. That bold ambition was realised on 28th May last when there was completed the final stretch of the fascinating 15 in. gauge railway that has been built to link up the ancient Cinque Port towns of Hythe and New Romney on the south-eastern coast of Kent.

The boy referred to is Captain J. E. P. Howey, who has formed an incorporated company under the Light Railways Act. He is the principal shareholder and is taking the leading part both in the construction and operation of the line. Capt. Howey is well known in motoring circles at Brooklands and other racing tracks and owns several famous cars.

The engineer and manager of the line is Mr. Henry Greenly, A.I.Loco. E., the famous designer of miniature locomotives, who has had a unique experience in every phase of miniature railway work.

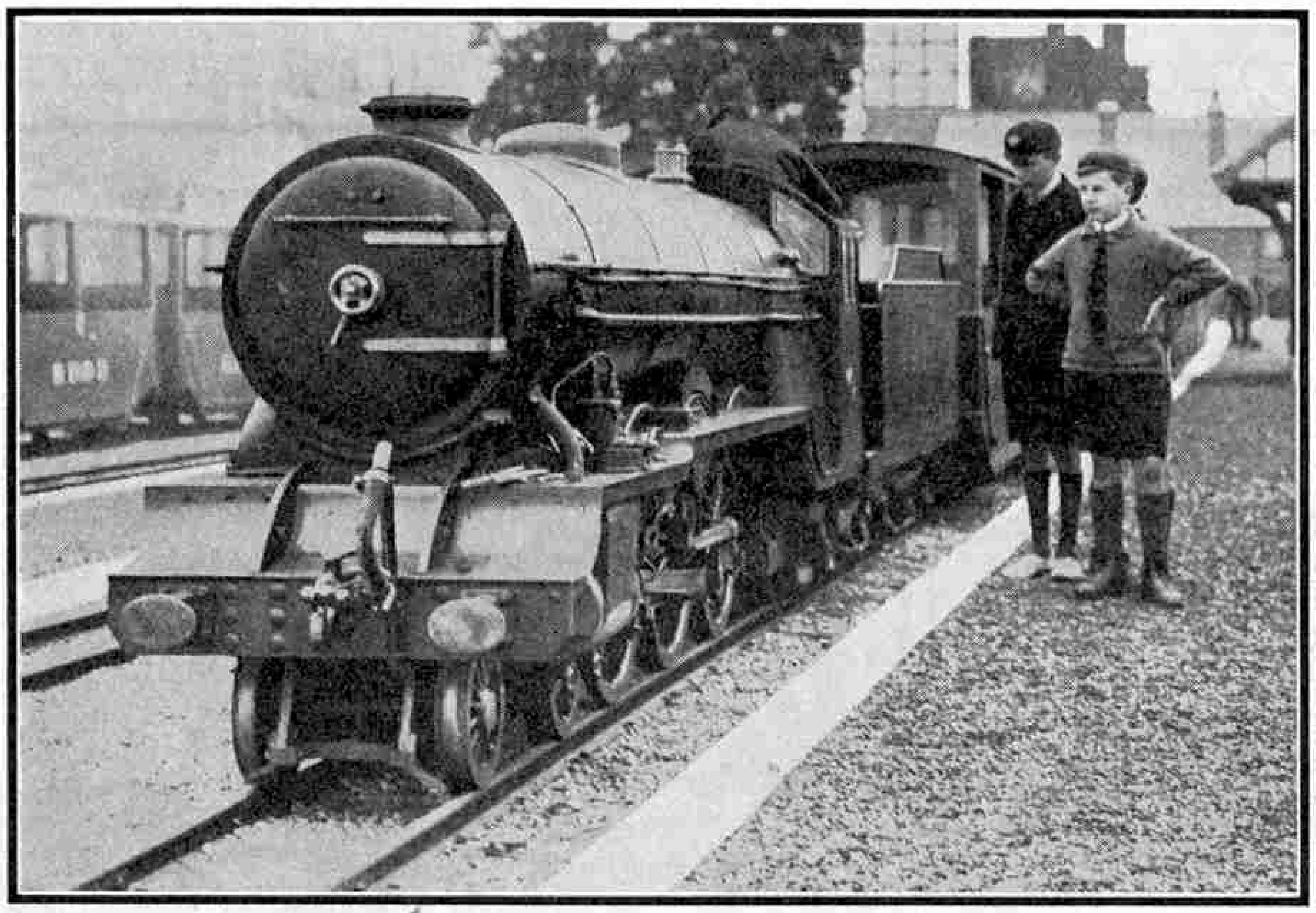
The Romney, Hythe and Dymchurch Railway serves a district that for the past 40 years has desired a railway. The development has been promised time and time again, and when Captain Howey's scheme was mooted the populace almost to a man voted for it. Some 20 years ago the Southern Railway applied for powers to establish a similar scheme in this area, but this was to have been a standard gauge line with a single track at an estimated cost of £60,000. It was practically impossible for the district then to justify the expenditure of so large a sum and for that reason nothing came of the project. It is interesting to learn that the approximate total cost of building and equipping the new railway is rather less than half that of the Southern Railway's scheme, and that Sir Herbert Walker, the general manager of the Southern Railway, has given a considerable amount of practical support to Captain Howey in the development of the line.

A small gauge line, Captain Howey contends, is the ideal feeder scheme for country districts that could not economically support the standard gauge. The Romney, Hythe and Dymchurch line is in the midst of a popular holiday district, Hythe itself being wonderfully situated, with natural amenities equal to those of many considerably more famous seaside resorts. Dymchurch, hitherto practically isolated, has wonderful sands, while New Romney is an ancient medieval borough close to which is Dungeness, a name with which every boy is familiar. All these places are linked by the little R. H. & D. Railway.

The Romney Marsh is an interesting stretch of country, being land reclaimed from the sea. Its nominal level is low, but there is an excellent drainage system, and at no point will the line be at all waterlogged. The adoption of a small gauge has allowed roads to be tunnelled successfully, for a cutting can go down to 5 ft. 6 in. in depth without encountering water, and thus the 6 ft. 7 in.

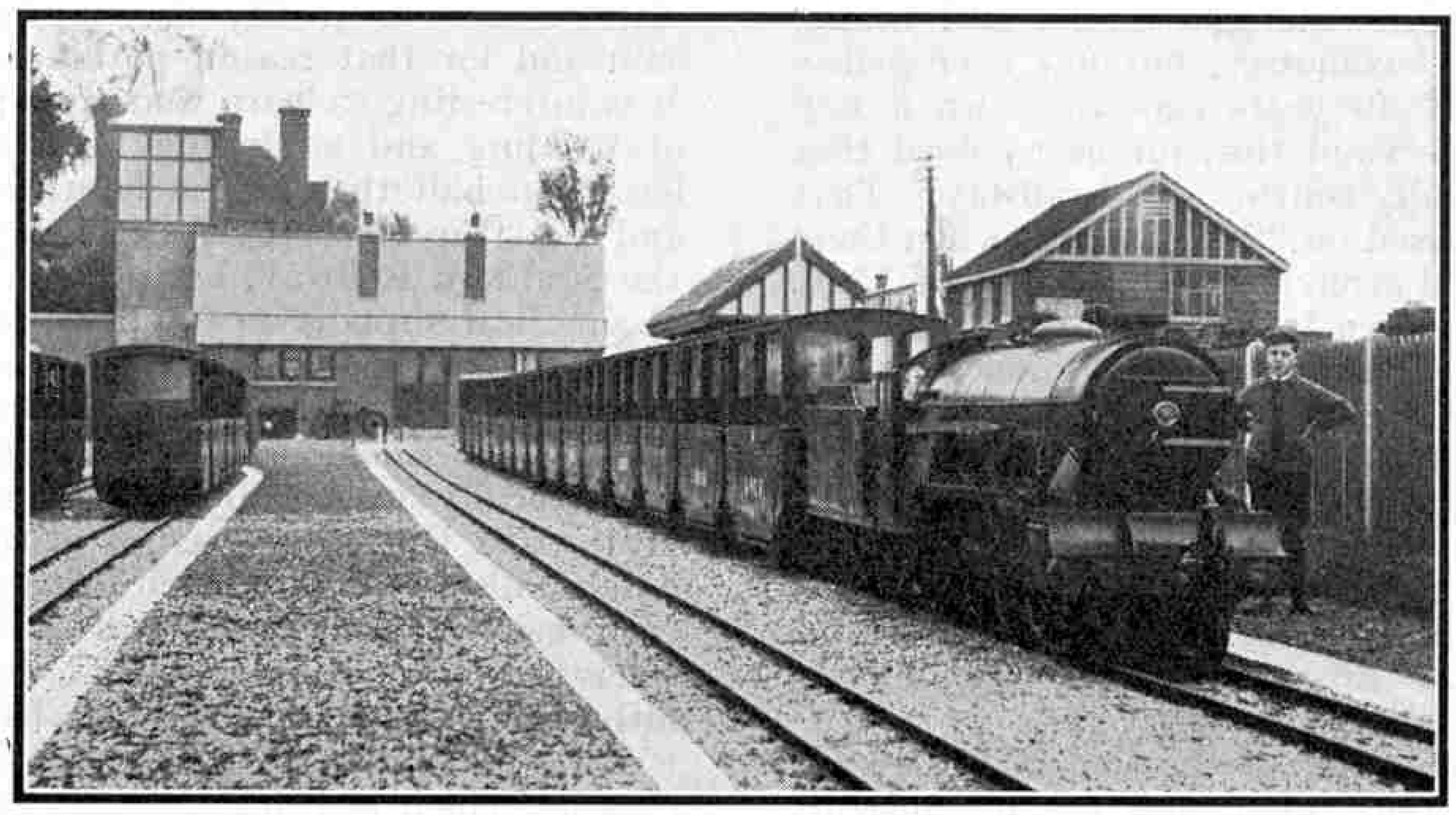
headroom allowed by the Ministry of Transport has enabled the line to be taken under the main road at New Romney and the secondary road at Hythe, at a reasonable cost and with a reasonable alteration of road gradient.

Several main drainage canals and innumerable dykes have had to be crossed in the course of the 8¼ miles track, the largest of these being that adjacent to the Duke of York's Camp at Jesson. This bridge is a single span skew "N" type girder bridge 56ft. in length, raised on reinforced concrete abutments. The road bridge at The Warren, New Romney, has two tunnels, each 50 ft. in length, and was built in reinforced concrete in 5½ weeks.



Inspecting the Locomotive at Romney Terminus

As already mentioned the gauge of the line is 15 in. This gauge was proposed many years ago by Sir Arthur Heywood, who adopted it for his own private line at Duffield Park in Derbyshire. Later he laid a 4½ mile system connecting Eaton Hall on the Duke of Westminster's estate with the neighbouring railway station at Balderton, and although Sir Arthur missed perfection in the design of locomotives he proved the usefulness of what he termed the "minimum gauge." The gauge was therefore adopted for several other pleasure park lines and some 25 years ago the first miniature or scale model locomotive was built. Designs were improved from time to time and in 1913 Captain Howey laid a private line at Stoughton Manor, Huntingdonshire, which was worked by a "Pacific" engine built to the designs of Mr. H. Greenly. In 1915 a narrow gauge (3 ft.) line at Eskdale in Cumberland was altered to 15 in. gauge and Captain Howey's "*Colossus*" was one of the locomotives tried out. Here the engine ran in direct competition with those of the Heywood type and showed a marked superiority in speed and efficiency. Another locomotive designed by Mr. Greenly, "*Green Goddess,*" also was tried out on the Eskdale Railway, and a brief account of this line and "*Green Goddess's*" performance will do more than mere statistics to convey some idea of this engine's superlative efficiency.



Photos] [*W. H. Evernden*

The train standing in Romney Station

The Eskdale line abounds in steep gradients and sharp curves, and the principal goods traffic consists of stone quarried from the hills. It was in front of a 34-ton mineral train that this miniature locomotive put up its best performance in attaining a speed of 35 m.p.h. without difficulty. On a level and perfect track 40 m.p.h. could have been reached. It should be borne in mind that this load to "*Green Goddess*" represents 850 tons to its prototype, Mr. H. N. Gresley's "*Flying Scotsman,*" which in practice is rarely called upon to tackle more than 550 tons.

The mechanism of "*Green Goddess*" is designed specially to meet the requirements of miniature railway work, and a very high degree of efficiency is obtained, the coal and water consumption being truly proportionate to the work done. The promoters of the R. H. & D. Railway believed that the miniature scheme could show a better performance than that achieved by the orthodox small gauge engine, and to prove their theory they purchased from the stock designs of an old-established firm of locomotive builders an engine built for use on contractors' small gauge lines. On runs of over six miles this engine failed dismally in comparison with Captain Howey's miniature engines. It possessed only half the power and burnt 2½ times as much coal.

From these beginnings the scale of 1/3rd (4 in. to the foot) was evolved, mainly with a view to obtaining increased power and speed, and providing for the better comfort of the engine driver. The disparity in size between the locomotives and coaches that must take "full size" passengers has been reduced, and the tenders arranged with a well seat that enables the driver to sit down and be sheltered by the "scale" cab.

The engines to be used on the R. H. and D. line will be eight in number and will be equipped with piston valves, superheaters, automatic vacuum brakes, pop safety valves, Wootten fireboxes, bogie tenders and every convenience that an engine driver could desire. All are miniatures of main-line types, built to a scale of 4 in. to the foot. Three of them—including the famous "*Green Goddess*" and the "*Northern Chief*" which are now at New Romney—are of the Great Northern (L.N.E.R.) "Pacific" type, and two express "Pacifics" with three cylinders have also been built. Two "Mountain" type (4–8–2) tender engines are on order and the locomotive stock is completed by a four-wheeled goods and shunting engine of special design. The standard passenger engines weigh over eight tons. They will haul in regular service a train of 20 carriages at 30 miles an hour with ease. The cylinders are $5\frac{1}{4}$ in. bore by $8\frac{1}{2}$ in. stroke. The driving wheels of the express "Pacific" type engines measure $25\frac{1}{2}$ in. diameter, and those of the eight-coupled engines are $19\frac{1}{2}$ in. In length the engines with tender total 25 ft. The valve gear is the complete Walschaerts' type, the prime motion being taken from a return crank on the driving crank. The reversing lever in the cab can be operated with a direct push and pull with a screw "vernier" adjustment, and at the Eskdale trials "*Green Goddess*" was able to haul a heavy train with the gear linked up to give a valve cut off of 35 per cent. of the stroke.

Dignity and Impudence ! 3-cylinder "Pacifics," "*Typhoon No. 7*" and "*Flying Scotsman*"

Semi-open and closed carriages will be used. Sixty of the former, each capable of carrying eight adults have already been constructed, and for the winter traffic the closed cars will be installed. Goods wagons of various types according to the needs of the traffic are under consideration and already sixteen one-ton trucks have been delivered.

In the course of the $8\frac{1}{4}$ miles of the line there will be five stations and halts. In the layout of these stations the organisers have anticipated maximum requirements in order that the efficiency of the line may not be impaired in the future.

The stations are as follows :—

New Romney (the main terminus) with four passenger roads, locomotive and works buildings, turntable, a carriage shed and an extensive goods yard. The Southern Railway have extended their line into this yard for purposes of goods transfer.

Holiday Camp near Jesson Farm and adjacent to Messrs. Allnatt's famous children's holiday-camp. This camp is also known as the Duke of York's Summer Camp. H.R.H. the Duke of York has displayed considerable interest in Captain Howey's venture, and when visiting the camp last year he drove a train over the section from New Romney to Holiday Camp. Mr. H. N. Gresley, the L.N.E.R. Chief Mechanical Engineer, was among the party present, and when it was suggested that a collection be taken for the driver his was the hat that went round. It was quickly filled with small change and at the end of the run was handed to the Duke with due ceremony. The incident caused great amusement and in the end the Duke handed the proceeds to the regular driver of the engine.

Dymchurch (Marshlands), adjacent to the St. Mary's and Bonnington Roads and to the Marshlands Hotel near to the western end of this charming seaside resort. The R. H. and D. Railway thus brings Dymchurch into direct communication with London, and will enhance the popularity of its beautiful stretch of sand.

Dymchurch (Dymchurch Bay and Burmarsh). A halt on the eastern end of Dymchurch on the road to Burmarsh village. From here the line passes under the shadow of Lympne Castle close to the hills under the West Hythe Road to Hythe alongside the southern bank of the Military Canal.

Hythe (Ashford Road). This terminus is close to H.M. School of Musketry and near to the Folkestone omnibus terminus.

It is of interest to note here that the whole of the work of construction, including the permanent way and works buildings, bridges, locomotives, carriages, wagons, and equipment generally, has been carried out to the company's designs.

The directors of the R. H. and D. Railway think that their present proposals offer a reasonable chance of success, and that as the East Kent coast is a popular holiday centre, there will be sufficient summer traffic to allow the service to be continued during the winter. What they lose on the roundabouts will be made up on the swings ! Therefore, in all probability, the inhabitants of the Marsh will be blessed with a service all the year round.

Our Wonderful World


TRANSPLANTING A BIG TREE.

150 Million Lives Saved

The largest stock-rearing concern in the world is probably the United States Bureau of Fisheries, which distributed no fewer than 5,000,000,000 fish and eggs last year to stock the waters of the United States, while in addition over 3,000,000 eggs found homes abroad, as far afield as Switzerland, Italy, Brazil, Argentine and Japan.

There are 38 hatchery stations and 32 sub-stations under the control of the Bureau, at which the fish are reared from eggs and the fry despatched to the waters from which the eggs came. Mostly commercial fish are dealt with, but trout and other sporting fish are also reared. Many of the eggs are salvaged from the nets of fishermen along the Pacific and Atlantic coasts and in the region of the Great Lakes. When an application is approved the fish are sent to the applicant's railway station free of cost in special cars that are fitted with pumps and machinery to keep the water aerated, for the great risk in a long railway journey is that the water is liable to become stagnant by loss of the dissolved air upon which the life of the fish depends. Last year the distribution of 5,000 consignments cost almost £12,000.

A curious minor activity of the Bureau of Fisheries is its work in connection with a temporary flood. When the flood subsides many fish are left stranded in rapidly drying pools, and these are rescued by the agents of the Bureau and returned to their native waters. The lives of no less than 150,000,000 fish were saved in this manner last year.

* * * *

Raindrops and Water Partings

There are many places to be found on the earth's surface where the waters of streams separated by only a short distance flow into different oceans at points thousands of miles apart. In these cases the watershed is often clearly defined. Some drops of rain falling on it flow in one direction while others falling only a few feet away flow in the opposite direction, and it is by no means impossible for a sudden gust of wind to change the destination of a rain drop from one ocean to another just before it reaches the ground.

Striking instances of this are to be found almost everywhere. In Africa the headwaters of the streams feeding lakes Tanganyika and Victoria Nyanza are exceedingly close together, but the former drains away down the Congo River into the Atlantic Ocean and the latter into the Mediterranean Sea by way of the Nile.

The crest of the Rocky Mountains in North America is one of the greatest water partings in the world, extending for more than 2,000 miles through Canada and the United States. In the United States the destination of the rain falling on the Rocky Mountains is the Pacific Ocean or the Gulf of Mexico, according to whether it falls on one side or the other of the line of the watershed.

In Canada the watershed is the boundary line between British Columbia and Alberta. At one point this line is marked by a monumental stone erected on the very crest, with the inscription "The Great Divide" over it. It is erected where the streams rise. A drop of rain falling on the western side flows into the Pacific Ocean, while one falling on the eastern side finds its way into a branch of the Saskatchewan River and thence into Lake Winnipeg. Ultimately the latter drop reaches the Atlantic Ocean by way of Hudson Bay.

The most remarkable instance of all, however, is to be found in North-West Canada. In its higher reaches the Yukon River is called the Pelly River and it derives some of its waters from a lake christened Finlayson's Lake by its discoverer, Robert Campbell, who explored the northern portion of British Columbia on behalf of the Hudson Bay Company. He reached the lake by ascending the Liard River and was surprised to find that the water of this lake flowed out at both ends in flood time. Thus water from the same lake flows down both sides of the mountains. In one direction the water flows past Dawson City and Klondike to the Pacific Ocean and in the other by way of the Liard and Mackenzie Rivers to the Arctic Ocean.

* * * *

Electric Weighing

Weight measurements made possible by scientific research range from the billions of tons of giant stars to incredibly minute quantities. Until recently the record for small weights was held by Ramsay and Spencer, who used an extraordinarily sensitive instrument called a micro-balance, in the construction of which quartz fibres almost too fine to be seen were used. These fibres were first used by Professor Boys, who made them by dipping the ends of arrows into melted quartz and shooting them into the air to draw out a thin fibre before the quartz finally solidified. With the aid of their micro-balance Ramsay and Spencer were able to determine weights as low as one millionth of a gramme.

To-day one millionth of a gramme is to be regarded as a comparatively large weight, for a weight 10,000 times less than this has been determined by Millikan, an American scientist. Needless to say he did not use a balance and a box of weights of the type used in science laboratories in schools. No doubt many readers have experienced the difficulty of finding a tiny ·01 gr. weight after dropping it on the floor, but the kind of weight that Millikan would have needed would be invisible when in its right place, even with a microscope! Actually he used an electrical method.

The apparatus for this purpose consisted of a small chamber in which were two horizontal condenser plates, the upper one pierced with a very small opening. A spray at the side distributed oil in exceedingly fine drops that gradually settled down to the bottom of the vessel. As readers of the article in the June "*M.M.*" on "*Falling an Inch in 2½ Months*" will know, if the drops are very small the rate of falling is exceedingly slow. Occasionally a drop passed through the opening in the upper condenser plate and so entered the 15 m.m. space between the two plates. The intermediate space was illuminated from the side by dark field illumination so that the drop was seen in the observing telescope as a brilliant spot of light in the same manner as small particles are seen in an ultra-microscope. The upper plate was attached to one of the poles of a battery and the electric charge, by attracting the oil drop, retarded its rate of falling. Suitable adjustment of the charge kept the spot of light dancing between the condenser plates for hours.

By varying the charge of the upper plate a position of equilibrium was obtained, when its electrical attraction exactly balanced the attraction of the earth for the drop of oil, this being shown by the stationary position of the drop. Calculation of the strength of the electric field then enabled the weight of the drop to be determined exactly. This apparatus is capable of weighing drops so small that 10 billions of them would only weigh one gramme!

* * * *

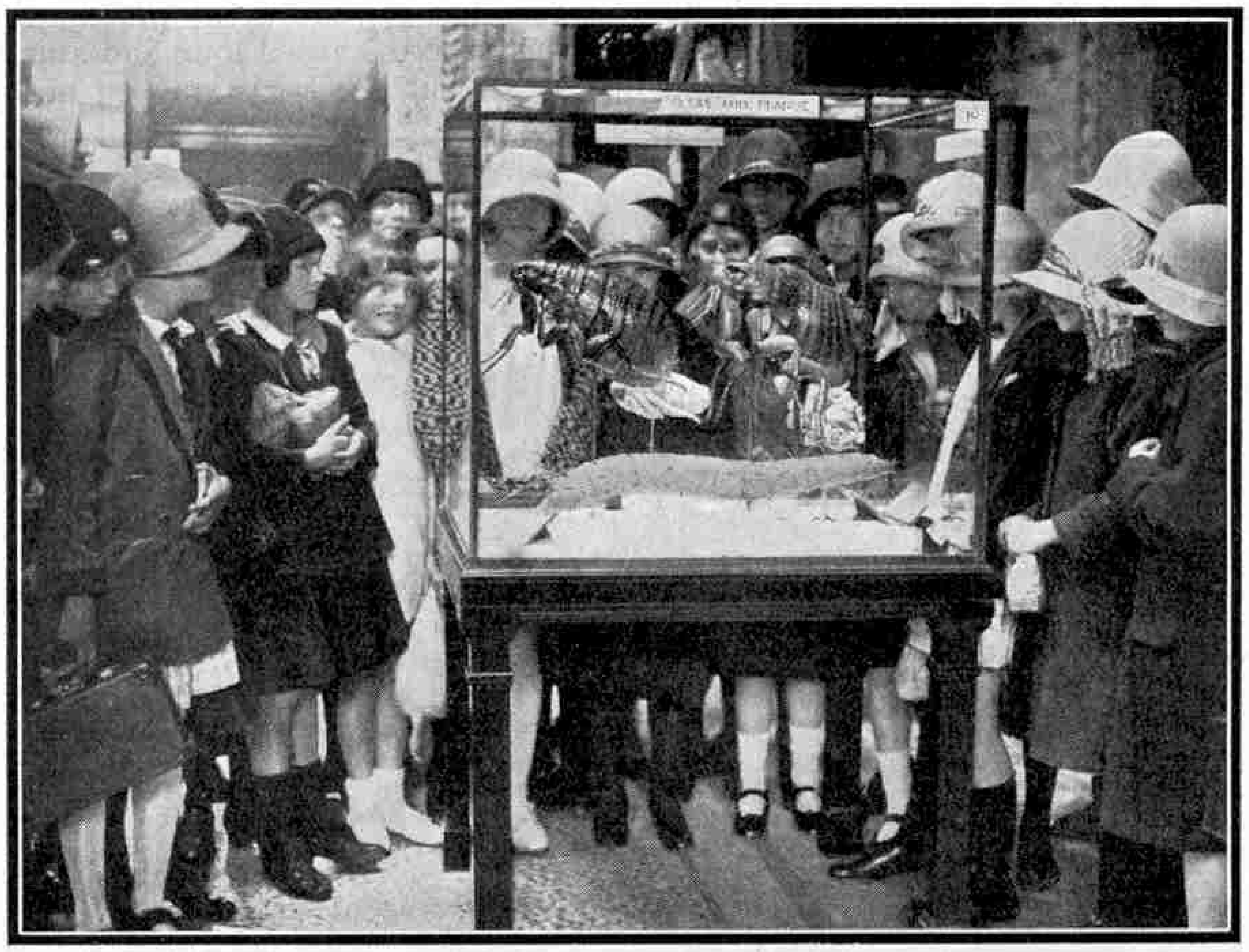
A Turtle's Annual Holiday

An American turtle commenced its annual journey to a holiday resort in the mountains last June. This particular specimen has been in the habit of making a summer trip for 21 years at least, its actions being traceable owing to a New York resident having scratched his initials on its shell for identification purposes. During the winter it remains in the marshes at Mount Washington, to which it returns again in September. The distance covered by it in this annual trip is not less than two miles, a great distance for a turtle, and its course has not varied by more than two feet over the whole period of 21 years.

Disease-carrying Insects

A wonderful series of large models showing disease-carrying insects is now on view in the Central Hall of the Natural History Museum at Kensington. The exhibition is unique, and there is no other series of models that can compare with it. The magnification of the insects ranges from twenty times to as much as two hundred times life-size. As might be expected the mosquitoes, including malaria and yellow-fever, are well represented. There is also a model of the tiny insect resembling a midge that carries sand-fly fever, a malady from which many of our soldiers who served in the Eastern theatres of the war suffered. There are models of a small West African horse-fly that carries calabar swelling, and also of two kinds of tse-tse flies that carry the parasites causing sleeping-sickness and nagana. Even the common house-fly is not forgotten and claims inclusion in the group on account of its unpleasant propensity of carrying disease germs. There are two forms of ticks, one affecting man, and the other domestic animals. The itch-mite, plague-fleas, and similar insects are included.

The models are made of wax and have been made by three gifted artists, two of whom are ladies.



Large models of Disease-carrying Fleas on view at South Kensington

It is interesting to remark in passing that although there are estimated to be over half-a-million different kinds of living insects, only a very small number of these are concerned in the spread of disease, either in human beings or animals. The known disease-carrying insects are fewer than sixty species, whilst only about twenty ticks, which belong to a different class of the animal kingdom to the insects, are capable of spreading diseases.

At first sight it might not be thought there was any direct communication between these insects and engineering, but as has already been mentioned in the "*M.M.*" at various times, there is a very direct communication. In certain areas where rain is scarce, irrigation schemes are being developed, and in the areas where dams and canals are being built, malaria and other fevers are very often prevalent. It seems in the light of recent research that malaria is on the increase in those regions that are artificially watered, and in this spread of fevers the disease-carrying insects play an important part. It was not possible for the construction of the Panama Canal to be proceeded with until malaria had been stamped out, and this was done by attacking the mosquitos in the marshes and destroying their breeding place. Until these insects had been stamped out the construction of the largest canal in the world was an impossibility. The mosquito has since been similarly banished from many other places, notably Singapore.

Strange Uses for Ice

An engineer in Florida was faced recently with the difficulty of lowering a 16-ton concrete slab on to 6-inch blocks. No jacks suitable for the job were available, so 32 fifty-pound cakes of ice were fitted under the concrete as supports. The ice gradually melted, thus lowering the slab on to the blocks placed in readiness.

This ingenious solution of an engineering difficulty is a reminder that ice finds other applications besides its obvious use as a cooling agent. The method of pit sinking in which water is excluded from the shaft under construction by freezing the surrounding soil is fairly familiar, and a somewhat similar method has been suggested for dealing with damaged ships. Preliminary experiments were made by enclosing an electrically-driven refrigerating plant in a caisson submerged to a depth of 40 ft. A block of ice was thus formed on the bottom of the vessel, to which it adhered.

In another experiment a sail, similar to those used in covering leaks, was provided with a cross system of flexible refrigeration hoses and employed for closing a leak, layers of ice forming on the sail. A layer of ice 6 in. in thickness was formed in 2½ hours upon the sail, which measured 10 ft. by 12 ft.

These experiments have shown conclusively that quantities of ice can be formed in sea water in a short time. The method is claimed as particularly suitable for use in places that cannot readily be reached by divers. An opportunity for testing it seemed to have arrived when the Spanish warship "*Espana*" struck a submerged rock near Melilla and suffered severe bottom damage. Unfortunately, while the refrigerating plant was being taken to the site of the accident, the wreck was completely destroyed by a hurricane, so that the possibilities of the method for the salvage of ships are as yet untried. An opportunity for testing this new use for ice will no doubt soon present itself.

Flood Protection in New York State

Although the City of New York has never yet suffered from floods in the same manner as the towns and cities on the lower reaches of the Mississippi, the New York State Authorities have taken steps that will effectually prevent the slightest possibility of such a catastrophe. The river concerned is the Hudson, which flows from the Adirondack Mountains to the Atlantic Ocean, past Manhattan Island on which the central portion of New York is built. This river carries a large volume of water and is tidal for a considerable distance above New York, so that normal flood waters in the river are absorbed by the sea before any damage is done in the city.

In the upper reaches, however, great damage has resulted from a series of floods that culminated in a disastrous flood in 1913, when damage amounting to millions of dollars was done to houses, farms, bridges and railroads. To prevent a recurrence of this the State of New York has adopted the method of providing a reservoir to absorb surplus water. Such a reservoir is to be constructed on the Sacandaga River, a tributary of the Hudson, and eventually it will take the form of a lake 27 miles in length and five miles in width. This vast lake will prevent any dangerous rise in the level of the river itself in virtue of its huge capacity of 36 thousand million cubic ft. of water, and any excess will be worked off slowly and safely when the level of the river falls slightly.

The effect of this measure will be closely studied, as similar methods have been proposed for the protection of the Mississippi Valley from a repetition of the flood conditions that have obtained during the present year. In former days safety lakes of this kind existed naturally on the banks of the Mississippi, but these have now disappeared, access to them being prevented by the huge embankments that have been built along the course of that river. The problem before the authorities now is whether to continue building higher embankments or to fall back upon the old natural method now being tried with the Hudson River.

* * * *

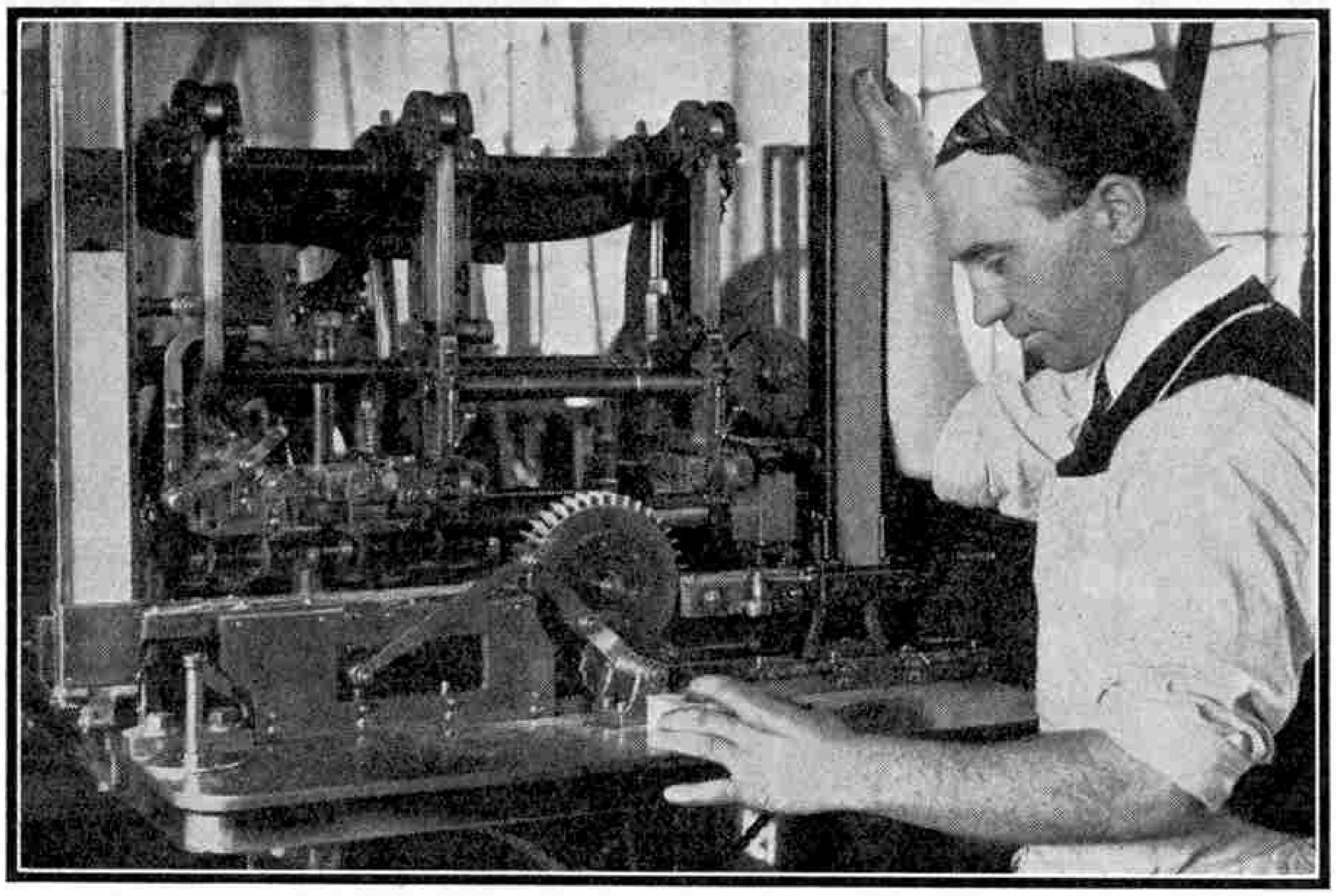
The Power of a Tornado

The whirling wind of a tornado often reaches a speed of 400 miles per hour and has been known to lift houses from their foundations, hurl wagons through the air, and to carry people on wreckage to a distance of half a mile and then deposit them gently on the ground without injury. It lends rigidity and penetrating power to straws, which are often driven into the bark and wood of trees as if they were stout nails.

"Tickets Please!"

The Interesting Story of Railway Tickets

In the early days of railways passengers were not provided with tickets, but their money was usually collected by the guard or engine driver of the train by which they were travelling, no receipt of any kind being given. As the number of passengers became greater, however, it was found necessary to have some means of readily distinguishing those who had paid from those who had not, and accordingly tickets were introduced.



Courtesy] [L.N.E.R.

This machine prints 10,000 tickets per hour. Each ticket, when printed on one side is turned over by the small paddle wheel and printed on the other side

First Tickets Made of Metal

The earliest tickets were made of metal and one issued for use on the Leicester and Swannington Railway is illustrated here. This line, of which Robert Stephenson was the engineer, was the first to be built in the Midland Counties and was opened on 17th July 1832. Like most of the early railways it was originally intended to be used for goods traffic only, but a carriage was provided to accommodate a few passengers. This carriage proved very successful and before long passenger traffic developed to such an extent that the fares alone were paying a dividend of one per cent. on the whole capital of the company, and passenger carrying was firmly established as a permanent and profitable feature.

If a passenger booked at Leicester to the then Ashby Road Station, one of these metal tickets would be issued to him and the transaction would be duly entered by the booking clerk in a book kept for the purpose. On arriving at his destination the passenger handed over his ticket to the guard, who placed it along with other tickets in a leather pouch he carried at his side. When the guard returned to Leicester he handed over the tickets to the booking clerk to be used again.

A Metal Ticket issued by the Leicester and Swannington Railway

Paper Tickets Introduced

One of the earliest railways to abandon the use of metal tickets was the Stockton and Darlington Railway, which issued paper tickets as early as 1835. On each of these tickets and also on the counterfoil, the destination, the name of the passenger, the signature of the clerk and the date all had to be entered by hand, and it does not require great imagination to understand that this process caused long and annoying delays in booking at all but the very quietest stations. On the back of these tickets were instructions that they were to be handed to the engine driver at the end of the journey. The use of these tickets was not compulsory, however, and many passengers still travelled without them.

In July 1835 the subject of tickets came up for serious discussion before the board of the Stockton and Darlington Railway and in the following year an improved system was introduced. Books were produced each containing about 1,000 tickets and counterfoils. On these tickets were printed the names of the starting station and of the destination, and the day of the month. All that required to be entered in addition was the month of the year and the name of the passenger.

Since the day of the month was already printed on the tickets it was necessary for the various stations to be supplied with sets of 31 books—one for each day, and consequently a station often had as many as 100,000 tickets in stock. No detailed account of these tickets was kept at the head office, and it was a simple matter to remove even an entire book without detection. This state of affairs, of course, was very unsatisfactory and improvements designed to prevent fraud were soon brought into effect.

The Newcastle and Carlisle Railway was at first run without tickets, the money obtained from the passengers being handed to the guard of the train, so that it was not necessary for those in charge of the stations to keep any books recording the fares. The fares thus collected were known as "road money." When tickets were subsequently adopted by the railway company, the number issued at each station during a journey was entered by the booking clerk concerned on a fare sheet, or "way bill," in the possession of the guard. For a long time, however, many people travelled on the system without bothering to procure tickets, paying the guard in the "good old-fashioned way," and the fare sheets contained a column in which the guard himself recorded these sundry "road monies," and also excess fares from passengers who over-rode their ticket journey.

From 1836 tickets were in general use for passenger traffic on railways in the North of England.

First Return Ticket

What is believed to be the first return ticket was issued at Wetheral on 22nd May 1837, for a journey to Carlisle and back on the same day. This ticket was printed on white paper. The fare was 1/- and the ticket had to be shown at Carlisle before the passenger commenced the return journey. Some four years later, in October 1841, return tickets for intermediate stations were issued on the Newcastle and North Shields Railway, but no reduction was made in the fare, the only advantage being that the passenger was saved the trouble of booking again for the return journey. The same year the company experimented with a turnstile as a means of checking the number of tickets issued to entraining passengers.

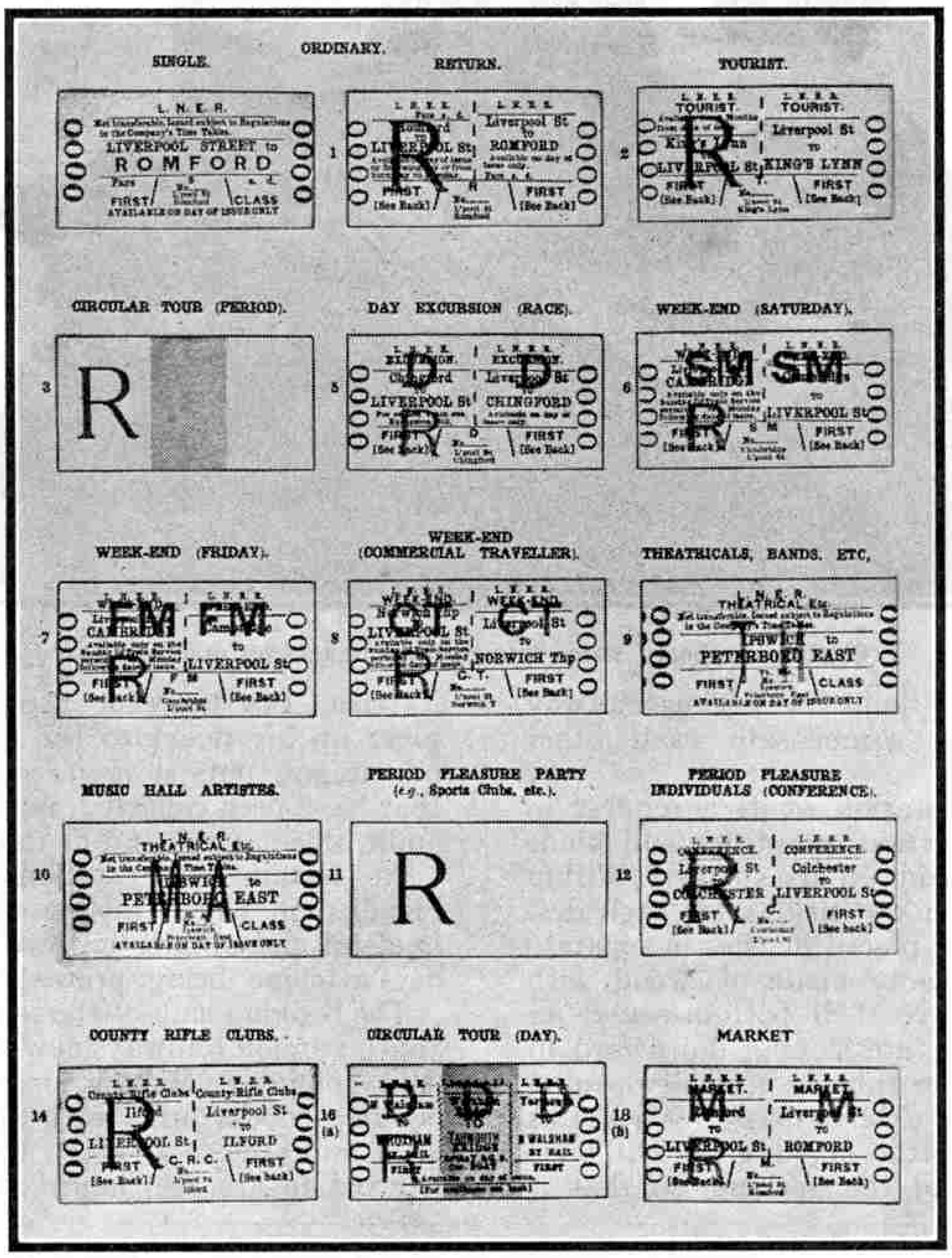
Edmonson's Great Idea

It was left to Thomas Edmonson to introduce the present type of railway ticket that has proved so successful. Edmonson was born at Lancaster in 1792. He was apprenticed to cabinet making and later set up in business for himself, but he failed to make a success of this and subsequently took a post on a railway in Northumberland. One day while out walking in the fields during his leisure time, the thought occurred to him that the toil of writing the name of each passenger on his ticket and on its counterfoil was entirely unnecessary, and that all that was really required was for the tickets to be numbered consecutively so as to afford a ready means of checking the number sold.

He at once communicated his idea to a friend, a watchmaker named Blaylock, and together they made machines for printing and numbering railway tickets. The tickets were made of cardboard instead of paper as hitherto. Edmonson and Blaylock then approached railway companies with a view to their taking up the scheme. The Newcastle and Carlisle Railway would have nothing to do with it, but fortunately the manager of the Manchester and Leeds Railway at once saw the possibilities of the scheme and accepted Edmonson's terms of 10/- per year per mile of road over which the tickets were used. Shortly afterwards the system was introduced on the Birmingham and Gloucester Railway and on many other lines, and Edmonson's income grew enormously.

The Many Kinds of Tickets

Modern tickets may be broadly divided into a number of groups, the usual divisions being (1) ordinary tickets, (2) excursion tickets, (3) other cheap tickets, and (4) season tickets or contracts.



Types of First Class Tickets issued by the L.N.E.R.

The ordinary tickets, of course, are issued between any two stations for the single or the return journey, and for first or third class. Single tickets and the outward halves of return tickets are usually available on the day of issue only, although there are a number of exceptions. The return halves are usually available for any day within two months of the date of issue when the journey is over 12 miles, and for the day of issue and the following day for journeys of under 12 miles. Passengers making journeys between certain places are entitled to break their journey at a number of stations en route, providing the time of availability is not exceeded.

Excursion tickets always cover both the outward and return journey. They are usually for third class only, and in most cases are available on the day of issue only and by certain special trains as advertised on the company's handbills. These tickets have grown very popular during the last thirty years and enable many people, who would otherwise be compelled to remain at home, to spend a day in the country or in another town.

A form of ticket that is also becoming increasingly popular is the cheap return ticket by ordinary trains. These tickets are usually available for the day of issue only and are issued on market days, early closing days, and so on.

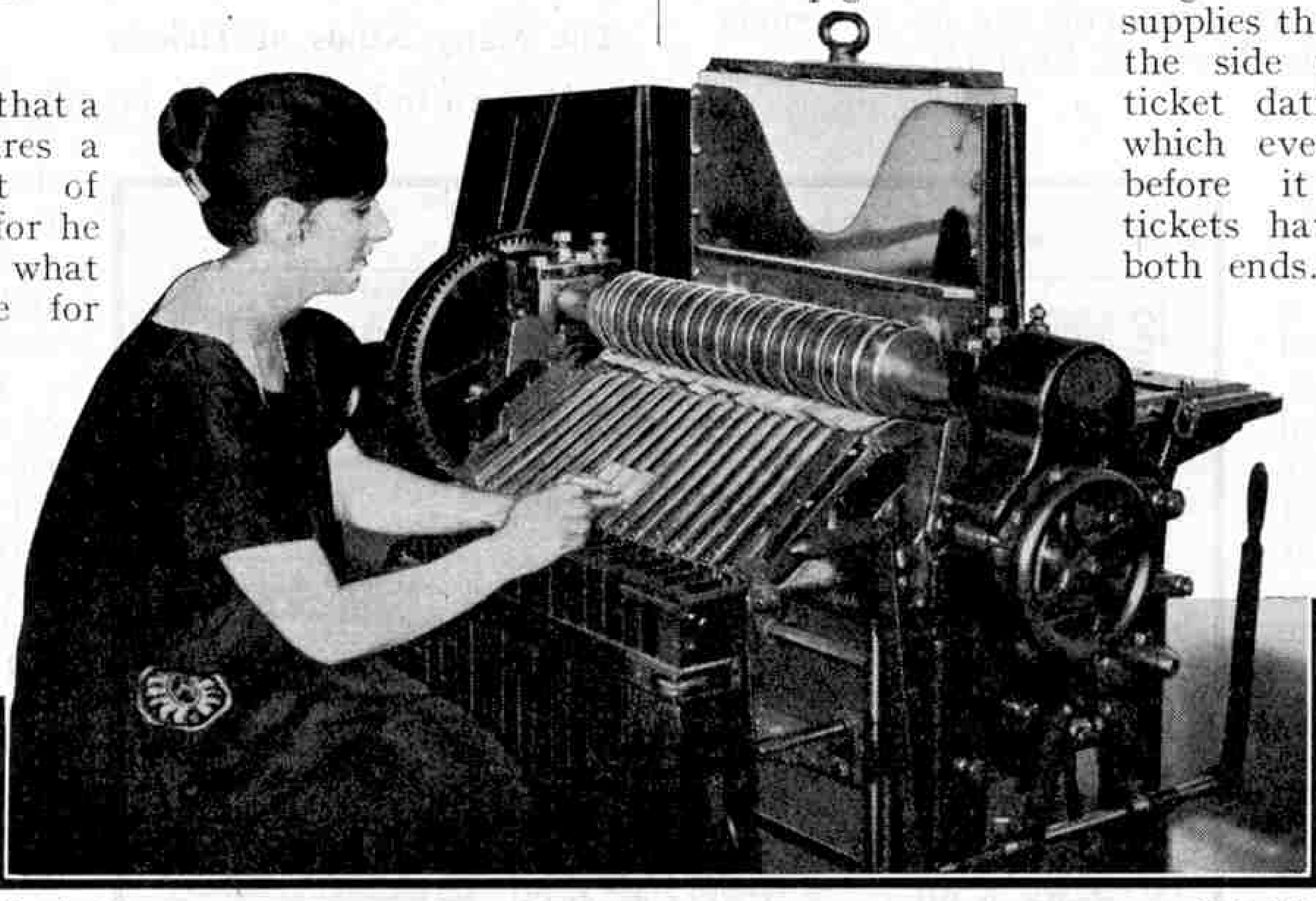
Season tickets and contracts are well known to all our readers. They are of great service to business men who travel to and from their work each day by rail. Providing the journey is made frequently, a season ticket saves its holder a considerable amount of money. A season ticket has the advantage that, in addition to being available between the two stations for which it was obtained, it is also available for journeys between any intermediate stations en route.

There are also many other kinds of tickets, such as workmen's tickets, commercial travellers' tickets, cheap tickets for parties, and so on. Many stations of the "closed type" also make use of platform tickets, which enable people to pass the barriers in order to see their friends on to the trains.

Ticket Punching

It will thus be seen that a ticket collector requires a considerable amount of knowledge and skill, for he must know at once what tickets are available for particular trains, and many other details.

It is interesting to note that ticket punching was introduced in 1864, when ticket examining stations were each allotted a distinctive number or sign, and an elaborate system of checking the travel of passengers over different companies' lines during a journey was built up. Thus railway companies became able to compensate each other for use of track, etc.



Courtesy] Cutting cardboard strips into railway tickets by machinery [*L.N.E.R.*

From time to time each station sends a request to the head office asking for certain quantities and kinds of tickets with which to maintain its stocks. Within the booking hall of a station the tickets for each destination and of each kind are placed in piles in separate ticket tubes, which are usually made of wood with metal rims. These tubes have their bottom set at an angle so that all the tickets are sloping downward in front. At the bottom of the tube is a small opening through which one ticket is able to pass. When this bottom ticket is removed by the booking clerk it pulls the next ticket partly out of the opening, so that it is easy for the clerk to pull it completely out when required.

The tubes are arranged so that those containing the tickets most in demand are nearest the window or "pigeon hole" through which the booking clerk supplies them to passengers. By the side of the clerk is the ticket dating machine through which every ticket must pass before it is issued, return tickets having to be dated at both ends.

Having obtained his ticket the passenger proceeds to the barriers leading to the platform from which his train departs, and has his ticket punched by the inspector on duty. This is a safeguard to prevent the ticket being used twice, if by any chance, it should not be collected at the destination.

When the traveller arrives at his destination he gives up his ticket to the collector, who at once cancels it and puts it in its place with the other tickets that have been collected, ready to be sent to the railway audit office at the end of the day.

At certain busy stations automatic machines are installed in which the passenger puts a coin or coins in a slot and obtains his own ticket, all the tickets from one machine being printed for the same destination.

The booking halls of the seven stations on the City and South London Railways new underground line from Clapham Common to Morden, are equipped with "Passimeter" booking-booths fitted with machines that automatically print and issue a ticket. The platform tickets already referred to are also issued from automatic machines.

Tour round the World—

(*Continued from page* 760)

consists of a flat rectangular piece of wood with two strips of wood across the bottom to protect the walker's feet from the wet and mud. The gata is fastened to the foot by means of a cord secured to the front and passing between the big toe and the remaining toes. To this cord is secured a piece of soft material that covers the top of the foot and is fixed to each side of the gata.

On entering a house it is customary to remove the gatas from the feet in order to avoid soiling the floors, which are covered with matting made of rice straw. The desirability of this will be readily understood when it is remembered that the Japanese people usually sit and take their meals on the floor.

The majority of the women I saw struck me as being very picturesquely attired, but what impressed me most of all was the elaborate dressing of their hair. They wear no hats and their hair is arranged in a most fantastic but artistic manner, a variety of ornaments being employed for adornment. So much time is occupied in building up the hair that long periods elapse before it is taken down and rearranged. In order to protect their hair at night it is the custom of the women to sleep with their necks resting on cushions made of bamboo cane.

I was greatly struck with the number of children and in fact it seemed to me that they were everywhere. The babies are carried as bundles on the backs of their mothers, being firmly secured by a scarf wrapped round both mother and child. Often also one sees babies carried by old men busy gardening and even by boys fishing. The Japanese children have quite a solemn expression and they look at you with their serious little eyes as though they were full of wisdom. It has been suggested that this wise look is a result of their being carried about everywhere and seeing everything from their earliest babyhood. Another thing that I noticed was that the Japanese youngsters are extraordinarily well behaved. In their games they never seem to quarrel and squabble as, I regret to say, I have heard British youngsters do, and a crying child appears to be uncommon. Generally speaking Japanese children, even of the poorest classes, are well treated and are perfectly happy.

Results of Model-Building Contests—

(*Continued from page* 816)

arm. Each end of the chassis is fitted with wooden life-guards.

L. Holman's entry, which takes the original form of a demonstration model of Walschaerts' locomotive valve gear, provides an excellent example of the educational value of a comparatively small Meccano Outfit when used for demonstrating principles of this kind. The connecting rod of the engine is reproduced in the model by a Strip mounted pivotally on a bolt that is secured in a 3" Pulley Wheel to represent the Crank Pin. The return crank rod, which operates the valve mechanism, is pivoted to the centre hole of a Meccano Crank that is fastened rigidly to the outer end of the crank pin.

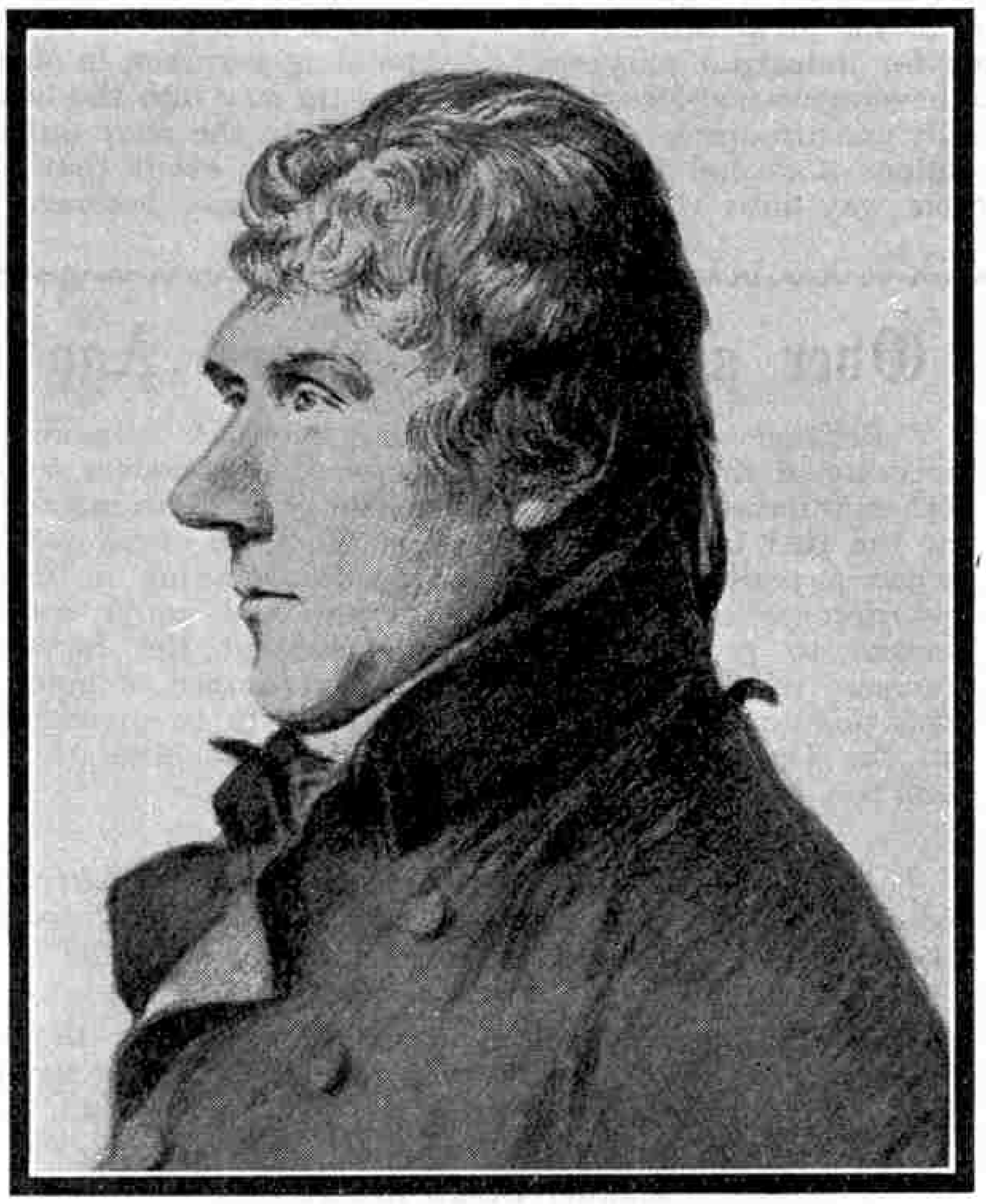
L. W. S. James and Stanley Jones both submitted designs for a Meccano pyrometer, an instrument for measuring the heat expansion of metals. In Stanley Jones' apparatus the metal bar to be heated is connected through a suitable gear train to a pointer moving over a graduated dial, while L. W. S. James uses a series of levers to multiply the very slight movement of the expanding metal.

Giving Away a Canal !

John Rennie's First Civil Engineering Work in England

All kinds of things have been given away at one time or another but surely no one has ever before offered to give away a canal ! Yet the Great Western Railway are offering the Kennet and Avon Canal as a free gift. All that is required on the part of the acceptors is that they can satisfy Parliament that they are suitable people to whom the responsibility could be transferred.

This canal that has fallen upon such evil days is of interest as being the first civil engineering work carried out in England by the great Scottish engineer John Rennie, whose career was described in the *"M.M."* for April, May and June, 1926. Rennie was consulted in 1792 respecting a canal to link up navigation between the Severn and the Thames. By 1794 plans had been drawn up, an Act of Parliament passed authorising the construction of the canal, and actual work begun.



John Rennie, F.R.S.

The Kennet and Avon Canal extends from Newbury where it leaves the river Kennet, a tributary of the Thames, and passes by way of Crofton, Wootton Rivers, Vale of Pewsey, Devizes and Bradford-on-Avon to Bath, joining the Bristol Avon just above the Old Bath Bridge. For 16½ miles from Newbury to Crofton the canal traverses the valley of the Kennet. At Crofton it rises 210 ft. by means of a flight of 31 locks to the summit level, where in the vicinity of Savernake it was found necessary to construct a tunnel 500 yds. in length approached by deep cuttings. On the western side of the summit level the canal descends 404 ft. by a flight of 48 locks.

Between Wootton Rivers and Devizes the bed of the canal had to be cut through chalk and sand, and great difficulty was experienced in forming a watertight bed. In the neighbourhood of Trowbridge a cutting had to be made along the surface of the steep and slippery hill. Even more serious trouble was encountered near Bradford-on-Avon owing to landslips, and on one occasion seven acres of land slid into the canal and forced the whole down into the river below. This difficulty was surmounted by carrying into the hillside an elaborate series of small tunnels and cross-drains. Below the canal various culverts, bridges and aqueducts had to be built.

The canal was completed in 1810 and in the following year was declared open for traffic. The total cost of the undertaking was £1,072,000.

As time went on and the importance of Bristol as the chief West of England seapórt steadily increased, the inland navigation from Bristol to London likewise became greater and the canal earned a handsome profit. The navigation was attended by certain difficulties, however. During the winter ice and floods were a frequent menace, while during the summer months low water in both canal and river was a source of considerable anxiety.

As the volume of traffic increased so did these difficulties become more serious, and finally the harassed traders began to consider the possibility of financing a railway to carry their goods with more speed and certainty to the London markets. This idea gradually obtained more and more support and on 19th August, 1833, it culminated in the formation of the Great Western Railway Company. Readers of the *"M.M."* are familiar with the construction of the G.W.R. under the brilliant superintendence of Isambard Kingdom Brunel. On 30th June, 1841, the railway was completed throughout its whole length and thus came into being a deadly rival to the Kennet and Avon Canal.

This new and speedier means of transport between Bristol and London was immediately successful and was accompanied by a steady decrease in the canal traffic. Within seven years of the opening of the railroad the profits of the canal had dwindled to little more than half the figure at which they stood in 1840. The canal continued to lose trade, and its proprietors, realising that sooner or later the competition of the railway would ruin them completely, decided to offer to sell the undertaking to the Great Western Company. The necessary authority for the transfer was granted by Parliament on the ground apparently that the struggle for trade between the railway owners and the canal owners had been conducted fairly. The canal undertaking was thereupon purchased by the G.W.R. for £210,000—less than one-fifth of the cost of its construction !

For twenty-one years after making their purchase the G.W.R. worked the canal as a carrying agency but the decline of traffic continued steadily and the owners found themselves heavy losers. To have improved the bed of the canal so that larger and better paying barges could use it would, it was estimated, have cost £2,167,000, which was appreciably more than the canal had cost to construct.

For many years past the Kennet and Avon Canal has led a life of almost pathetic quietude, and so far no decision has been made as to its future.

Of General Interest

Murder by Government!

The enforcement of prohibition in the United States has proved to be a matter of some difficulty owing to the great demand for alcohol and alcohol-producing materials for industrial purposes. To prevent this from being used as a beverage wood-alcohol is added to it, this material being theoretically unfit to drink. Nevertheless ten million out of the 90 million gallons of alcohol produced under Government supervision find their way into the hands of the boot-leggers.

This is the cause of the charge of "murder" that public men in the United States are bringing against the Government at the present time. It is impossible to eliminate the wood-alcohol completely from the industrial spirit, although the boot-legger no doubt does his best. Consequently, the boot-leggers' customer drinks a fair quantity of it, with extremely deleterious results, yet the Government continues to use this substance in spite of its knowledge of these facts.

The remedy, of course, is to find a material to mix with the spirit of such an obnoxious character that the drinking of industrial alcohol becomes impossible, but at the same time there must be no simple way of removing it. For some time now a chemical war has been raging between the Government and those carrying on the illegal traffic in spirits. The Government chemists have tried dozens of new substances and have always been compelled to fall back upon wood-alcohol, because the chemists employed by the boot-leggers were able to devise a simple method for removing the added material. The latest suggestion is to use a combination of evil-smelling and evil-tasting oils with wood-alcohol, and it is hoped that the use of this new compound will bring the trouble to an end with a victory for the Government.

Over a Hundred Years Ago!

"Petition against Steam Navigation—A numerous meeting of the merchants, shipowners, shipmasters, and others interested in shipping, was held on the 14th instant, at the Red Lion, on the Quay in the town of Swansea, when a petition, previously prepared, praying for the interference of Parliament to devise and adopt some means to protect sailing vessels against the further increase of steam vessels for the conveyance of goods, was unanimously adopted, and ordered to be presented to the House of Commons."—"LIVERPOOL MERCURY," 29th Dec., 1826.

The Author of "Ivanhoe"

"At Paris a great sensation was excited by the arrival of Sir Walter Scott, and half the nobility, and every literary character, have left their cards at his hotel."—"HANTS ADVERTISER," 6th Nov., 1826.

"Sir Walter Scott, it is reported, is shortly to be married to a lady of immense wealth, the maiden sister of the late Mr. Bruce, Printer to the King of Scotland."—"THE TIMES," 27th Sept., 1826.

Another Ocean Record!

"The steam-packet St. George sailed on Monday evening last for Dublin, at ten o'clock, and arrived at Kingstown Harbour at forty-five minutes past eight the following morning; thus making the passage in the short period of ten hours and forty-five minutes."—"LIVERPOOL MERCURY," 22nd Sept., 1826.

A Mixed Metaphor!

"The United States Telegraph gives the following extract from Mr. M'Duffies' speech:—'My father and grandfather both saw the darkness of midnight glitter on the blaze of their dwellings!'"—"LIVERPOOL COURIER," 26th April, 1826.

Protecting Wood from White Ants

The extent of the damage to timber in Australia due to white ants is enormous. No matter what kind of wood is used for building purposes, in nine out of ten cases this pest will eventually find its way into the heart of it and eat it out to such an extent that only the mere outside shell remains.

A tragic event that happened recently shows how dangerous this pest may become. As the Brisbane mail train hauled by two engines was crossing a small trestle bridge spanning a creek, the weight of the train caused the trestles to give way, one of the engines and a coach overturning into the creek. The coach was splintered to matchwood by its fall, five persons being killed and 30 more or less seriously injured as a result.

On examination, the timbers of the structure were found to be in a terrible state from the depredations of white ants, which must have been at work some considerable time. In the shell that the ants left there were holes several inches across, and apparently the weight of the second engine caused the collapse of the weakened trestles.

Until recently there seemed to be practically nothing that would eradicate the pest. According to the latest reports, however, a process has been discovered by an Englishman of the name of Powell, by which timber of all kinds can be preserved against this kind of pest. It is said that his idea originated in the fact that the wooden vats used in sugar refining do not decay.

The treatment is simple. The wood to be "Powellised"—for the process is named after the inventor—is placed in tanks of hot sugar solution. No pressure has to be used to make the sugar pass into the substance of the wood, and by this process the wood is completely protected against rot of any kind. When the wood has been sugared it can be dried in a kiln and is then ready for use.

The protection that the process affords against the ravages of insects should be of particular value in a country such as Australia, and hopes are entertained that it may solve the white ant problem.

What We Are Made Of!

Speaking at the Congress of the American College of Surgeons at Montreal recently, Dr. Allan Craig pointed out that the average human body of 10 st. 10 lb. contains enough lime to whitewash a hen-coop. In addition there is sufficient phosphorus to make 2,200 matches, a pinch of sulphur, enough sugar to fill a small basin, water, and iron sufficient for a tenpenny nail!

The value of these ingredients is about four shillings, but insurance companies estimate the economic value of a man at £1,000. Obviously brain is more valuable than brawn.

On the other hand, "*Homestead Marvel*," a famous Yorkshire terrier that has recently been sold to an American fancier, is worth £3-10s.-0d. per ounce. Which is this the price of, brain or brawn?

An Oak Tree with a History

In the centre of a business district in the town of Wewoka, in Seminole Country, Oklahoma, is a giant oak tree that was used by the Cherokees and later by the Seminoles as a whipping tree. Offenders against tribal regulations were tied to it, and hundreds of Indians and some white men suffered punishment under its branches. A proposal was made recently to cut it down, but the Indians protested so strongly that the tree was left unmolested.

Invisible Light Used for Television

Mr. J. L. Baird, the inventor of a well-known television system, has succeeded in modifying his apparatus in a remarkable manner so as to enable him to dispense with visible light at the transmitter.

Articles on television appeared in the "*M.M.*" last summer, and it was made clear in them that it is necessary first to translate light impulses into variations of an electric current by means of a photo-electric cell, and then at the receiving end to transform these variations back again into light. Until recently it was necessary to use very powerful lights at the transmitting end, but Mr. Baird has so improved his apparatus that the blinding glare of these lights can now be replaced by the invisible light rays described usually as infra-red. All sources of light give out these rays, and for this particular purpose the ordinary visible rays are cut out by the use of suitable screens.

The infra-red rays do not differ from ordinary light except in their effect on the eye and in having greater wave length, and therefore they will act on a photo-electric cell in exactly the same way as those formerly used by Mr. Baird. If the "subject" of the transmission be a human being, he will see nothing of these rays, but they will be reflected from him, and by their action on the cell will register his movements. The transmission of the wireless waves remains unaltered, as does their reception at the other end. It will thus be seen that there is no new principle involved, but only a very ingenious re-arrangement.

Various suggestions have been made already for the use of these rays for vision at night and in fogs, as they penetrate the latter more readily than do rays of ordinary light. In ordinary television as carried on at 2 T.V., Mr. Baird's station, the rays acting on the photo-electric cell are reflected from comparatively large objects close to the apparatus. For open field work, on the other hand, the reflected rays, presumably from a beam of invisible light projected by a searchlight, come from objects very far away, and consequently small in appearance.

The construction of apparatus to accomplish vision in such circumstances involves great difficulties, of which the greatest is perhaps the production of a photo-electric cell sufficiently sensitive to respond to the rays coming from small objects at a great distance. Mr. Baird says he has solved these various problems, however, and that he is able, for instance, to "see" an approaching airship at night through thick fog when it is completely invisible by any other means.

It is clear that the successful use of this new method would add enormously to the safety both of aircraft and shipping, while its value in warfare may safely be left to the imagination of the reader.

Visiting Big Game Haunts in Canada

Our photograph, which is reproduced by permission of the Canadian National Railways, shows lunch-time on the Blanc Bec Trails. The party are visiting trap lines and journeying through the woods under the organisation of the Canadian National Railways, who provide facilities for visitors who are desirous of spending their holidays in the Canadian forests. The parties visit the trap lines and big game haunts under the guidance of experienced trappers and woodsmen

Where You May See the Domesday Book

The Museum of the Public Record Office in London contains a wonderful array of treasures for those interested in antiquarian research. The exhibits not only include the Domesday Book, compiled under instructions of William the Conqueror at the end of 1085, but also such interesting documents as the log of H.M.S. "*Victory*," describing the battle of Trafalgar; a despatch from the Duke of Wellington, giving an account of the battle of Waterloo, and many ancient treaties, writs, etc., of great historical value and interest.

Speeding Up in Press Photography

In order to still further reduce the interval between the taking of a photograph and the production of the finished print, an enterprising photographer has conceived a means of turning his motor-car into a travelling development room. After having taken the photographs he hastens to his car, and whilst being driven home he gets to work on the subjects.

Opening out a cupboard that has been placed behind the driver's seat, he draws out a framework covered with an opaque cloth. Illumination is given by a darkroom lantern connected to the lighting circuit of the car. Within his cupboard-laboratory, and often whilst the car may be travelling at high speeds, the photographer is enabled to put to good use the time spent in travelling back to his studio.—"*English Mechanics.*"

Electricity in the Orchard

Electric lights to attract the moths away from the trees is the latest suggestion for helping the fruit-farmer. A number of lights hung low over pans filled with paraffin have been found to lure the moths from the foliage, and it was not long before the insects fell into the destructive pans below.

There is a large annual loss by fruit spoilage due to the activities of certain moths and it is hoped that this suggestion may help to combat the pests.

Interesting Link with Charles I.'s Physician

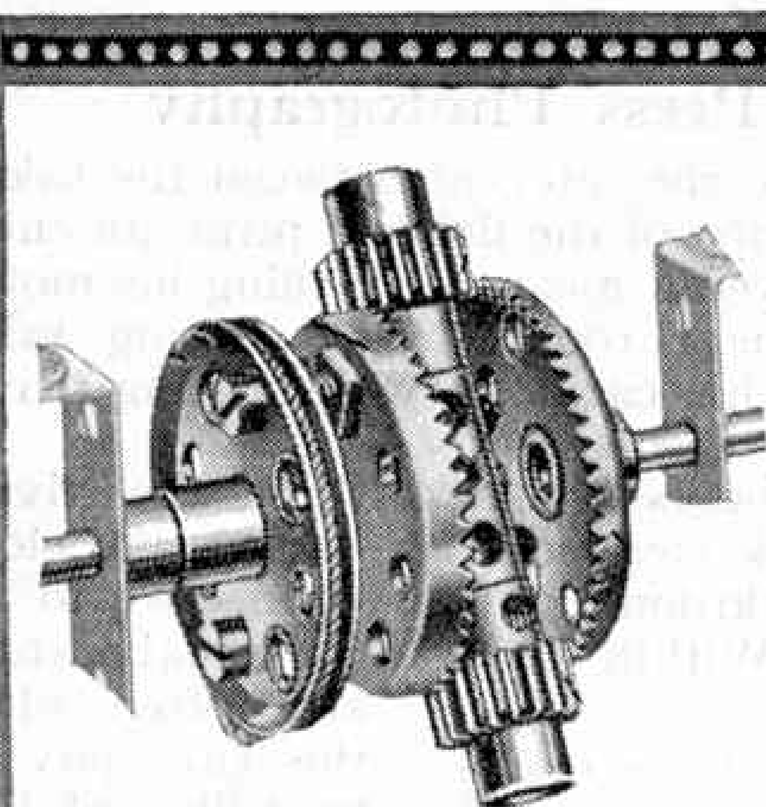
Some of our readers, whose friends possess microscopes, probably have been delighted at some time or another by seeing the wonderful spectacle of the blood circulating in the web of a frog's foot. The circulation of the blood was discovered by King Charles I.'s physician, Dr. William Harvey, a native of Folkestone. Dr. Harvey, although a renowned anatomist, never had the pleasure of witnessing the phenomenon under the microscope, for he died in 1657. It was not until 1661 that Malpighi traced the connection between the arteries and veins, and not until 1668 that Leeuwenhoek saw the actual circulation in the leg of a frog.

We heard recently that the circulation of the blood in the tail of a tadpole has been seen by a pupil at the Folkestone Grammar School (founded by Sir Eliab, Dr. Harvey's nephew), using a simple microscope made by himself.

Electric Trains Affect Greenwich Observations

The Astronomer Royal, Sir F. W. Dyson, states that the regular train service that began on 28th February 1926, on the electrified section of the Southern Railway, passes within about a mile of the Royal Observatory, Greenwich. The magnetic instruments were from that date so strongly disturbed that further observations were deemed useless and were discontinued. On 10th May 1926, additional sections of the line were brought into operation, and simultaneously disturbances to the magnetic instruments increased to an extent that made the continuance of records of little value. The complete electric train service will result in the discontinuance of magnetic observations at Greenwich. A new magnetic observing station at Abinger, near Dorking, Surrey, has, however, been in full working order since the beginning of 1925.

It appears that only remote sites in the country are of value for magnetic observatories now that electricity is coming so largely into use for locomotives and tramcars.



Epicyclic Gear Clutch Mechanism

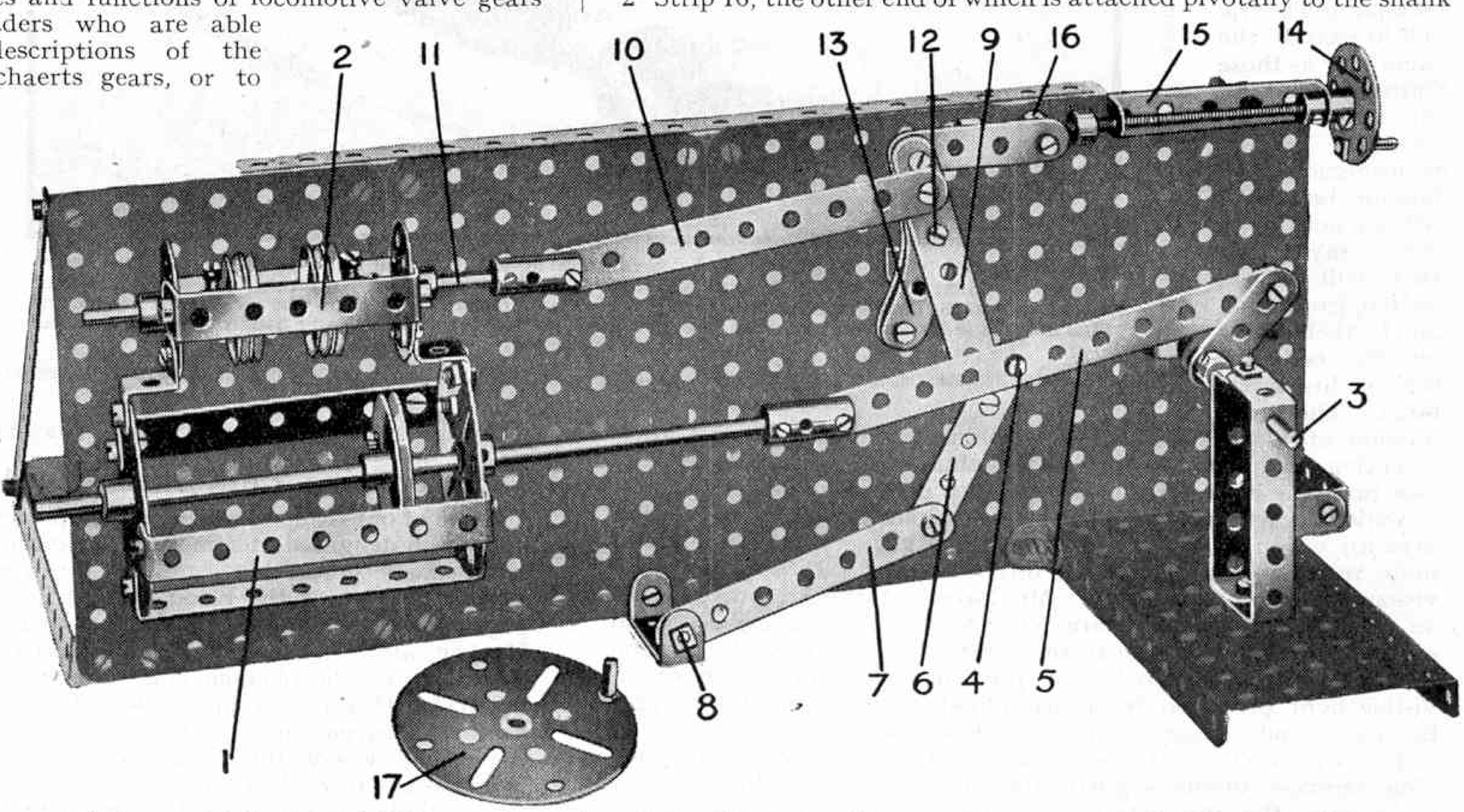
Suggestions Section

Edited by "Spanner"

(97)—Demonstration Model of Joy's Valve Gear

(C. P. Rawlings, Scarborough; G. D. Sweeney, Oakamoor, N. Staffs.; and G. V. Redfern, Two Dales, near Matlock)

ON previous occasions we have dealt with two of the most important types of locomotive valve gears, namely, Walschaerts' (see Standard Mechanism No. 277) and Stephenson's (Suggestion No. 58, October, 1926, "*M.M.*"), and we are able now to describe a Meccano demonstration model of Joy's valve gear. Joy's gear, although not so widely used as the two others mentioned, was extremely popular until quite recent times. It is of the type known as "radial valve gears," in which the valve movement is derived from the motion of the connecting rod and transmitted to the valve by means of levers. The chief advantage of the gear is the fact that no eccentrics are required and therefore more room is available for lengthening the journals of inside cylinder engines. The principles and functions of locomotive valve gears will be clear to readers who are able to refer to our descriptions of the Stephenson and Walschaerts gears, or to the article in the 1926 Hornby Book of Trains.



The operation of Joy's valve gear may be followed in the Meccano model (Fig. 97). The cylinder of the locomotive is represented at 1 by means of two Face Plates connected together by $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, one of which is bolted to the demonstration frame. The steam chest 2 consists of two Bush Wheels connected by $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, and is attached to the cylinder by means of two $\frac{1}{2}''$ Reversed Angle Brackets. The crankshaft, or driving axle of the engine, is built up from two Cranks mounted on the end of short Rods 3 and rigidly secured together at their outer ends by a $\frac{1}{2}''$ Bolt, on the shank of which the connecting rod 5 is pivoted. A $1\frac{1}{2}''$ Pulley takes the place of the piston and the 8" Rod to which it is secured forms the piston rod. The crosshead consists of a Strip Coupling.

The motion is derived from a point 4 in the connecting rod 5, at which point the connecting link 6 is attached pivotally by a bolt and two nuts (see Standard Mechanism No. 262). The lower end of the connecting link 6 is pivoted by the same means to an anchor link 7, which, in turn, pivots about a fixed point 8. It may be noted that the point 8 is the only fixed point in the gear. The valve lever 9 (a 3" Strip) is pivoted to a point in the link 6 just below the bolt 4, and at its upper end is bolted pivotally to the valve rod 10. One end of the latter is connected to the valve spindle 11 by means of a Strip Coupling. The piston valves are represented by two pairs of 1" Pulley Wheels butted together and secured to the valve spindle in the positions shown. A bolt 12 passed through the lever 9 is secured rigidly by means of two nuts to an Eye Piece representing the quadrant block, or die, which slides in a curved guide, or quadrant, consisting of two $2\frac{1}{2}''$ large radius Curved Strips 13. These Strips are secured at top and bottom by $\frac{3}{8}''$ bolts and are spaced apart by two Washers on each bolt to allow room for the Eye Piece to slide freely on the outer Curved Strip. The centre hole of the inner Curved Strip of the quadrant is attached pivotally by bolt and nuts to the centre of a Double Bent Strip secured to the supporting framework.

The quadrant may be rocked about its pivot on operation of the reversing handle 14. The latter is secured to a $4\frac{1}{2}''$ Threaded Rod that is journalled in the Double Angle Strip 15 and carries near its other end a Threaded Boss, in the transverse bore of which the shank of a bolt is free to turn. This bolt is fastened rigidly in the end of a 2" Strip 16, the other end of which is attached pivotally to the shank of the $\frac{3}{8}''$ bolt at the top of the quadrant. Collars are secured to the Threaded Rod to prevent the Threaded Boss being moved too far in either direction on rotation of the handle 14.

In our illustration the gear is in mid-position, with the quadrant 13 placed vertically. In this position a minimum movement of the valve takes place and each port of the cylinder is opened by an amount equal to the lead of the valve.

In order to place the engine into full fore-gear the reversing handle is rotated so that the Threaded Boss 16 moves towards the cylinders, thereby inclining the quadrant 13 in the same direction. The engine will now run forward and the valves will be opened to their fullest extent, admitting a maximum amount of steam for each stroke of the piston. Any intermediate position between these two may be used and the "cut-off" thereby varied, i.e., the amount of steam supplied for each movement of the piston diminished or increased. To reverse the engine, the handle 14 is turned in the opposite direction and the quadrant 13 inclined backward. This has the effect of reversing the order in which the valves are opened. The hand wheel 17 may be secured to the end of the crankshaft 3 and used to operate the model.

(98)—Improved Differential Gear

(James B. Rudd, Glen Innes, N.S.W.)

In essentials the differential gear shown in Fig. 98 closely resembles Standard Mechanism No. 251, but it embodies important improvements in the layout of the gear, with the result that an important saving in space is obtained. When used in model motor cars, etc., the improved arrangement has the effect of bringing the gear more nearly in the centre of the axle, which is very desirable.

The two portions of the axle 1 and 2 are inserted in opposite ends of a Coupling 3, and a ¾" Contrate Wheel 4, 5 is secured to each portion. These Contrate Wheels engage with two ¾" Pinions 6 and 7, which are free to turn about a 2" Rod secured in the centre transverse bore of the Coupling 3. It should be noted that a Washer is placed between each Pinion and the Coupling to obtain the correct spacing.

The outer ends of the 2" Rod are passed through 1"×½" Angle Brackets bolted to opposite holes of a Bush Wheel 8. The latter is free to revolve independently about the axle 2, and is connected rigidly by two 2" Threaded Rods to a 1½" Contrate Wheel 9 that is free to turn on the axle 1. One of the 2" Threaded Rods is shown in the illustration; it is secured to the Contrate Wheel, as to the Bush Wheel, by two nuts secured one on each side of the wheel. Two Washers should be placed between the Contrate Wheel 9 and the boss of the ¾" Contrate Wheel 4.

The propeller shaft is journalled as shown in a 2½"×1½" Double Angle Strip and the drive is transmitted to the 1½" Contrate Wheel 9 by means of the ½" Pinion 10. Care should be taken to see that the various parts work quite freely, and a little oil should occasionally be applied to the gear teeth and bearings of the Rods, etc.

The functions of differential gear will be clear on reference to S.M. No. 251, or to the article on "Motor Car Differential Gear" that appeared in the "*M.M.*" for April, 1927.

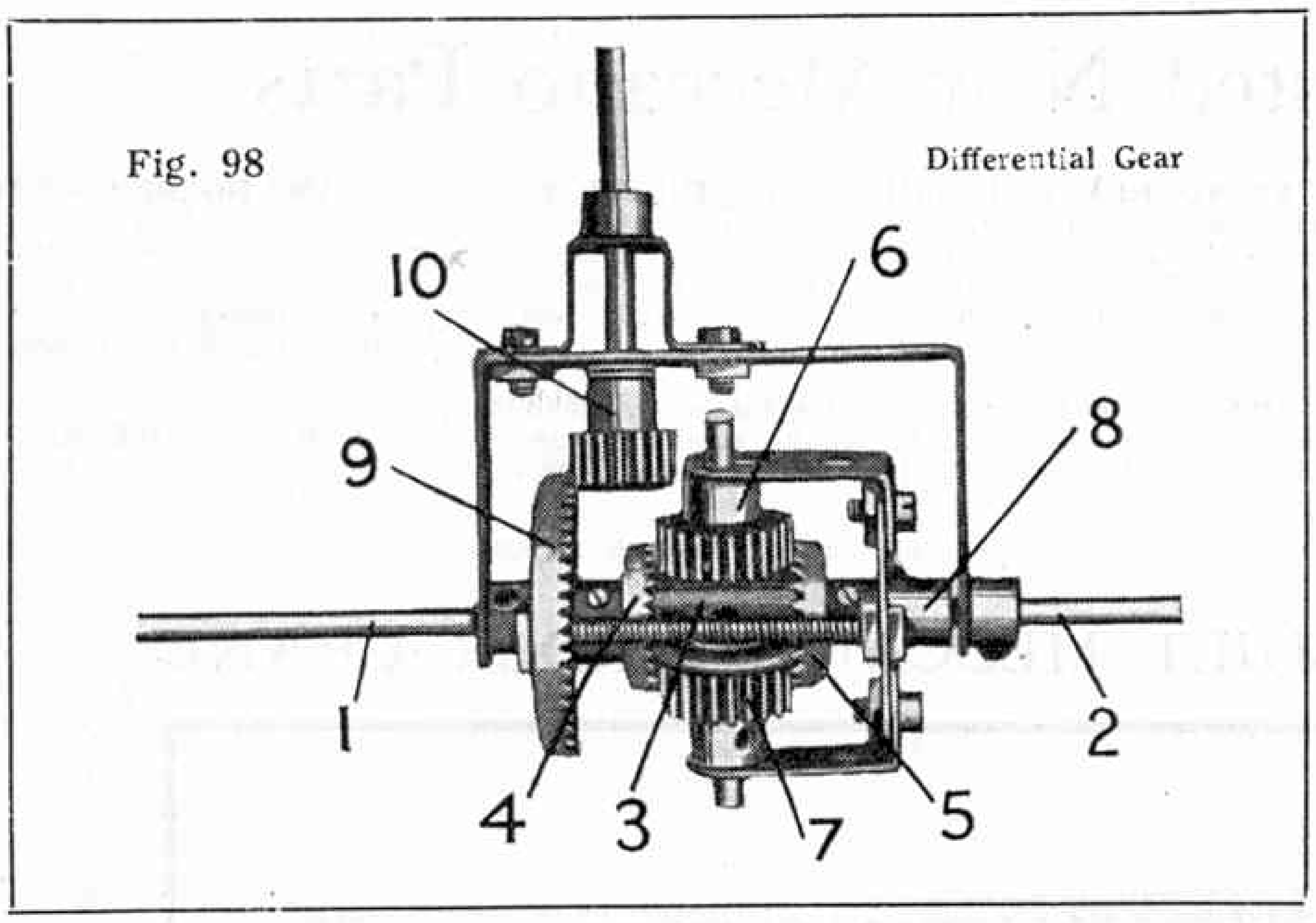


Fig. 98 Differential Gear

(99)—A Tent Pole Clothes-Hanger

Readers who make a practice of camping out, and particularly those who are Scouts, will be interested in the very useful device shown in Fig. 99. The object of this is to provide a set of hooks that may be clamped to the tent pole or any convenient rounded post and on which clothes, lanterns, and other camp "kit" may be hung. An accessory of this kind will be a great help towards tidiness and efficiency in any camp.

It is built up from two 3½" Strips carefully bent to semicircular form and bolted to a Meccano Hinge 1. The best way to bend the strips is to hold them against some rounded object, such as the edge of a 3" Pulley Wheel, and tap gently and continuously with a mallet. One of the 3½" Strips is bolted to a 1½" Strip (overlapped two holes) and in the end hole of the latter is secured a Threaded Boss 2. The transverse bore of the Boss is engaged by a 2" Threaded Rod 3, which passes through a 1"×½" Angle Bracket 4 bolted to the second hole of the other 3½" Strip.

Supporting the Tent Lantern

The arm 5, which is intended to support the tent lantern, is mounted on the Threaded Rod 3 and is built up from two 5½" Strips bolted one on each side of a Corner Bracket 6. The construction of the four shorter arms will be clear from the illustration.

By rotating the ½" Pinion 7, which is secured rigidly to the Threaded Rod 3, the device may be adapted to poles of varying thicknesses. In order to remove it altogether from the pole, the Threaded Rod must be withdrawn from the Boss 2.

It will be noted that Washers are placed under the heads of bolts inserted in the 3½" Strips; this is to ensure that their shanks shall not protrude too far beyond the nuts and thereby prevent the clamping of the device close against the pole.

Contributions for the "Suggestions Section" are invited. If possible they should be accompanied by clear drawings or photographs, and the envelopes should be addressed to "Spanner." Special awards are given each month for all suggestions published in the Section.

Miscellaneous Suggestions

Under this heading "Spanner" replies to readers who submit interesting suggestions regarding new Meccano models or movements that he is unable to deal with more fully elsewhere. On occasion he offers comments and technical criticisms that, he trusts, will be accepted in the same spirit of mutual help in which they are advanced.

(M.6). **Meccano Water Motor.**—Suggestions have been advanced from time to time concerning the construction from Meccano parts of a motor to work by water power, but we find that such models are not very popular, principally for the following three reasons: (a) they are too "messy" in operation; (b) the parts used in their construction quickly rust; and (c) the power developed is relatively small. Incidentally we may remark that great loss of power would result in your proposed motor, but its efficiency could be increased by cutting down the existing alternative outlets by means of which the water can escape before performing its work on the vanes of the wheel, and by increasing the number of these vanes. *(Reply to C. Israel, London, E.8, and others).*

(M.7). **Non-slip Belt Drives.**—"When using a cord or string drive between pulleys in Meccano models, the string often becomes slack and tends to slip round the pulleys. A simple remedy for this is to connect the ends of the string by means of a small piece of elastic or Spring Cord, which keeps the string always taut." This is an excellent plan and one that, we think, other readers may care to adopt. Of course, for short drives where only light power is required the ideal method is to replace the string driving band entirely by Spring Cord. *(Reply to Alfred Proctor, Chingford, London, E.4).*

(M.8). **Screw-operated Brake.** — "A suitable hand-wheel is secured to a shaft carrying a Worm that engages with a Gear Wheel on a secondary Rod. On the latter Rod is secured a Crank, to the outer end of which is tied a length of cord that passes round a Pulley mounted on a further shaft. Rotation of the hand wheel increases or diminishes the grip of the cord about the Pulley, thereby controlling the speed of the shaft to which the Pulley is secured." This would undoubtedly form an efficient and easily adjustable brake, but it is similar in principle to Standard Mechanism No. 85. Of the two methods of construction, the latter (i.e., S.M. 85) is more economical in the use of Meccano parts. *(Reply to Eric Hall, Ripley, Derby).*

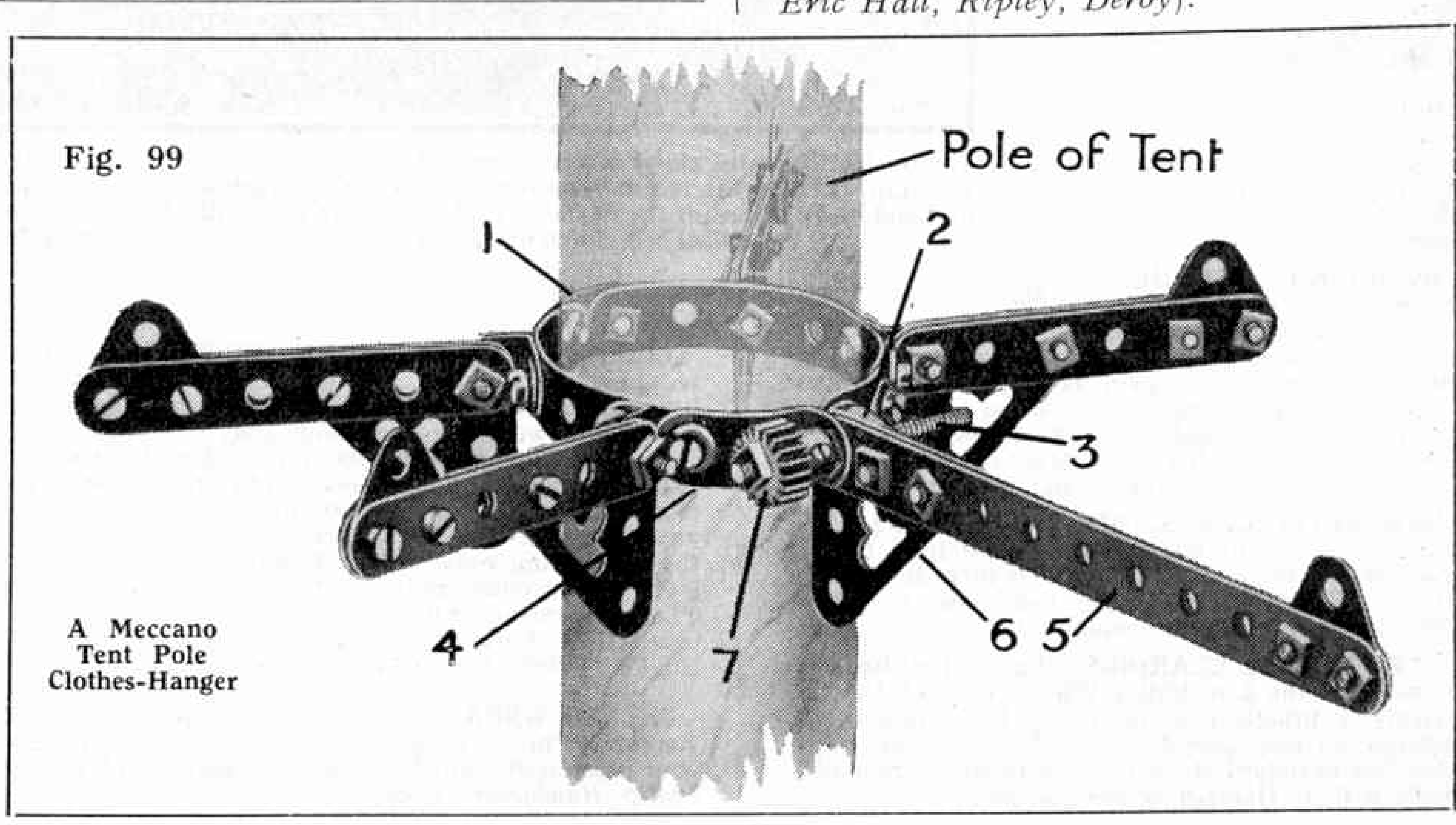
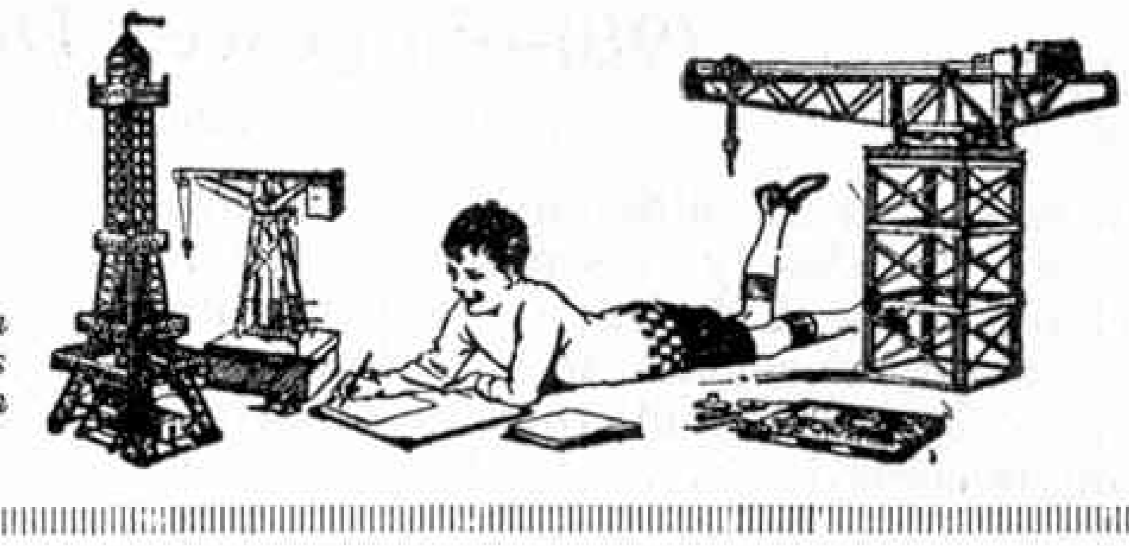


Fig. 99

A Meccano Tent Pole Clothes-Hanger

In Reply



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

Suggested New Meccano Parts

HUB FOR CART WHEELS, ETC.—We are interested in your proposal concerning a wheel hub designed to secure six or eight Axle Rods in radial formation to act as spokes of a large wheel. This would be a very difficult and expensive part to manufacture, however, and we doubt whether your idea can be put into practice. The 3" Wheel (part No. 19) should prove suitable for most models where spoked wheels are required. *(Reply to J. Jones, Ascot Vale, Victoria, and Philip Hambleton, London, N.W.6).*

EYE PIECE WITH BOSS.—In response to many requests we have decided to add a boss to the existing Eye Piece in the near future. Several uses for this new part will readily suggest themselves to Meccano model-builders. A further announcement on the subject will appear in the near future. *(Reply to C. Harper, Sydney; B. Timms, London, S.E.; J. Ralphs, Bournemouth; E. Jackson, Newcastle; F. E. C. Early, Torquay; and many others).*

IMPROVED CRANKSHAFT.—We regret that practical considerations make it impossible to manufacture the Crankshaft in two parts designed so that they may be joined at the centre by a screw and socket arrangement. The diameter of the standard Axle Rods is not sufficient to allow of an internal thread being tapped longitudinally. Built-up crankshafts are fairly easy to assemble from existing parts and an example of this form of Meccano construction is shown in the Standard Mechanisms Manual (see detail No. 274). *(Reply to J. P. Smith, Birkdale, Southport).*

RUBBER WASHERS.—Rubber washers might serve to protect the enamel of the new Meccano coloured parts against scratching but we have not found any special protection necessary. The enamel used is of the highest grade and is capable of withstanding a lot of hard usage. *(Reply to A. Nichols, Darlington).*

WINGS FOR AEROPLANES.—Wings for aeroplanes can be built up from existing parts without any difficulty and we do not think the introduction of a special part would be popular. *(Reply to B. Smith, London, S.E.9).*

IMPROVED LOADED HOOK.—Several requests for the introduction of an improved Loaded Hook have been received and we intend to introduce as soon as possible a new part arranged so that a Strip can be bolted to each side of the existing lug. *(Reply to S. Thompson, West Hartlepool; F. Green, Llandudno; G. Malcolmson, Kettering; T. Proud, Stratford-on-Avon; and many others).*

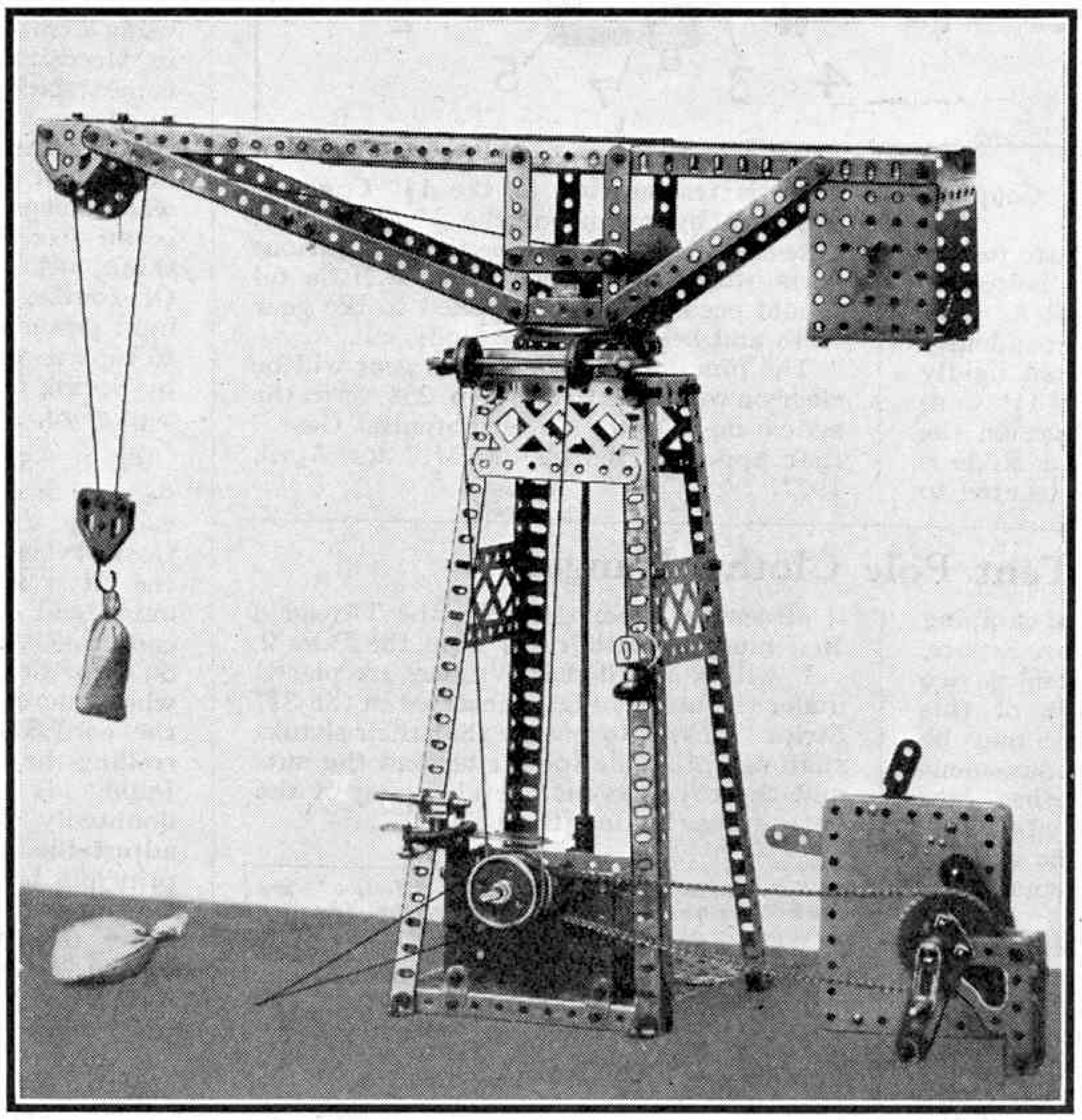
NEW BEVEL GEARS.—Many suggestions for new sizes in Bevel Gears have been received from time to time, and we hope to adopt some of them in the near future. *(Reply to T. Hunger, Bethlehem, S. Africa, and J. R. Grimsdell, Weymouth).*

LARGER BALL BEARINGS.—Larger Ball Bearings for use with the 6 in. Pulley Wheel and Hub Disc are scarcely a practical proposition. For large swivel-bearings we recommend the use of wheels or roller-races (see Standard Mechanisms Manual, Section VII). *(Reply to C. L. Horsden, Mount Evelyn).*

STANDARDS FOR BRIDGE CONSTRUCTION.—There are few advantages that would accrue from the introduction of standards for use in connection with bridge-building. Suitable standards for this purpose can readily be assembled from the existing parts. *(Reply to T. Hunger, Bethlehem, S. Africa).*

SMALL TYRES.—We shall give further consideration to your proposal regarding rubber tyres to fit the 1" Pulley Wheels. *(Reply to B. B. Lee, London, S.W.1).*

A WELL-BUILT MECCANO GIRDER CRANE



The model illustrated above secured a special Certificate of Merit for Tony MacLachlan, aged 12, of Dunedin, N.Z., in the recent Meccano "Crane" Competition. The model can be operated either by hand or by means of the Clockwork Motor shown in the illustration. It is fitted with a spring-controlled belt clutch of similar design to Standard Mechanism No. 18a

CONNECTING-ROD END BEARINGS.—We cannot see our way clear to introducing special units to form end bearings for connecting rods in steam engines, etc. Such parts would be applicable only to models of a certain size and we consider it is preferable in every case to build up the connecting-rod and its bearings from existing parts so that it can be designed to suit any particular model. Where Axle Rods are used as the connecting rods, either couplings or Fork Pieces will form excellent end bearings. A good example of a big end bearing for use in connection with the Meccano Crankshaft (Part No. 134) was shown in Suggestion No. 78. *(Reply to O. P. Hart, Stevenage).*

MILLED KNOB.—We think you will find that a Meccano Pinion forms an excellent substitute for your suggested milled, or knurled knob. *(Reply to Philip Hambleton, London, N.W.6).*

LAMP HOLDER.—A lamp holder to take standard pocket lamp bulbs is already included in the Meccano system (Part No. 310, price 3d.) Although the design of this part differs somewhat from your suggested accessory, we think that it will be found more satisfactory in many ways. *(Reply to J. Wray, Remuera, Auckland, N.Z.)*

LARGER BUFFERS.—We have noted your suggestion regarding the manufacture of special spring buffers for use in Meccano models. We fear, however, that if constructed on the same scale as the majority of Meccano locomotives and similar models, these parts would prove somewhat expensive to manufacture. As previously pointed out in these columns, a realistic representation of a buffer can be obtained by securing a ½" or 1" Pulley Wheel to an Axle Rod, the latter being slideable in its bearings and controlled by a small compression spring. *(Reply to E. Parker, London, N.W.8).*

FLANGED TRIANGULAR PLATES.—The addition of a flange to the 2½" Triangular Plate has been suggested on previous occasions, but the proposal has so far received little support. We are unable to discover any particular advantages to be obtained from such an alteration; moreover, the new part would not be suitable in many cases where the existing flat Triangular Plate proves extremely useful. *(Reply to P. Pottier, Purley, Surrey).*

NEW PROPELLERS.—We are giving careful attention to your suggestions regarding larger propeller blades and new 4-blade propellers, etc. We hope to make certain improvements in this connection in the near future. *(Reply to G. F. Simpson, Dover; F. Holt, Torquay; and S. Grant, Newcastle).*

SMALL PINIONS.—We are interested in your suggestion regarding the introduction of pinions having the same width of tooth-face as the Gear Wheels. In many ways, however, such parts would not prove so efficient in operation as the existing pinions, and the narrowness of the engaging surfaces would allow very little margin for the necessary play of the axles in their bearings. *(Reply to D. H. Williams, Ipswich).*

NEW SHIP'S FUNNEL.—We note your suggestion regarding the introduction of an improved ship's funnel. We are already experimenting with new parts of this type. *(Reply to S. Conway, Yarmouth).*

PULLEY BLOCKS.—We are considering the possibility of introducing special pulley blocks, complete with two or three sheaves, for use in Meccano cranes, etc. A further announcement concerning them will appear shortly. *(Reply to S. E. Sinclair, Windsor, and J. Cameron, Edinburgh).*

CIRCULAR SAWS.—Many suggestions have been received concerning the introduction of miniature saws for use in Meccano machine tools, etc., and we are at present experimenting with the object of introducing a special circular saw that can be secured to the standard Axle Rods and thus incorporated in numerous models. *(Reply to O. P. Collins, Richmond).*

Suggested Hornby Train Improvements

SHUNTERS' POLES.—Miniature poles of the type used by shunters in coupling and uncoupling moving wagons would scarcely be suitable accessories for the Hornby System. When required it should be quite easy to manufacture this accessory from a scrap of wood and a piece of bent wire. (*Reply to N. E. Woods, London, S.W.18*).

WHEEL FLANGES.—We were interested in your suggestion regarding the wheel flanges of Hornby rolling stock. While we are unable to say whether the present flange will be altered, we will keep your suggestion in mind. (*Reply to Colin Outtrim, Melbourne*).

AUTOMATIC COUPLING FOR ROLLING STOCK.—The introduction of a system of coupling and uncoupling wagons automatically would certainly add interest to the Hornby system, but we fear that it would prove somewhat complicated and expensive. However, we shall bear the idea in mind. (*Reply to B. Herbert, Sunderland*).

TRACK FENCING.—We note your suggestion to the effect that convenient lengths of fencing, similar to that used on the stations, should be available for fencing in the railway track. We shall give further consideration to this proposal. (*Reply to L. J. Cato, London, N.16*).

SOUTHERN COLOURS.—The question of introducing engines and other rolling stock in the livery of the Southern Railway has been raised by many enthusiasts and we are keeping a careful record of all suggestions received on the subject. (*Reply to E. S. Milk, Hanworth; H. J. Welch, Weston-super-Mare; W. H. Crowhurst, Surbiton; H. W. Jacomb, Godalming; M. Rowlett and C. Wood, Gillingham; M. W. Neville, Reading; W. R. Tomkins, London, S.W.16; D. Gilbert, Guildford; E. L. Killick, Tonbridge; J. Masters, Cheltenham; M. English, London, S.E.3; J. Archer, Poulton-le-Fylde; W. A. Fox, London, S.E.25; F. Reynolds, London, S.W. 11; S. Wilcox, Sherbourne; S. Bruce, York; A. Nicholls, Tenterden; and others*).

PRIVATELY-OWNED WAGONS.—Suggestions regarding privately-owned goods wagons have been received at different times but their number does not indicate that these accessories would be very popular. Nevertheless, a careful note is being kept of all readers who support the idea. (*Reply to T. F. Dyer, Felsted, Essex; R. Bryant, Aberdeen; and J. Bompas Smith, West Didsbury, Manchester*).

NEW GOODS SERIES.—We do not consider that models of French goods trains would meet with general demand. The Riviera "Blue" Passenger Set is only included in the Hornby series owing to the fame of its prototype. (*Reply to E. B. Moss, Bromley, Kent*).

NEW BRIDGES.—We are unable to consider at present the introduction of the various types of bridges that you suggest, as these would prove very costly and difficult to manufacture. Moreover, a large number of Hornby enthusiasts prefer to construct accessories of this kind from Meccano parts, for they are then able to design them to exactly suit their individual requirements. A glance through any Meccano Manual of Instructions will discover numerous bridges that are suited for use in connection with Hornby railways, and others have been illustrated in the "*M.M.*" from time to time. (*Reply to P. Stephenson, Newcastle-on-Tyne*).

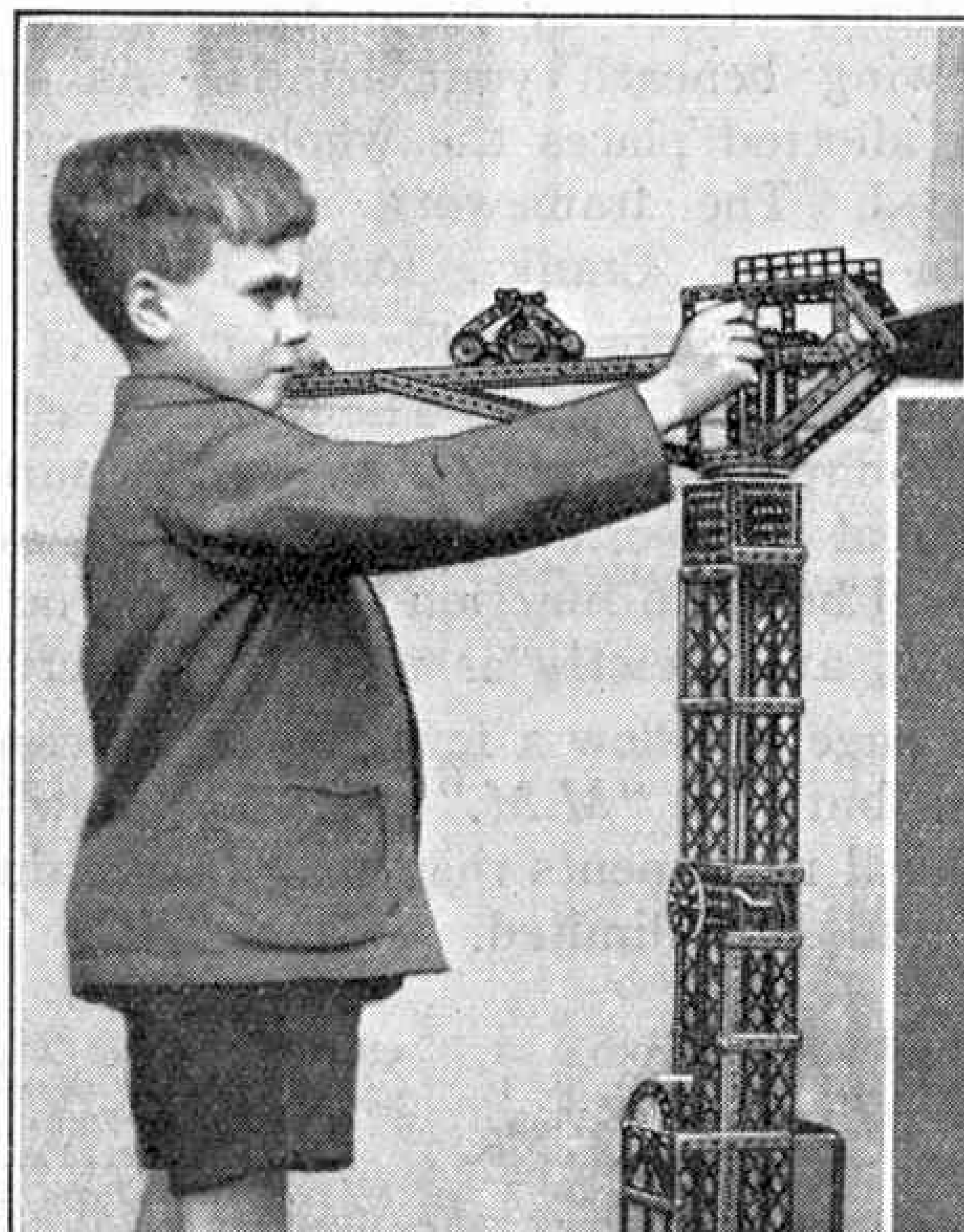
"FAIRLIE" TYPE LOCOMOTIVE.—We fear that the cost of manufacture of a locomotive of this type would prove prohibitive. (*Reply to B. E. Smith, Dunstable*).

LIGHTING ELECTRIC TRAINS.—We regret that the inclusion of small accumulators in the electric trains to maintain illumination of the coaches while the engines are stationary is not practicable, owing to the size and weight of the accumulators and many technical difficulties. (*Reply to J. Willmet, Yeovil*).

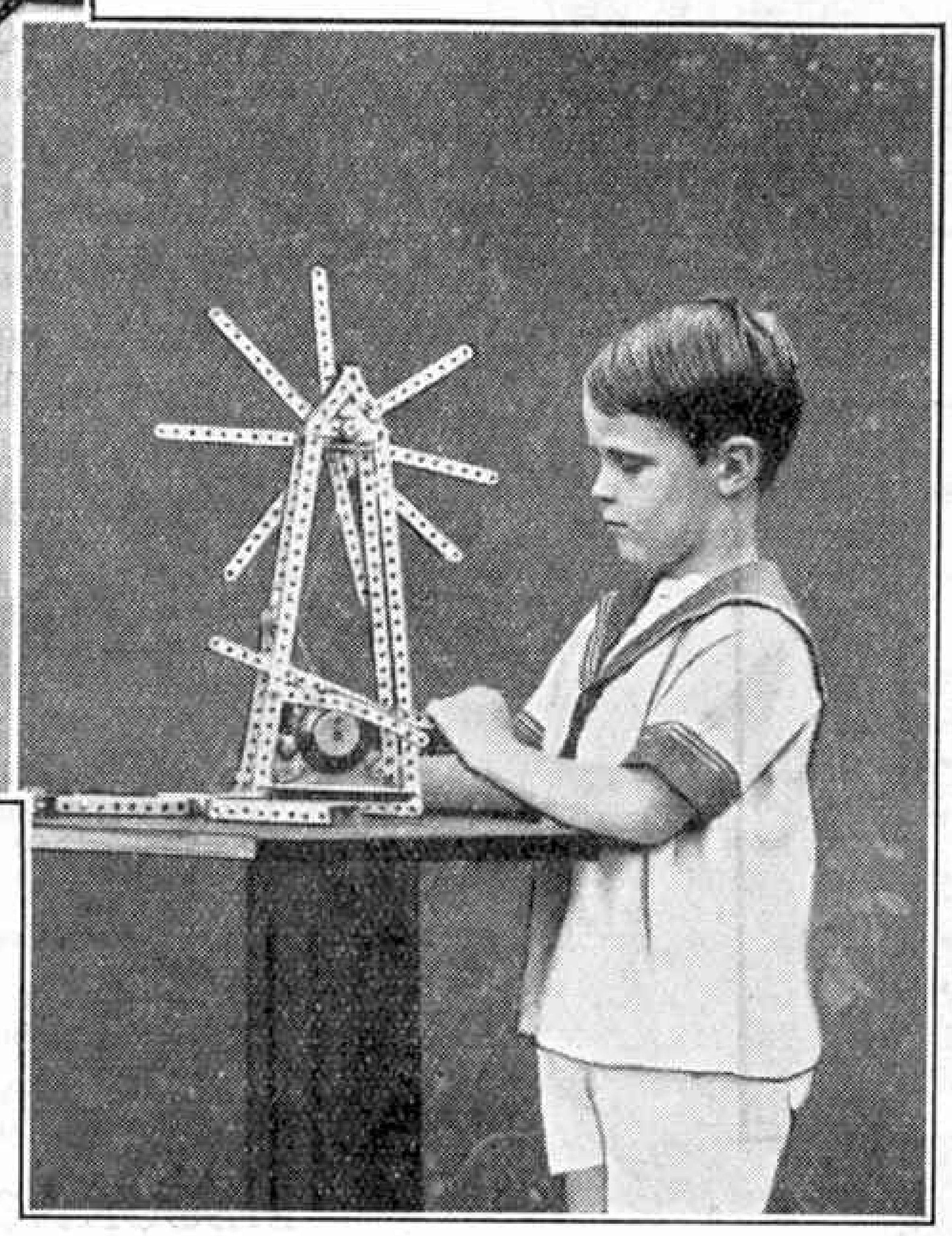
IMPROVED GUIDE BRACKETS.—We are considering the possibility of adding further holes to the Hornby Control Guide Bracket. We think this alteration should facilitate the erection of complicated rodding mechanism. (*Reply to G. J. Simpson, Dover, and S. Lucas, Malvern*).

NEW STATION.—The numerous suggestions received regarding the manufacture of a small wayside station, in addition to the existing "Windsor" Station, are receiving careful attention and we hope to make a further announcement on the subject very shortly. (*Reply to G. Cameron, Edinburgh; A. Simons, Bristol; and many others*).

MECCANO AT HOME AND OVERSEAS



Although more than ten thousand miles separate these two Meccano boys their interests are identical, as the camera clearly demonstrates. On the left is John Andrews, of Gillingham, Kent, who is already an experienced Meccano and Hornby enthusiast, and—



—on the right is Spencer G. Cottrell, who lives in Napier, New Zealand. John is 7½ years of age and is seen at work on an elevated radial crane of excellent design, while Spencer is shown in the act of testing a model windmill that he built before he was five. Both boys show promise of rising high in Meccano fame before they are very much older

"ATLANTIC" TYPE LOCOMOTIVES.—The conversion of the No. 2 Hornby Locomotives to the "Atlantic," or 4-4-2, type by the addition of pony-trucks would not constitute any important improvement, but would tend to increase the cost of each locomotive considerably. We were interested in your description of the method by which you made this alteration, however, and we think you will be interested to hear that the small wheels used in the leading bogies of the No. 2 Locomotives may now be obtained separately, price 4d. per pair (mounted on axle). These wheels may prove useful to you. (*Reply to S. E. Sinclair, Windsor*).

IMPROVED HOPPER WAGON.—We shall give further consideration to the merits of your suggested improvement in the unloading mechanism of the Hopper Wagon, by means of which the contents of the wagon would be discharged through a sliding bottom in preference to the existing lever and hinged-flap arrangement. At present we cannot see that any advantages would accrue from adopting the alterations you suggest. (*Reply to R. Roberts, Ilkley*).

WIDER TUNNELS.—We are interested in your proposal regarding a tunnel of sufficient width to take two parallel lines. Several ideas regarding improvements to the present Hornby Tunnel have been received and the whole question is receiving careful attention. (*Reply to R. Blackburn, Wavertree, Liverpool, and C. B. Fox, Warrington*).

FURNITURE FOR COACHES.—The idea of introducing miniature furniture in the Hornby Pullman Coaches, etc., is certainly novel. We consider, however, that these accessories would be purely ornamental, and that they would scarcely justify the increase in the cost of production that their introduction would incur. (*Reply to W. G. Morris, Worcester*).

RAIL TRANSPORT WAGONS.—We note your proposal regarding a flat truck designed for the transport of rails and resembling the wagon used by permanent-way gangs. We would point out, however, that the No. 1 and No. 2 Lumber Wagons or the Trolley Wagons are suitable for this purpose; indeed, the suggested accessory would closely resemble these vehicles and we doubt, therefore, whether it would prove popular. (*Reply to E. F. Graham, Melbourne, Victoria, and D. Ely, Christchurch, N.Z.*)

IMPROVED LOADING GAUGE.—We have noted your proposal regarding a slight alteration in the design of the Hornby Loading Gauge. We hope to introduce a revised model of this accessory in the near future. (*Reply to C. Hewitt, Chester*).

No. 1 CONTROL LOCOMOTIVES.—The Hornby No. 1 Locomotives and No. 1 Tank Locomotives may now be obtained fitted with special mechanism for Hornby Control. The prices of the new locomotives are 16/- and 15/- each respectively. (*Reply to F. Holt, Torquay; S. Grant, Newcastle; and many others*).

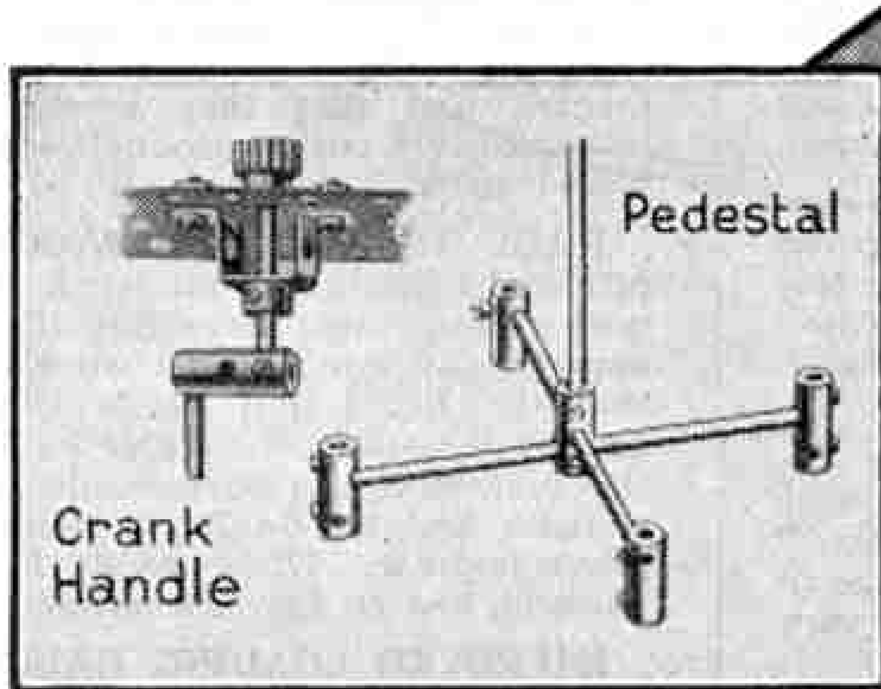
BUFFERS FOR SERIES "M" LOCOMOTIVES.—We note your suggestion regarding the addition of buffers and other fittings to Series "M" Hornby Locomotives, but we fear that alterations of this kind would tend to increase considerably the cost of production. The Series "M" trains were introduced principally to cater for the younger Hornby enthusiasts and for those who wished to include small suburban services in their model railways, and our main consideration when designing the trains was economical construction. It was only by keeping this end always in view that we were able, after much experimental work, to introduce a complete passenger train set at the modest price of 7/6. (*Reply to H. Nicholls, Tenterden, Kent*).

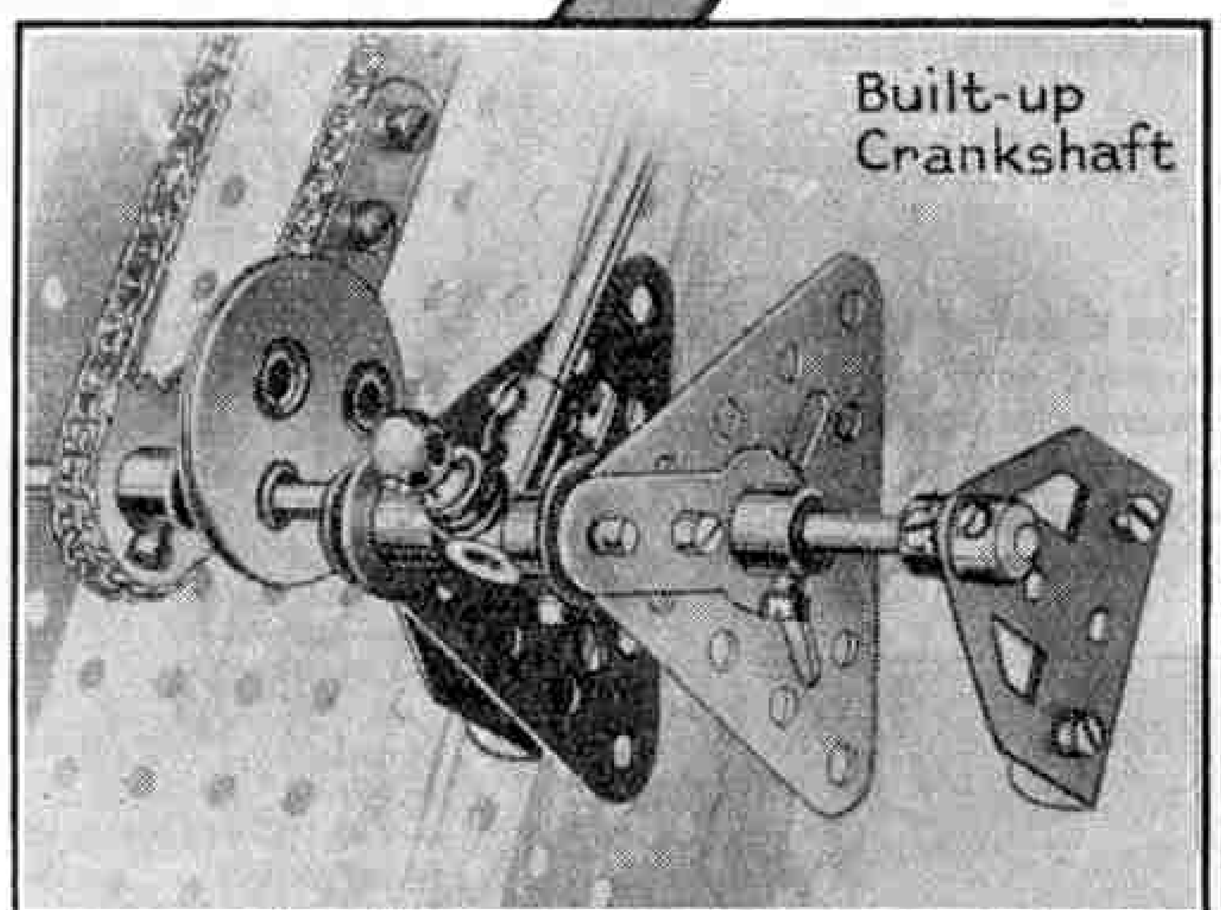
NEW CONTROL RAILS.—Your suggestions regarding various alterations in the design of the existing Hornby Control Rail has been noted. We may mention that two different Control Rails are now available. The first (No. 1) is 15 ins. in length and is intended for use in connection with all No. 1 Hornby Locomotives that are fitted with the special control mechanism (see our reply under the heading "No. 1 Control Locomotives," above). The price of this rail is 2/-. The No. 2 Control Rail is 20 ins. long and may be used to control all No. 2 Hornby Trains, including the No. 2 Riviera "Blue" locomotive, and the No. 3 Metropolitan engine. The additional 5 ins. in the length of the rail are necessary because the No. 2 engines require a greater length of track in which to come to a stand-still after the brakes are applied. The price of the No. 2 Rail is 2/3. (*Reply to S. Smitheram, Canterbury, and C. B. Fox, Warrington*).

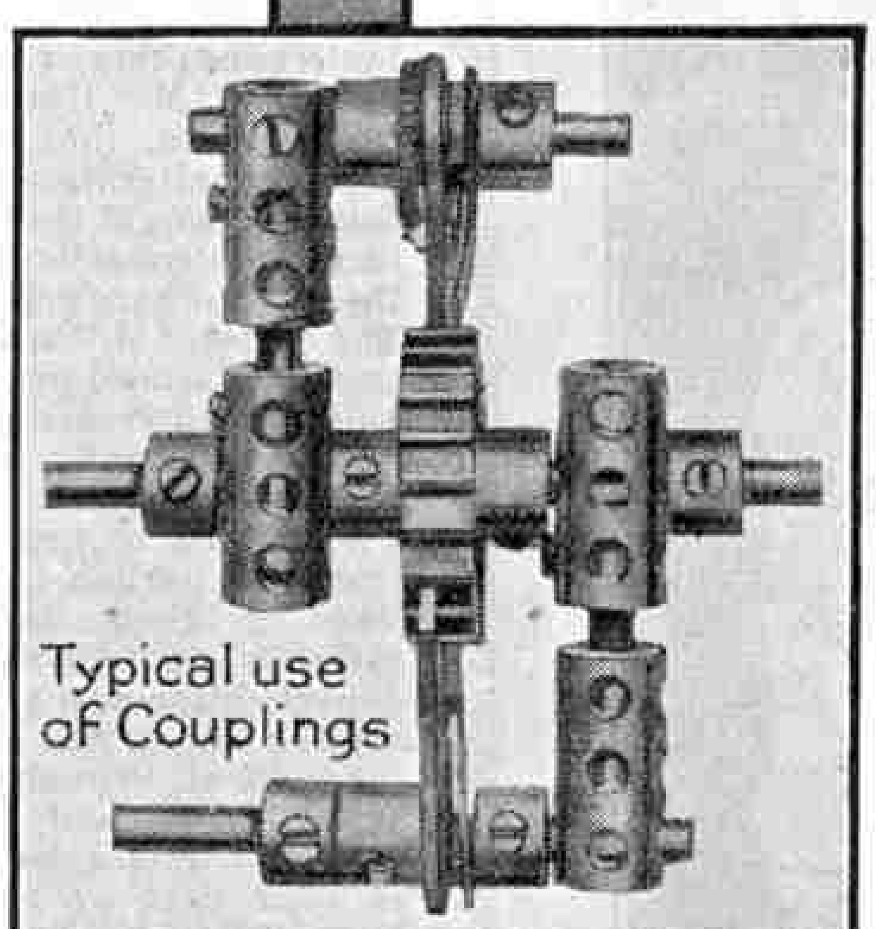
HYDRAULIC BUFFERS FOR ROLLING STOCK.—We regret we are unable to consider your proposal regarding the addition of hydraulic buffers to locomotives and other rolling stock, as this would be contrary to actual practice. (*Reply to J. H. Smith, Shoreham*).

LEVEL CROSSING FOR SINGLE RAIL.—We do not consider that a single-line level crossing would meet with much demand. Nevertheless, we are considering your suggestions. (*Reply to J. W. Pearson, Halifax; R. Porter, Southsea; R. C. Penoyne, Barnbury; and M. English, London*).

MECCANO — ENGINEERING IN MINIATURE







MECCANO ACCESSORY PARTS

Cranks, Couplings, etc.

CONSTRUCTING a Meccano model is a fascinating pastime. Piece by piece, you are able to watch it growing beneath your hands. As the Strips fall into their allotted places the whole structure is gradually strengthened. The framework completed, you add the mechanism—Gears, Cranks, Rods, Pulleys, Cords, etc.

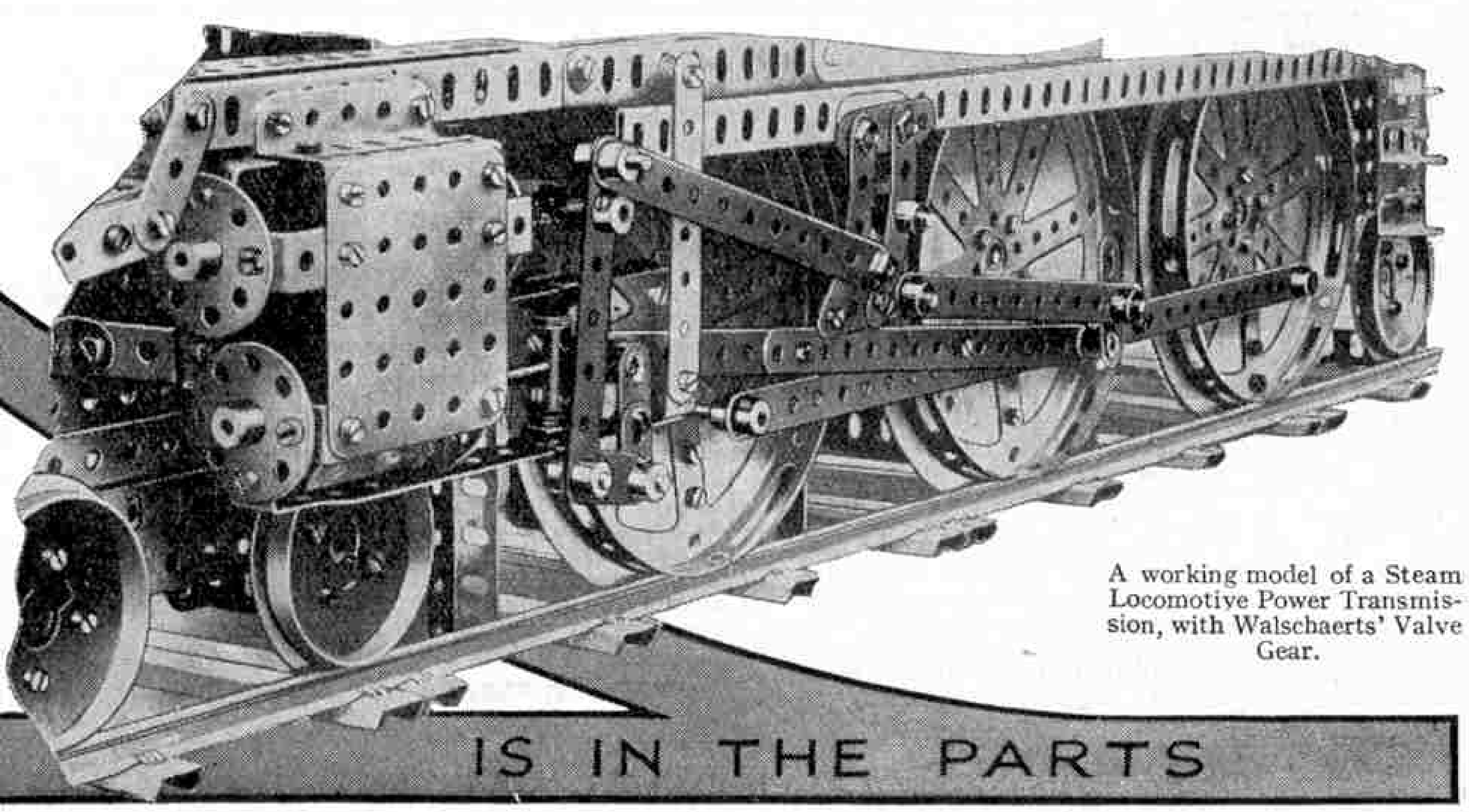
Then comes the most thrilling moment of all, when you set the model in motion. Thanks to the accuracy and wonderful adaptability of the Meccano Couplings, Cranks, and other real engineering accessories, the movable portions of the model begin to function exactly as you had intended they should, and exactly as they do in actual practice.

On this page we show a few uses of Meccano Cranks and Couplings, but—as *"M.M."* readers know—the number of mechanical movements that may be obtained with these parts is almost unlimited.

No.			s.	d.	No.			s.	d.
19.	Crank Handles	each	0	3	63c.	Threaded Couplings	each	0	6
38.	Washers	doz.	0	1	64.	,, Bosses	,,	0	2
43.	Springs	each	0	2	65.	Centre Forks	,,	0	2
50.	Eye Pieces	,,	0	2	115.	Threaded Pins	,,	0	2
57.	Hooks	,,	0	1	116.	Fork Pieces	,,	0	3
57a.	,, (scientific)	,,	0	1	120.	Buffers, for locos, etc.	,,	0	2
57b.	,, (loaded)	,,	0	5	120a.	Spring Buffers	per pair	0	8
58.	Spring Cord	per length	0	9	121.	Train Couplings	each	0	2
59.	Collars with set-screws	each	0	2	127.	Simple Bell Cranks	,,	0	3
62.	Cranks	,,	0	3	128.	Boss Bell Cranks	,,	0	4
62a.	Threaded Cranks	,,	0	4	134.	Crank Shafts, 1" stroke	,,	0	3
63.	Couplings	,,	0	6	136.	Handrail Supports	,,	0	3
63a.	Octagonal Couplings	,,	0	8	140.	Universal Couplings	,,	0	9
63b.	Strip Couplings	,,	0	8	144.	Dog Clutches	,,	0	6

Your dealer will be pleased to show you all the Meccano Parts; ask him for a complete Price List.

MECCANO LTD., BINNS ROAD, LIVERPOOL



A working model of a Steam Locomotive Power Transmission, with Walschaerts' Valve Gear.

THE GENIUS IS IN THE PARTS

A Famous Organist Who Builds Meccano Models

It seems a far cry from the creation of beautiful church music to the building of Meccano models. Yet Dr. E. C. Bairstow, the well-known organist of York Minster, likes nothing better than to snatch an hour or two from his busy days and to spend them building Meccano models for his six-year-old son.

Dr. Bairstow has demonstrated his mechanical aptitude by a series of ingenious models. One of these was a model motor delivery van complete with left-hand drive, Ackermann steering, and gear box giving two speeds forward and reverse. The chassis and working details were constructed entirely from Meccano parts, and the model was equipped with a body devised from three-ply wood. When demonstrated recently the motor proved itself capable, in low gear, of climbing rugs and any other small obstacles in its path.

His most successful model, however, was of a grandfather clock with which he secured a first prize offered for the most original working model. This clock was not a mere toy, of course, for it kept accurate time until it was dismantled. Dr. Bairstow bought the weight with which to drive his model from a well-known Leeds clockmaker. The latter remarked, on learning the object for which the weight was required, "Oh, you had better leave it alone. You'll never get it to work. In the first place the gears are too small, and you'll never manage to contrive an escapement."

We wonder what this clockmaker would say if he were told that even now scores of Meccano boys all over the country are building clocks that not only keep perfect time but prove a constant source of delight and wonder to all who see them!

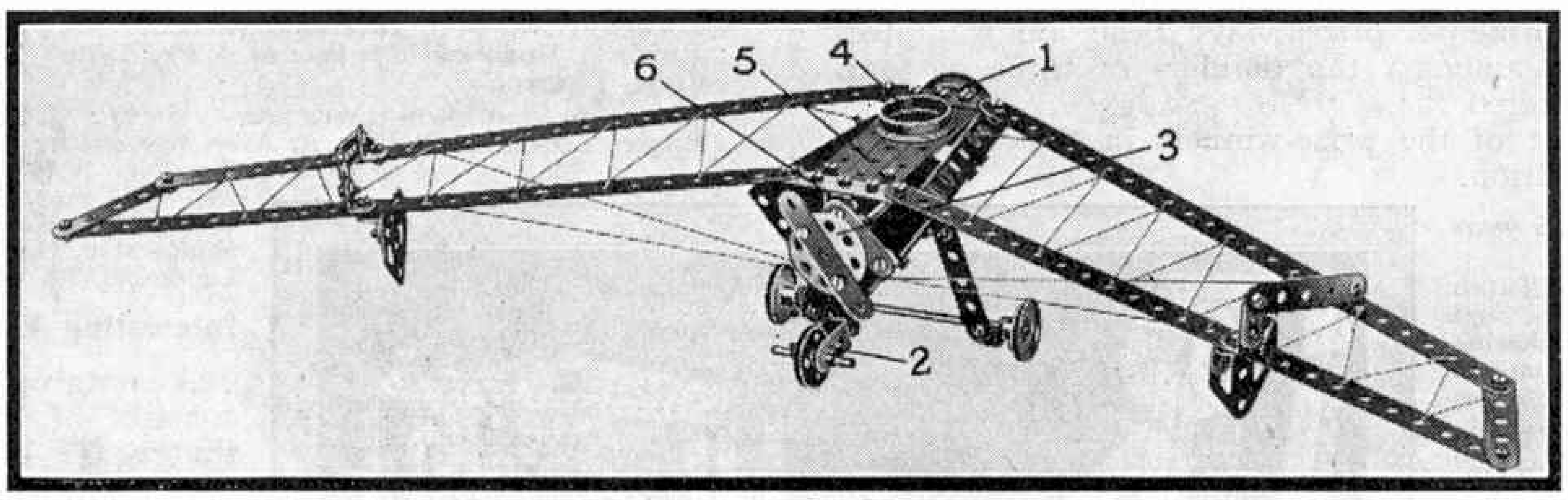
Fortunately Dr. Bairstow continued undaunted with his determination to build a successful model, with the result already indicated. At the time he was unaware, no doubt, of the existence of the special Meccano Clock instruction leaflet, for he remarks that the escapement proved the most difficult part of the mechanism and cost him many hours of deep thought. The face of the clock was fashioned from the lid of a tobacco tin and the hands also were home made. The only other non-Meccano parts that were used were the weight and a wooden bobbin on which the cord was wound. Even the bobbin could have been substituted, however, by a Meccano Wood Roller (part No. 106).

Dr. Bairstow refused to regard his work as anything extraordinary. "A child could make it," he declared, referring to his clock. This, we feel, is a remarkable tribute to the simplicity of the Meccano system, but a child could scarcely think out a clock of such excellent design and precision.

Writing to the Editor of the "*M.M.*" a few years ago, Dr. Bairstow remarked that "it has always been my custom to have on hand something that, whilst appealing to the imagination and general interest, is in complete contrast to my usual work. The building of original models in Meccano has been the pleasantest of my hobbies during the last twelve years. The most interesting experience of all has been the building of the clock which won me the prize. There were many problems to solve and the solution of each one had to be attempted by several different methods before success was finally attained."

Over and over again it has been demonstrated that Meccano appeals not only to inventive boys but to men of every rank and profession—engineers, schoolmasters, doctors, artists, musicians, soldiers and sailors. Every one experiences the same sense of satisfaction in watching something grow and take shape under one's own hands—it may be a mechanical model, a garden, a picture, or music.

A MECCANO MODEL OF A TAIL-LESS AEROPLANE



This realistic No. 2 Outfit model of Capt. Hill's "Pterodactyl," or tail-less aeroplane, which was described in the "*M.M.*" for April 1927, represents a combination of the ideas of H. A. Tippetts (Birmingham), W. Levie (Aberdeen), B. Dawson (Leigh-on-Sea), and H. Hartley (Leeds), all of whom secured awards for models of this description in the "No. 2 Outfit" Competition, as announced last month.

The V-shaped fuselage consists of two Sector Plates bolted together. Two 1″×1″ Angle Brackets are bolted one to each Sector Plate in the front of the machine and are placed so that their ends, directed inward, meet just behind the Flanged Wheel 1 forming the nose of the fuselage. A 1½″ Axle Rod secured in the Flanged Wheel passes through these Angle Brackets and through a ½″×½″ Angle Bracket secured in the centre hole of a 2½″ Strip that serves to connect the front 12½″ Strips of the wings. A Flat Bracket bolted to this 2½″ Strip is bolted also to another Flanged Wheel 4, which represents the cockpit. This wheel rests between two 3½″ Strips and is further secured by a 2½″ Strip 5. The Single Bent Strip 2 carrying the rear running wheel is spaced away by three Washers from the lower end of a 2½″ Strip, the other end of which is bolted to an Angle Bracket secured in the top of the fuselage. The 2″ Rod carrying the propeller 3 passes through the second hole of this Strip and is further supported by a Double Bent Strip inside the fuselage. Two 1½″ Strips also are secured to the Angle Bracket 6 and each is connected to one of the Sector Plates.

Opportunities for Keen Meccano Boys

Last month we announced two special Meccano Model-building Competitions, both of which afford splendid opportunities for "brainy" Meccano boys to profit by their ingenuity.

The Second Special Summer Competition closes for home readers on the 30th of this month, and for overseas readers on 31st December next. Any type of model may be submitted and any number of parts may be used in its construction. Originality of ideas, as expressed either by the type of apparatus selected as the subject of the model or by novel uses of Meccano parts, is the quality that will weigh most heavily in the competitor's favour. The competition is divided into various sections, according to the ages of the competitors, and many handsome prizes are offered. Full particulars and rules governing the Competition were published on page 731 of the August issue.

The Roundabout Competition is somewhat unusual in that competitors are asked to complete a Meccano roundabout built by a Dutch boy and illustrated on page 725 of the August number. The model is of straight-forward construction and is finished except for seats, etc., to carry the passengers. As every Meccano boy knows, modern roundabouts are equipped with galloping horses and other interesting mechanical devices and we believe that the task of fitting such items to the model offers a wide scope for our readers' ingenuity. This competition will be divided into the following sections: Section A for readers residing in the British Isles, and Section B for overseas readers. Closing dates, for Section A: 30th September; Section B: 31st December. A First Prize consisting of Meccano products to the value of 10/6 and other awards will be distributed in each section. The roundabout should be as realistic as possible, but it need not necessarily be equipped with the ordinary dragons or motor cars to be seen in all fair grounds. Anything original, or anything you think that you would like to ride on yourself, would finish the model admirably and, incidentally, might augment your Meccano or Hornby Train set to the extent of 10/6 worth of new accessories!

Results of
Meccano Model-Building Contests

By Frank Hornby

"No. 3 Outfit" Competition, Home Sections

THE entries in the "Outfit" Competitions continue to maintain the same high standard of merit, and in the No. 3 Contest in particular it was found extremely difficult to decide between the rival merits of many of the models submitted. In each section, therefore, the principal prizes have been amalgamated and distributed equally amongst the builders of three or four of the best models entered.

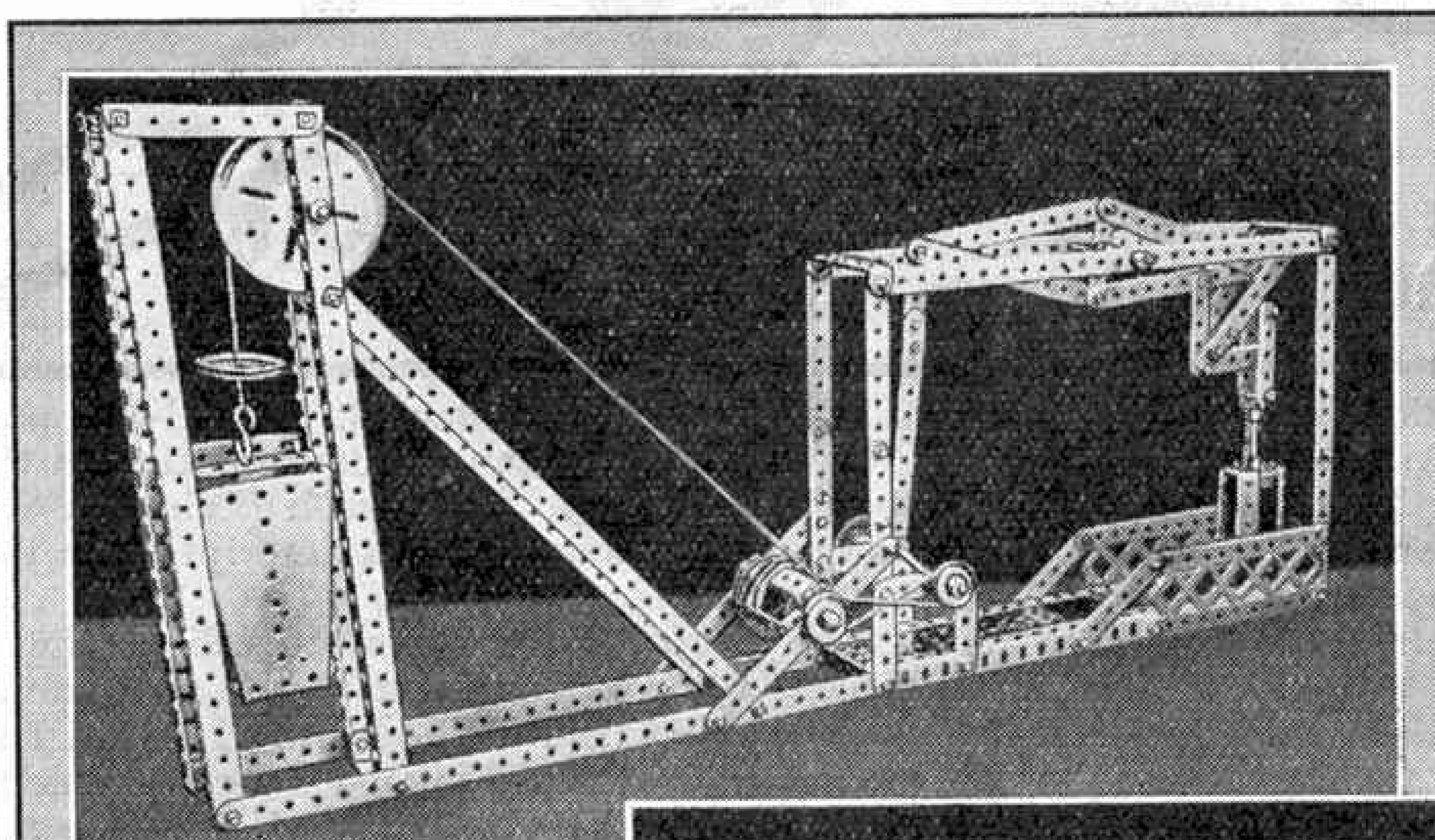
The following is a list of the prize-winners in the "Home" Sections of this competition.

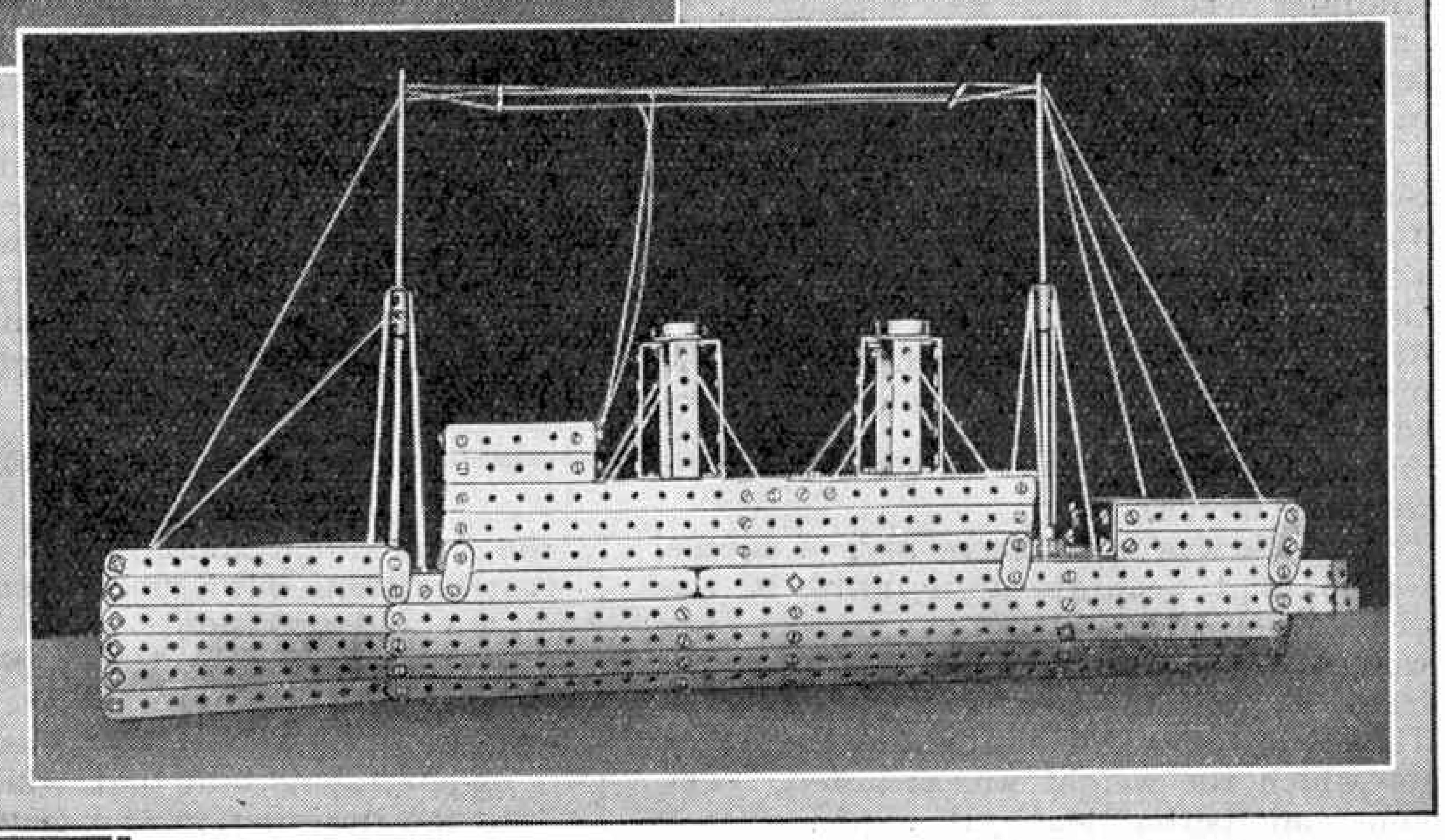
Section A (Competitors over 16 years of age).

THE FIRST, SECOND AND THIRD PRIZES have been combined and divided amongst the following four competitors, each of whom will receive Meccano products to the value of one and a half guineas: S. T. Temple, Streatham Hill, London, S.W.; Ralph Sewell, St. Ives, Hunts.; R. G. Branstone, Portsmouth; and A. F. Williams, Newport.

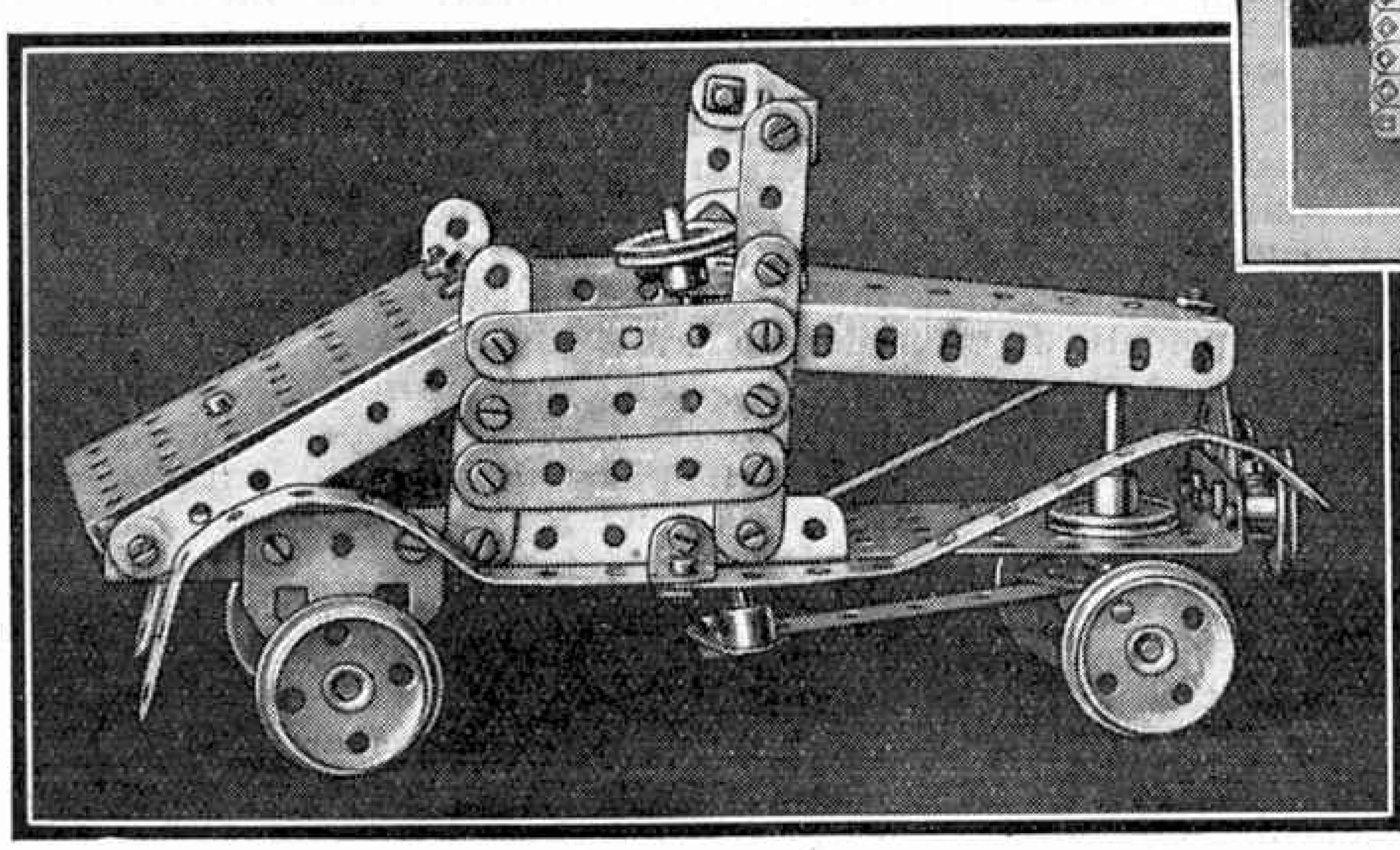
SIX PRIZES, each of Meccano products to value 10/6: H. Mitchell, Dalston, London, E.8; S. B. Rickards, Hull; O. Leach, Wallasey, Cheshire; K. Freeman, Coventry; E. F. Adams, London, S.E.1; J. Grant, Blackpool.

SPECIAL COMMENDATION (Certificate of Merit): H. C. Thompson, Scotstoun, Glasgow; James McManus, Derry, Ireland; Albert Ellithorne, London, W.6; E. P. Mirams, Horsham, Sussex; R. Hannah, Dorchester, Dorset; C. P. Conroy, Torquay; P. S. Smith, Dover; J. Harrison, Tring.





Above: Pit Head Gear and Winding Engine, by B. Moberley (awarded prize in Section C). Note the parallel motion device fitted above the piston of the Winding Engine. Right: Liner, by P. Barry, and below: Two-seater Car, by L. Fielding, both prize-winners in Section B



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

THE FIRST, SECOND AND THIRD PRIZES have been combined and divided amongst the following six competitors, each of whom will receive Meccano products to value one guinea: Leonard W. Parsons, Midsomer Norton, Bath; P. F. Dormer, Totland, I.O.W.; R. Comfort, Bury; Lester Fielding, Leeds; G. W. Ellis, Bolton; L. Holman, Camborne, Cornwall.

SIX PRIZES, each of Meccano products to value 10/6: L. W. S. James, Langside, Glasgow; Stanley Jones, Widnes; Richard Manchée, West Molesey, Surrey; A. Wright Rhodes, Macclesfield; John R. Watson, Dundee; P. Barry, Cork.

SPECIAL COMMENDATION (Certificate of Merit): C. Wilkie, Cork; A. W. Marshall, Cromer; Francis W. Keyworth, Melton Mowbray; Thomas E. Whittle, Charnock Richard, near Chorley; D. C. Young, Sheffield.

Section C (Competitors under 12 years of age).

THE FIRST, SECOND AND THIRD PRIZES have been combined and divided amongst the following six competitors, each of whom will receive Meccano products to value one guinea: G. M. Tompkins, Islip, Thrapston; H. Westbrook, Heaton Park, Manchester; Bryan Moberley, Stourbridge; B. Collins, Frinton-on-Sea; Raymond Harrop, Reddish, Stockport; B. Brockwell, Kingston Hill, Surrey.

SIX PRIZES, each of Meccano products to value 10/6: Albert Jones, Camden Town, London, N.W.1; H. D. Hosegood, South Norwood, London, S.E.; S. Baker, Paddock, Huddersfield; Samuel Mark, Leith; W. Thomson, Leith; G. E. Cross, Liverpool.

SPECIAL COMMENDATION (Certificate of Merit): J. M. Todd, Liverpool; R. T. F. Brown, Lee-on-the-Solent; A. Aves, Greenwich; A. F. Scott, Ipswich; F. Lee, London, W.11; K. Ashworth, Rochdale; W. E. Evans, London, E. 15; J. Vinsen, Rugby; C. Hancock, Leigh; B. Weisgard, Manchester; Dennis Cain, Watford; L. Palmer, London, S.W.1; J. Bompas Smith, Manchester.

Interesting Entries

A notable entry in Section A consists of a model signal gantry that S. T. Temple designed for use with his Hornby model railway. It is fitted with six signals, all of which may be controlled by hand levers in the base of the model.

The horizontal steam engine by A. F. Williams is of excellent construction, although personally I should have designed the model to a slightly smaller scale, using a flywheel built up from four small radius Curved Strips. This would obviate the necessity of bending 12½" Strips to circular form, and would also have the effect of bringing the size of the crankshaft and piston more in keeping with the rest of the model.

Four interesting entries in Section B are included in the accompanying illustrations. Perhaps the most original model is the miniature gas cooker illustrated on the opposite page. This was sent in by G. W. Ellis, and as will be seen, is most realistic in appearance. It is complete with gas rings, pipes, and hinged door, and the taps are represented by Spring Clips.

Lester Fielding's two-seater motor car is well designed and neatly made. A portion of the steering gear, which is operated by means of a crank and connecting rod as in Standard Mechanism No. 117, is just visible in the photograph. P. Barry's model liner is also very shapely and the lines of the hull, bridge, and upper decks are reproduced in a very pleasing manner. Readers will note that the vessel is equipped with a wireless aerial.

Ronald Comfort's four-wheeled tram car is another model of good, clean-cut design. The car is of the closed upper-deck type and is fitted with a spring-controlled trolley (*Continued on page 806*)

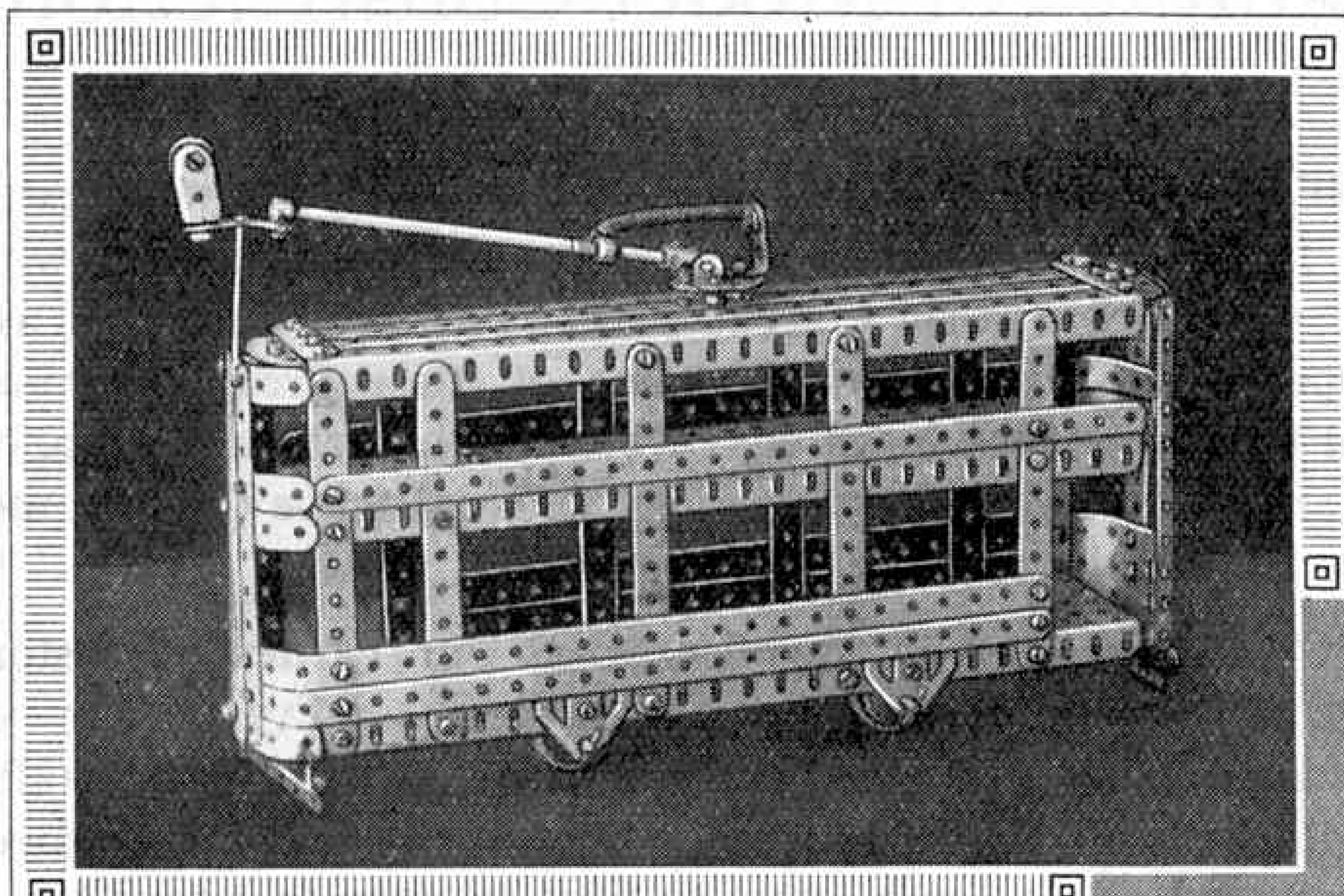
"No. 0 Outfit" Competition, Overseas Section

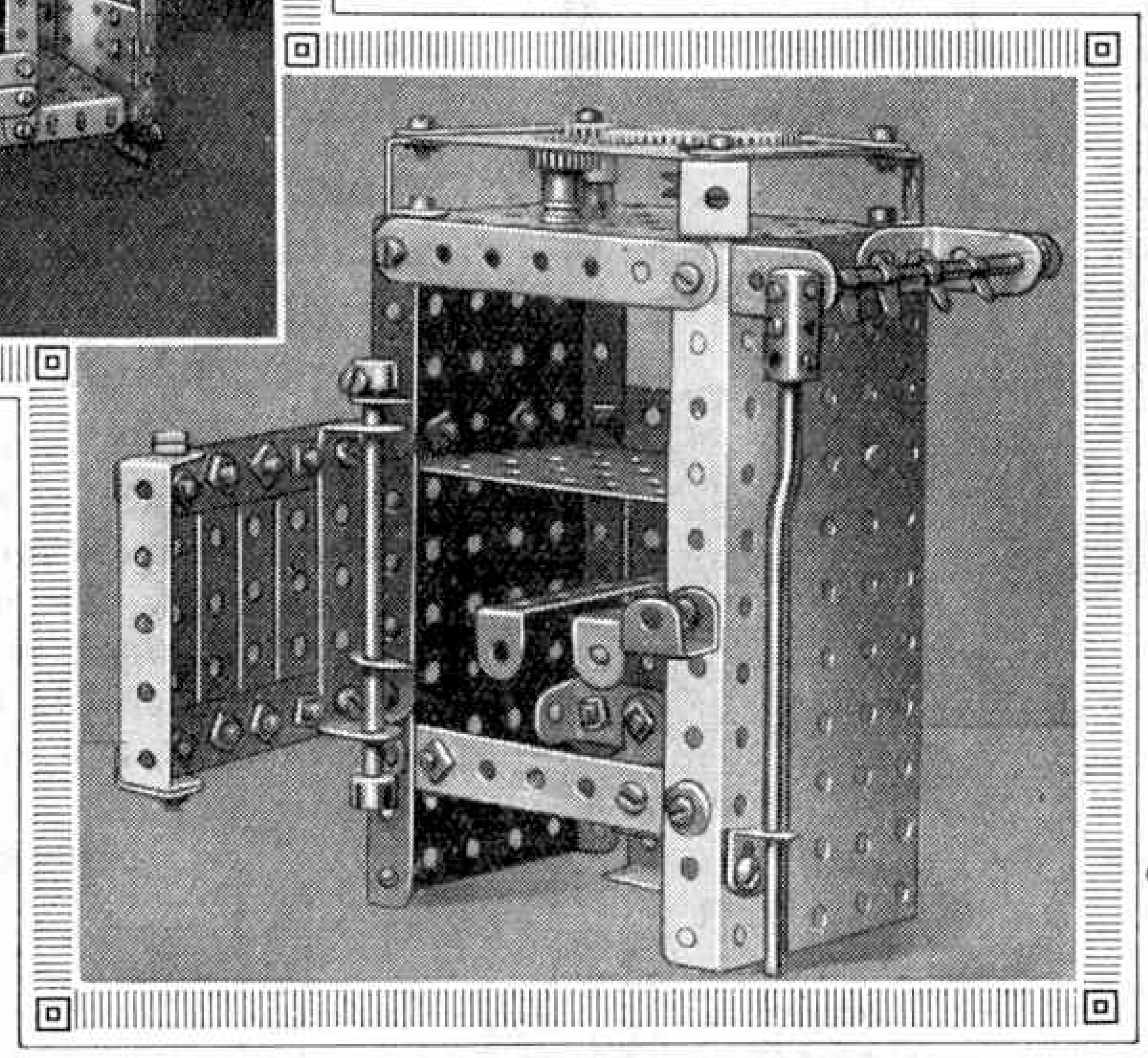
The results in Section C (for Overseas readers) of the "No. 0 Outfit" Competition are as follows:—

FIRST PRIZE (Meccano products to value £3-3s.): Chand Mal, Kashmere Gate, Delhi, India. SECOND PRIZE (Meccano products to value £2-2s.): H. A. Rodrigo, Randenbroekerweg 81, Amersfoort, Holland. THIRD PRIZE (Meccano products to value £1-1s.) Willie Welsh, 97, Lees Avenue, Ottawa, Canada.

SIX PRIZES, each of Meccano products to value of 10/6: Nelson Eustis, Alberton, South Australia; S. Budge, St. Sampsons, Guernsey, C.I.; D. Pengelley, Walderston, Jamaica, B.W.I.; L. G. Mauger, Balingup, W. Australia; Ng Ang Oh, Bukit Timah Road, Straits Settlements; P. Grant, Johannesburg, South Africa.

SPECIAL COMMENDATION (Certificates of Merit): D. S. Framroze, Navsari, India; A. Kumar, Delhi, India; S. Galdes, Valletta, Malta; W. Graham, Ettswold, Queensland, Australia; M. Falkof, Johannesburg; S. Falkof, Johannesburg; I. Levitt, Montreal, Quebec; Noel Loney, Maritzburg, Natal, S. Africa; K. Hart, Sydney; C. G. Turner, Winnipeg; C. Harris, Christchurch, N.Z.





Two further prize-winning entries from Section B of the "No. 3 Outfit" Contest. Above: Tram Car, by R. Comfort. Right: Gas Cooker, by G. W. Ellis

Chand Mal and W. Welsh, who secured First and Third Prizes respectively, both submitted Meccanographs, but each model is of very different design. Those readers who have constructed the well-known Meccanograph that is made with a No. 7 Outfit will appreciate the fact that it is no easy matter to construct a model of this type from a No. 0 set; nevertheless, these two competitors were successful and both are able to produce many excellent designs on their machines. Some of the patterns submitted by Chand Mal are perfectly symmetrical.

H. A. Rodrigo's entry is in the form of a monoplane of a type much favoured by the Dutch air lines. It is cleverly designed and most realistic in appearance.

D. Pengelley sent in designs for four different models, namely, a footbridge, rifle, crane, and "walking man." The best model from a purely constructional point of view is the crane I think, although the "walking man" is very original. Each has points of interest and altogether I consider D. Pengelley richly deserves his prize.

An Unusual Crane

Ng Ang Oh's entry is in the form of a crane of novel type. It comprises a horizontal boom built up from $12\frac{1}{2}''$ Strips and secured to an upright support consisting of two $5\frac{1}{2}''$ Braced Girders. These Girders are bolted to a travelling base formed from a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate fitted at each end with two 1″ fast Pulleys secured to a $3\frac{1}{2}''$ Axle Rod.

Nelson Eustis and L. G. Mauger both submitted particularly interesting models. That of the former represents a derrick crane and is designed on practical lines; the latter competitor chose as the subject of his model a steam shovel. This swivels upon a travelling base and is fitted with a bucket consisting of Flat Trunnions bolted to the movable bucket arm, which is constructed from $5\frac{1}{2}''$ Strips.

Pile Driver, Motor Chassis, and other Models

S. Budge's model is in the form of a pile driver, the hammer of which is guided in its movement up and down two vertical $5\frac{1}{2}''$ Strips by means of Double Brackets. The hammerhead, which is built up from Flat Trunnions and Angle Brackets, is raised on operation of a Crank Handle and, on release of the latter, drops by its own weight. The pile driver forms an interesting working model of the type that never fails to appeal to all Meccano boys, both young and old.

A very original effort sent in by P. Grant represents a complete motor chassis, and in view of the limited number of parts available, I consider this competitor has reproduced the more important details of a motor chassis in a very ingenious manner.

The brothers Michael and Samuel Falkof have scored several successes in past competitions, and I must congratulate them on again closely approaching prize-winning standard. On this occasion the first-mentioned competitor sent a model locomotive, the construction of which is particularly good. The boiler is built up from $5\frac{1}{2}''$ Strips bolted by means of Angle Brackets to a Bush Wheel, and the driver's cab is constructed from $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips that support a $2\frac{1}{2}''$ small radius Curved Strip forming the cab roof. Samuel Falkof chose as his subject a four-wheeled tram car, the base of which consists of a $5\frac{1}{2}''$ Flanged Plate with $5\frac{1}{2}''$ Braced Girders for the sides. Flat Trunnions at each end of the vehicle represent the controllers, and the trolley arm consists of a $5\frac{1}{2}''$ Strip pivoted to an Angle Bracket in the roof of the car and carrying at its outer end a $\frac{1}{2}''$ Loose Pulley.

A letter balance by Anaud Kumar, and a very original ink-stand by Desai Seavax Framroze were specially commended.

"New Meccano" Competition, Overseas Section

A very fine collection of models was received in connection with the Overseas Section of the "New Meccano" Competition. The prize-winners are as follows:

FIRST PRIZE (cheque to value three guineas): O. P. Skinner, Cape Town, South Africa; SECOND PRIZE (cheque to value two guineas): Mervyn Morgan, Homebush, Sydney, N.S.W. THIRD PRIZE (cheque to value one guinea): Kwa Soon Hock, Singapore, Straits Settlements.

SIX PRIZES (each consisting of Meccano products to the value of half a guinea): G. Keller, Taumarunui, New Zealand; E. Eales, Sherwood, Queensland; M. Kucharsky, Montreal, Quebec; E. G. Hannaford, Belair, South Australia; P. T. Hewitt, Geneva; O. Sanderson, Johannesburg.

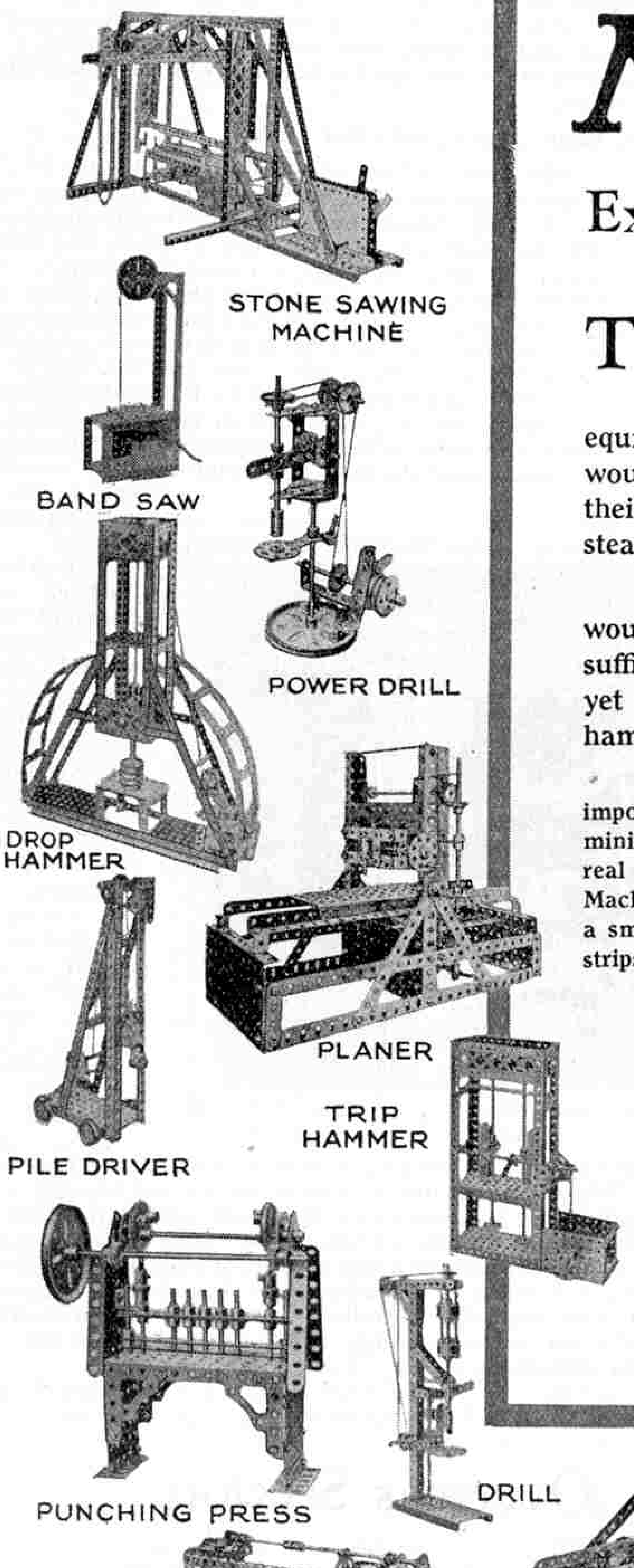
SPECIALLY COMMENDED (Certificate of Merit): Lionel Miller, Otago, N.Z.; Stanley Large, Lahore Cantonments, Punjab, India; C. Marchison, Melbourne; T. Cook, Durban, South Africa; C. Hentall, Bombay; F. E. Brookfield, Buenos Ayres, Argentine.

O. P. Skinner secured First Prize with a fine model roundabout equipped with prancing horses, an "organ," and many other interesting details. One of the photographs submitted shows the top of the model covered with coloured silk, with here and there a brightly-coloured flag, and the effect so obtained is certainly very striking. Its designer tells us that the model is well suited for use in connection with exhibitions, etc., and that on one occasion, when the roundabout was being displayed, he attached to the Electric Motor a small "musical box" of the type that can be obtained from most toy-dealers, so that music (?) was actually produced when the model was in motion.

I should like to mention particularly the model sent in by Mervyn Morgan. This is in the form of a jig-saw, which can be worked either by hand or by means of a treadle. It is constructed from a No. 5 Outfit with two additional Eye Pieces and a fret-saw, and judging from the photographs received, which include samples of work produced with the apparatus, it can be used for many practical purposes.

Kwa Soon Hock sent in a model of a transporter bridge, in which excellent use is made of the new coloured parts. The model presents a very pleasing appearance, especially when set in motion. This competitor also sent in a model of a suspension bridge, which, although not so shapely as the transporter, is very effective.

THE NEW MECCANO



Examples of Model Construction:

1. MACHINE TOOLS

THERE is nothing more fascinating to every boy interested in engineering than the giant mechanical tools with which the world's great workshops and foundries are equipped. The daily work of some of these great machines would have employed hundreds of men a generation or so ago; their enormous strength has brought into existence the dynamo, steam engine, locomotive, and battleship.

It is interesting to surmise what our earliest ancestors would have thought of a man who could deliver blows of sufficient strength to forge a steel ingot into a liner's crankshaft; yet with a touch of the finger, the operator of a modern power hammer controls a force equal to fifty or sixty foot-tons !

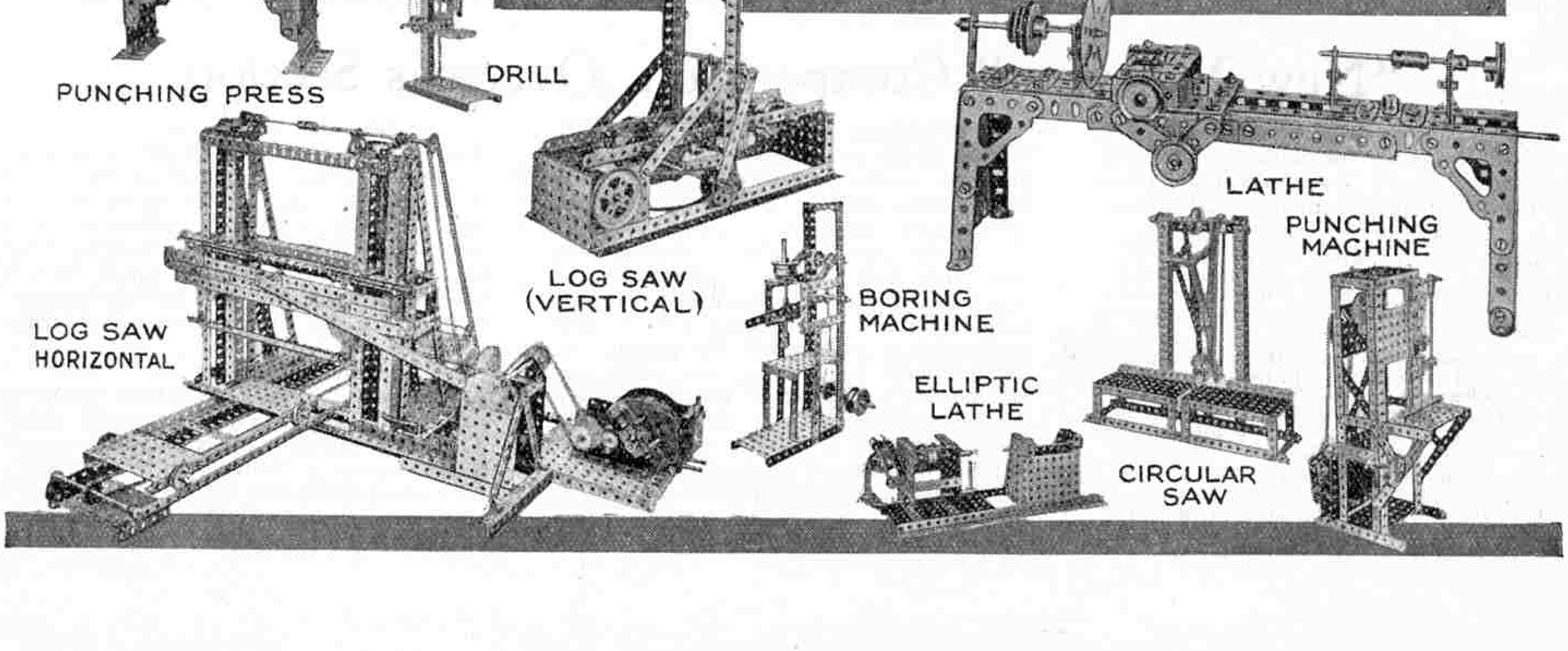
We illustrate a selection of Meccano models, representative of this important branch of engineering. Meccano Machine Tools are not only miniature reproductions of the real thing; they may be *worked* like the real machines. By adding a fretsaw or hacksaw blade to the Sawing Machines, small pieces of wood may be cut through; similarly, by inserting a small twist-drill in the Drilling Machines, holes may be bored through strips of wood, and so on.

MECCANO PRICES

COMPLETE OUTFITS	
No. 00	3/6
No. 0	5/-
No. 1	8/6
No. 2	15/-
No. 3	22/6
No. 4	40/-
No. 5 (in well-made carton)	55/-
No. 5 (in superior oak cabinet with lock and key)	85/-
No. 6 (in well-made carton)	105/-
No. 6 (in superior oak cabinet with lock and key)	140/-
No. 7 (in superior oak cabinet with lock and key)	370/-

ACCESSORY OUTFITS	
No. 00a	1/6
No. 0a	4/-
No. 1a	7/6
No. 2a	8/6
No. 3a	18/6
No. 4a	15/-
No. 5a (in well-made carton)	50/-
No. 5a (in superior oak cabinet with lock and key)	80/-
No. 6a (in superior oak cabinet with lock and key)	210/-

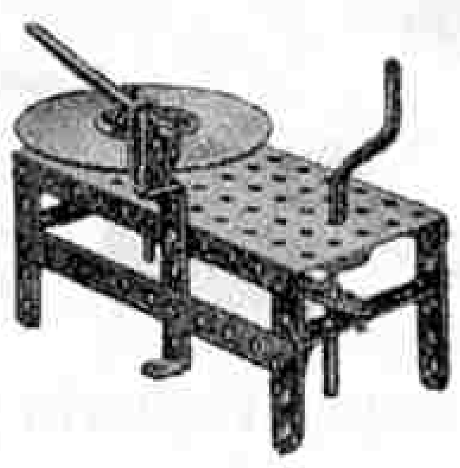
MECCANO LTD., Binns Road, LIVERPOOL



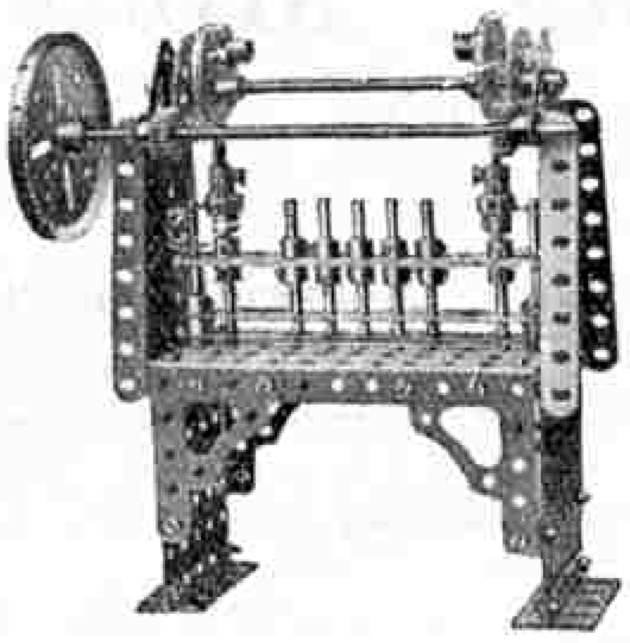
Grand New

Meccano Model-Building Contest

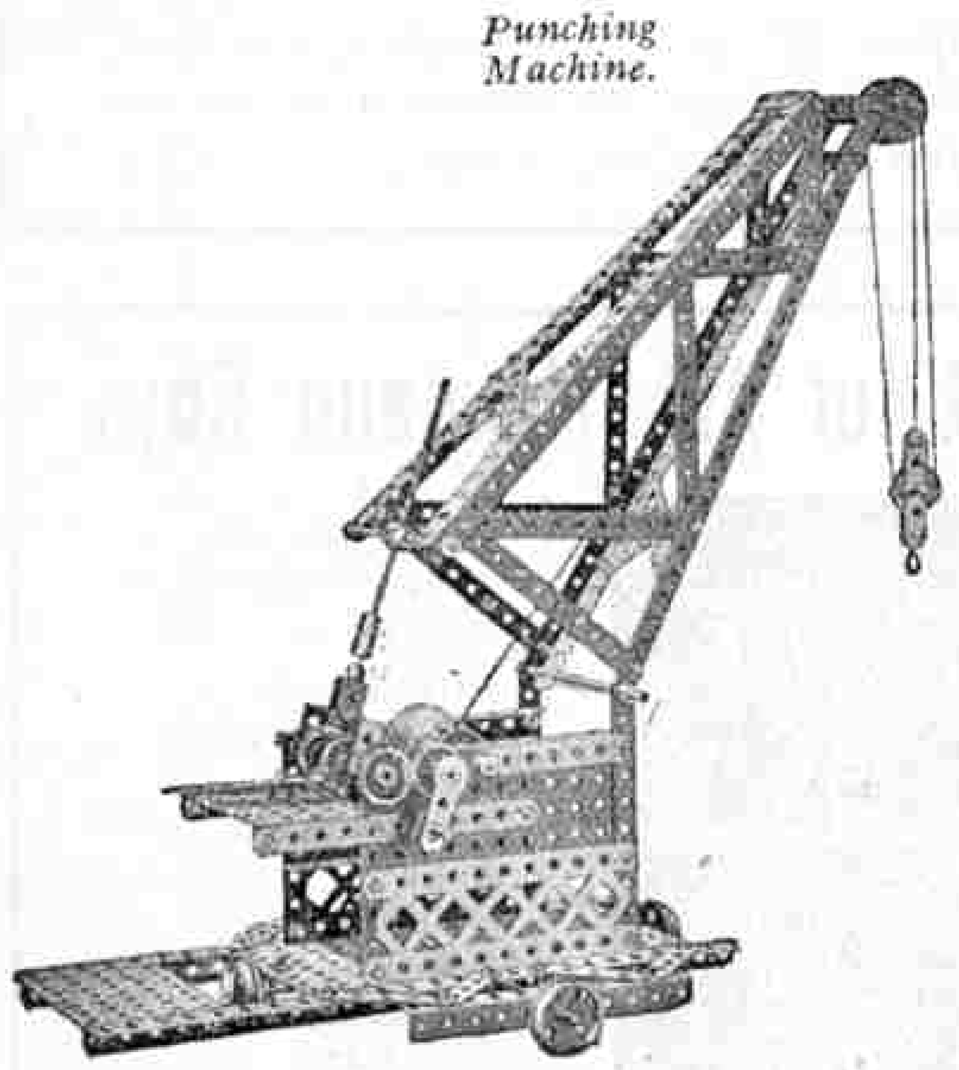
FOR ANY TYPE OF MODEL



Potter's Wheel.



Punching Machine.



Rotating Crane.

During September many readers turn to their Meccano Outfits with renewed interest. In the northern countries in particular, the lengthening autumn evenings induce boys to start model-building in earnest and the fun and excitement rapidly increase as winter approaches. That is why we are announcing this month one of the most important model-building contests yet organised in connection with the "*M.M.*" Many valuable prizes are offered and every Meccano boy should send in at least one example of his work.

How to Enter

Any type of model may be submitted in this competition and any size of Outfit or quantity of parts may be used. It is important to remember, however, that it is not necessarily the most intricate or elaborately-constructed models that will carry off the prizes; special consideration will be given to any model that comprises new movements or novel uses of Meccano parts. The most telling point will be originality of thought, as expressed either by the type of apparatus selected as the subject of the model, or by the ingenious combinations of the parts used in its construction. All models submitted in the competition must be the competitors' own unaided work, both in design and construction.

We hope to be able to select from the prize-winning entries a number of models for inclusion in future Instruction Manuals. The best entries will also be described in forthcoming issues of the Magazine.

Entries will be divided into the following Sections: Section A, for competitors residing in the British Isles. Section B, for competitors residing overseas. In each Section the competitors' ages will be taken into careful consideration.

List of Prizes

Prizes will be awarded for the best entries FROM EACH SECTION 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."

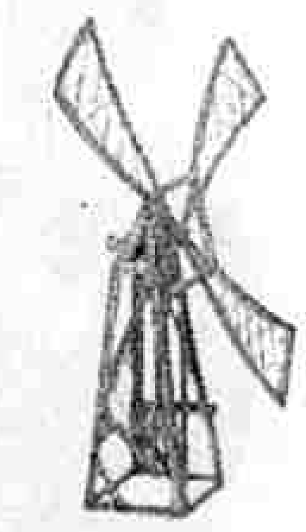
Actual models should not be sent. A clear photograph or drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Limited.

Important Instructions

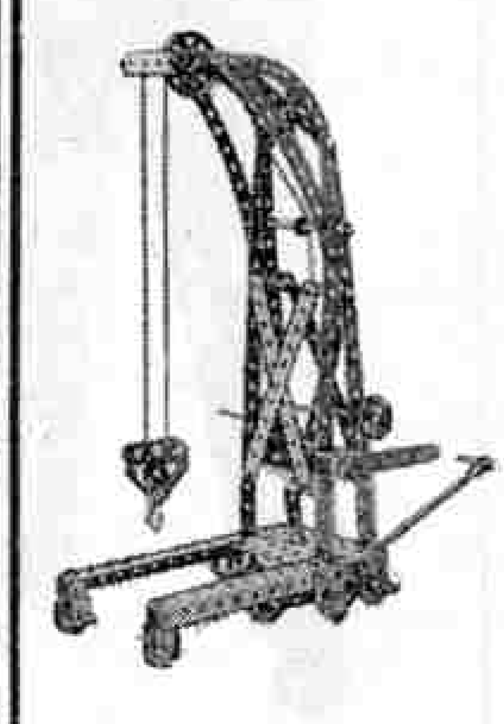
Readers should send in clear photographs or good drawings of their models together with any explanations that may be necessary. The following instructions must be followed closely:—The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition ("September" Model-building Competition) and the Section in which the model is entered. Envelopes should be addressed "September" Model-building Competition, Meccano Ltd., Binns Road, Liverpool.

Closing Dates

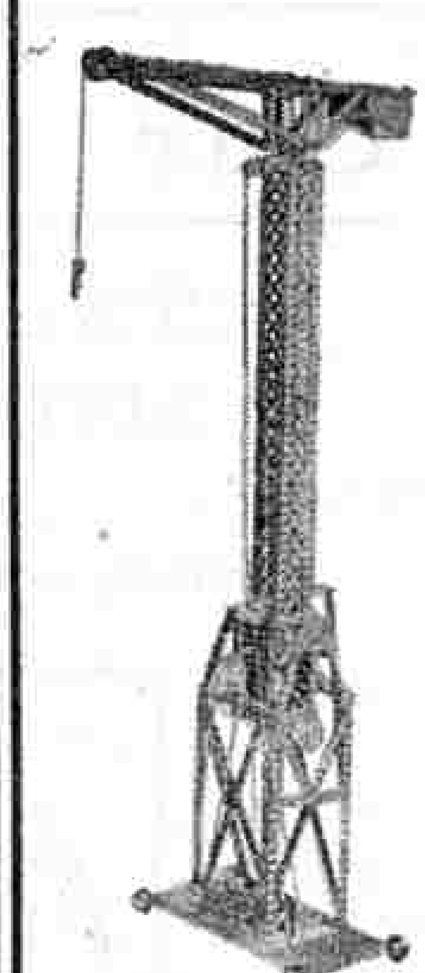
Entries for Section A must be received not later than 31st October, 1927. Closing date for Section B; 31st January, 1928.



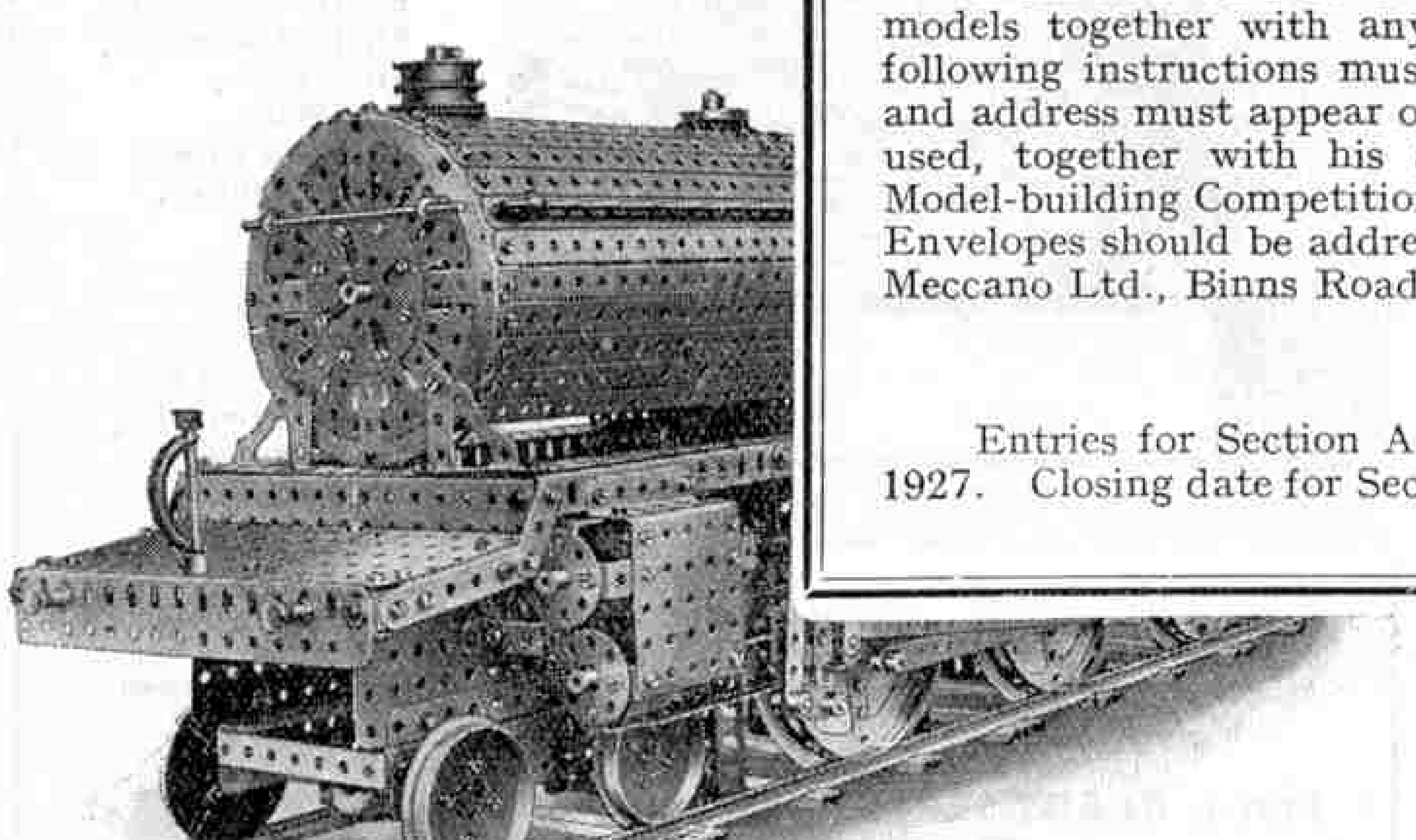
Windmill.



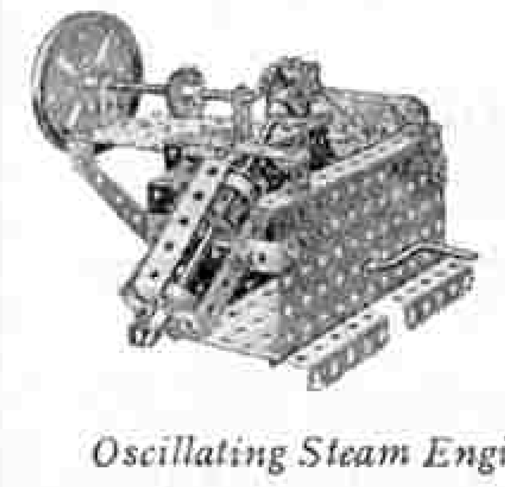
Platform Crane.



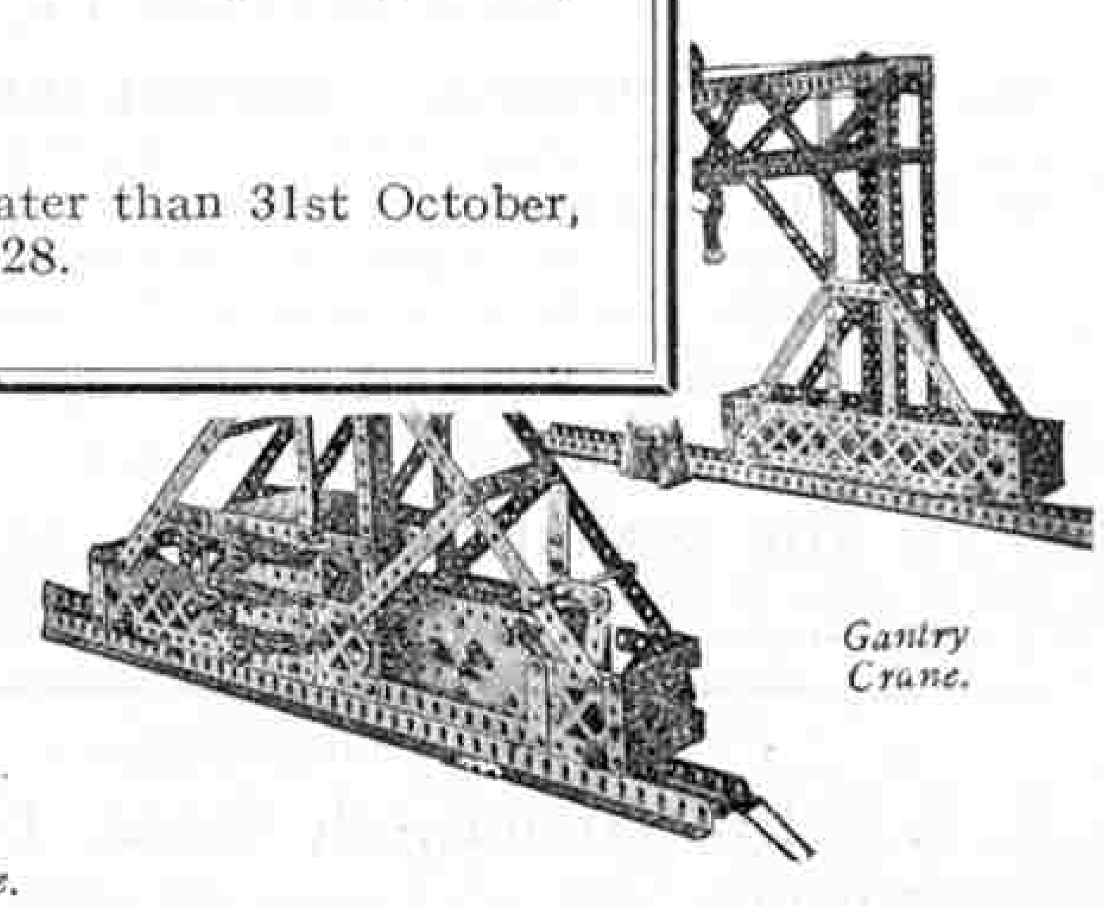
Elevated Crane.



4-6-2 Tank Locomotive.



Oscillating Steam Engine.



Gantry Crane.

"From India's Coral Strand"

We receive many letters from Overseas and foreign countries. Sometimes these letters are interesting and at other times they are amusing. The undermentioned application for employment from Calcutta belongs to the latter category :—

To the Editor of the "*Meccano Magazine.*" Deeply Honoured Sir,— Early in the dawn of today's lucky day it came to me, to my intoxicating gladness the very pleasant thought that your benevolent honour has for his disposal a fine job where I may be able to display my real zeal and abilities to their utmost height, so that by the grace of the All Impotent God it may prove beneficial to all connected and to the just cause of Meccano.

I am belonging to a Holly Brahmin family full of respectability, but by some unforeseen pleasures of God it is not prosperous nowadays.

As to my adjustments I appeared for the Matric Examination at Ooty, but failed, the reason for which I shall now describe. To begin with my writing was illegible, this was due to climatic reason, for I having come from a warm in a cold climate found my fingers stiff and very disobedient to my wishes.

Further I had received a great shock to my mental system in the shape of the death of my small dog the day before. Besides, most honoured sir, I beg to state that I am in very uncomfortable circumstances, being the soul means of support of my fond brothers' seven issues consisting of three adults and four adultesses, the latter being the bain of my existence owing to my having to support two of my own wives as well as their issues of which the feminine gender predominates.

My ambition was to pass my B.A. examination, but honoured sir, amidst such above mentioned monstrous and thundering difficulties, lying like hideous mountains in my way, it was beyond my humble and humane power.

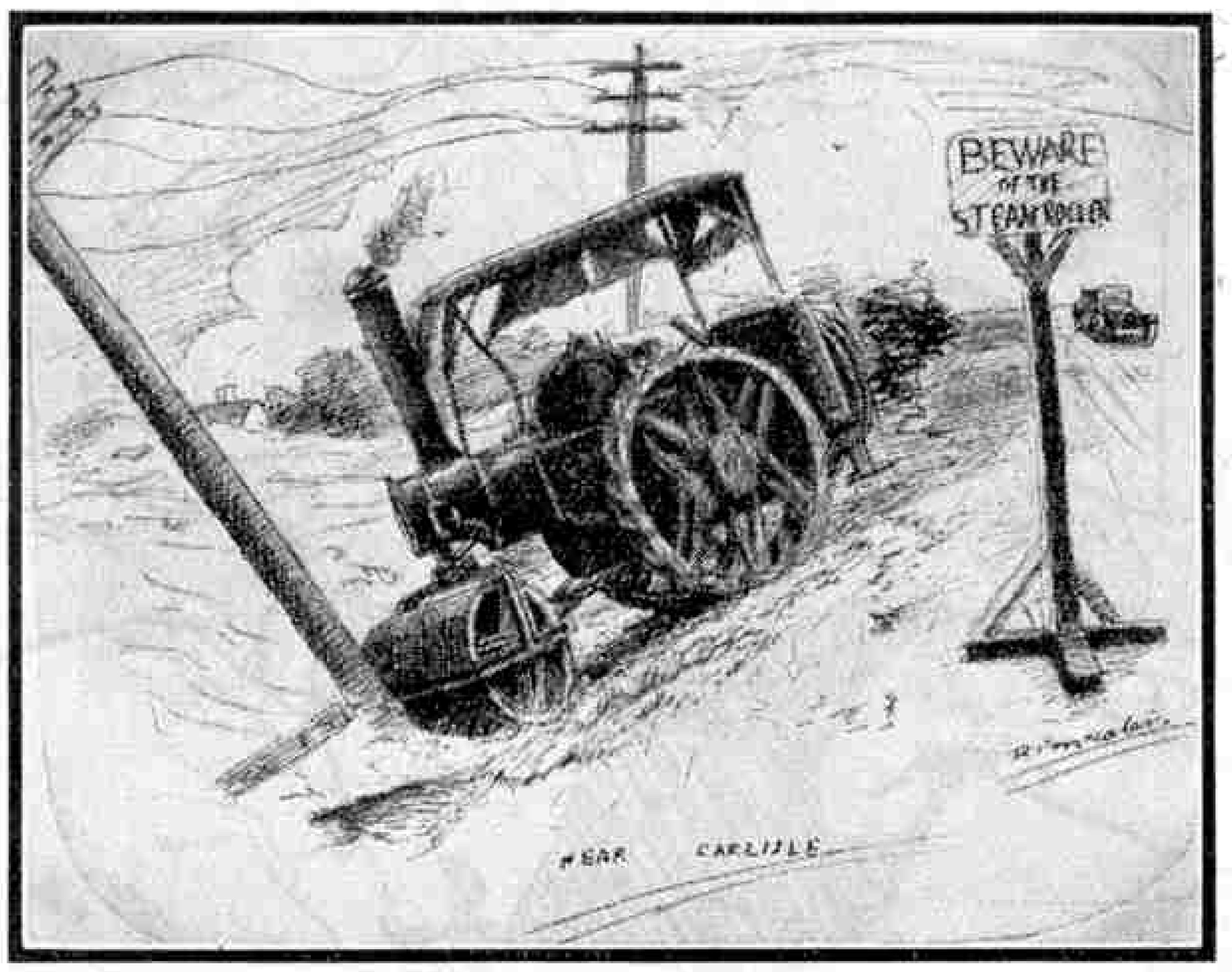
Honoured Sir, if by wonderful good fortune these few humble lines meet with your benign kindness and favourable turn of mind I the poor menial shall ever pray for the long life and prosperity of yourself as well as your honour's posthumous olive branches.

I remain honoured sir,

Your obedient servant,

R——— N———

Reader's Clever Drawing



This drawing, of an accident to a steam roller, was made by R. Forrester of Carlisle, and was awarded Second Prize in the "B" Section of our 19th Drawing Competition

This May Help You !

The above illustration shows a cleverly decorated cycle entered by a Meccano boy for a Cycle Parade and Carnival. Here is a suggestion that may be of use to others who intend to enter similar competitions

Railway Police

A distinguished guest at one of our annual dinners told a story of a railway constable placing his hand on a bookmaker's shoulder, whereupon the latter turned sharply around and exclaimed, " Good—I thought you were a *real* policeman."

The suggestion of unrealism as applied to railway police is the product of ill-founded suppositions held by persons who regard railway police as an adjunct or auxiliary force with limited powers, and of comparatively recent birth. As a matter of fact, a railway constable takes the same oath of allegiance, has the same power of arrest, enjoys the same protection and privileges, and is subject to the same penalties, as any City, County or Borough constable. His sphere of operation, however, covers a wider field than that of his contemporaries, for he is empowered to act on and off the railway within a certain specified area, in any place or part of the country through which the railway runs.

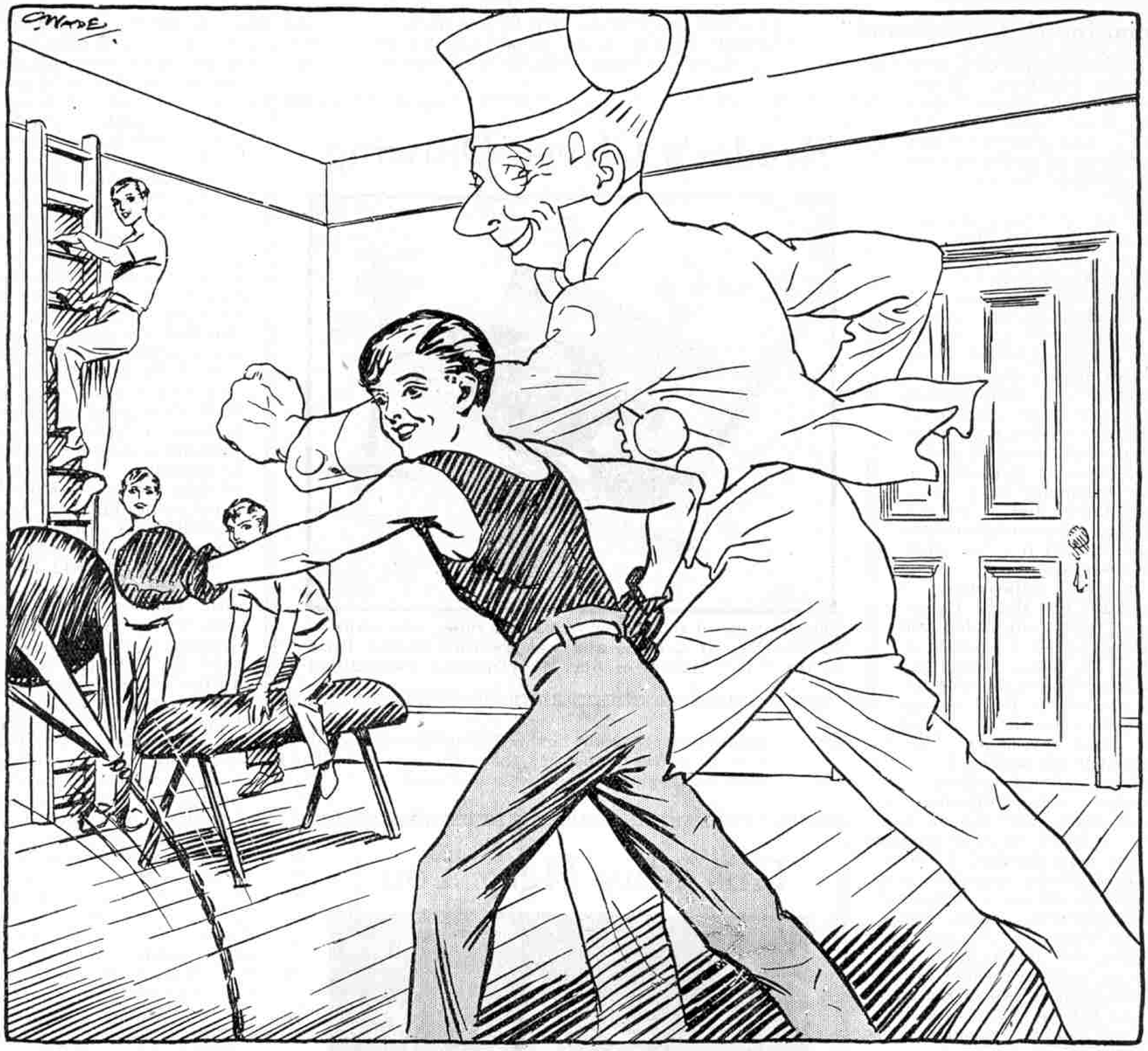
Chronologically, the railway police comes next to the Metropolitan Police Force, which was established in 1829. In 1837, an act was passed making it compulsory for railway companies to employ special constables at a wage of not more than 5s. per day. Two years later the City of London Police was created with an organisation closely resembling that of the Metropolitan Police, and in the same year, namely 1839, Parliament empowered the justices in Quarter Sessions to establish a paid constabulary for each county. The act was permissive, and was not universally acted upon until 1856, when the establishment of a County Police Force was made compulsory.

So far back as 1842, Parliament authorised Railway Police to seize and detain persons found committing offences against the company's regulations, and to take the offender before some Justice of the Peace *without any other warrant or authority.* Similar powers are given by Section 156 of The Companies Clauses Act, 1845, and The Railway Clauses Act of the same year, to arrest transient offenders. It is, therefore, clear that prior to the compulsory employment of county police, the railway companies' staffs possessed certain powers in regard to the arrest, detention and conveyance of offenders before the magistrates. By Section 56 of The Great Western Railway Act of 1877, these powers were extended, wherein it is laid down that a railway constable shall have all such powers, authorities, protections and privileges in respect of the execution of his duties, as constables have, or are subject to, by the Laws of the Realm.

Section 65 of The Great Western Act of 1899 gives authority to railway police to follow and arrest any person who has escaped from a railway station or works after committing therein or thereon, any offence for which he might have been arrested, so that while our friends in the City, County and Borough constabularies, are more or less confined to the jurisdiction for which they have been sworn in (*vide* the Municipal Corporations Act, 1882) the railway police are empowered to act in any part or place through which their employing company's railway runs.—G.S. in the "*Great Western Railway Magazine.*"

* * * *

It is interesting to note that another body of police with special functions is the force that protects the Royal Naval Dockyards. The Dockyard constable, whether stationed at Portsmouth, Chatham or Rosyth, is for administration purposes a member of the Metropolitan Police Force, the only police force that is directly under the control of the Secretary of State for Home Affairs.—Editor "*M.M.*"



THERE'S "FORCE" BEHIND THAT!

Zip! thud! zip! thud! Good timing. Clean hitting. Keyed up to concert pitch, there's a power behind Jim that keeps him fit for anything.

What gives him this driving force? Think. The other fellows call him "Sunny" Jim because his favourite food is "Force." He eats "Force" at breakfast. He gets a topping feast of crumpy crisp flakes of whole wheat served up with steaming hot milk. The very taste of it puts a feeling of fitness into you!

But this fitness is more than a fancy. It's really there! Whole wheat cooked with malt and toasted is the finest and most powerful food you can eat. *That's* where Jim get's his "punch" from. Ask mother to see that you have "Force" regularly *every* day. You'll like it too.

FORCE

WHOLE WHEAT FLAKES
MALTED AND TOASTED

"*The energy maker.*"

FOR A FREE SAMPLE OF "FORCE" SEND POSTCARD TO "SUNNY JIM," 197, GT. PORTLAND STREET, LONDON W.1

Competition Page

DOUBLET PUZZLES (III.)

The two "Doublets" Competitions that we held last year proved remarkably popular and in response to very numerous requests from readers we announce this month a third contest of this type.

For the benefit of new readers we repeat the rules governing these fascinating word puzzles.

Two words, each containing the same number of letters, are given, and are termed the Doublet. It is required to change the first word into the second by placing connecting words between the two, each new word differing from its predecessor by the alteration of one letter only, and without any shuffling of the letters. These connecting words are called "links," and the object of the contest is to effect the necessary change from one word of the doublet to the other with the smallest possible number of links. As an illustration we give the following examples.

Change COLD to HEAT
COLD—hold-held-head—HEAT
Make LION ROAR
LION—loon-loan-roan—ROAR

The doublets that are to be solved are as follows. Competitors should note that in making the links only English words appearing in a standard dictionary may be employed. Proper nouns—names of persons, places, etc.—are not permitted.

Set	WORD	in	TYPE
Raise	TREE	from	SEED
Drop	WIND	to	CALM
Catch	FISH	on	HOOK
	BUILD	with	BRICK
Produce	PLAY	as	FILM
Reach	LAND	on	RAFT
Paint	EYES	of	BLUE
Make	VEST	of	SUIT
Get	WICKET	with	YORKER
Fill	TANK	with	FUEL
Produce	GOLD	from	LEAD

Meccano or Hornby Train goods to the value of £1/1/-, 15/- and 10/6 respectively will be awarded to the senders of the three solutions showing the lowest total of links used. In addition there will be a number of consolation prizes.

Entries should be addressed to "Doublets No. 3, Meccano Magazine, Binns Road, Liverpool," and sent to reach this office not later than 30th September. Overseas closing date, 31st December.

33rd Photographic Contest

September is a month of widely varying outdoor interest and it is fitting that a photographic competition covering this month should present a wide field for its subject. Prizes, therefore, are offered for "The Best Holiday Snapshot."

Every reader has an equal chance for photographs of any size may be submitted. The only rule is that the exposure must have been made by the competitor.

There will be the usual two sections, A for those aged 16 and over, B for those under 16. The prizes will consist of photographic materials or Meccano products to the value of 10/6 and 5/- respectively for the 1st and 2nd entries in each section. Entries should be addressed to "33rd Photo Contest, Meccano Magazine, Binns Road, Liverpool," and sent to reach this office not later than 30th September. Overseas closing date, 31st December.

My Most Interesting Holiday Experience

Before the end of this month most of our readers will have returned from their holidays, and will have many interesting recollections of certain pleasant episodes that occurred during this period. We are anxious to know how our readers have spent their summer days, and this month we announce an Essay Contest having the subject "The Most Interesting Experience of My Holidays."

The accounts should not exceed 1,000 words in length. The prizes will consist of Meccano products to the value of 10/6 and 5/- respectively for the two best entries in each of the customary two sections, A for those aged 16 and over, B for those under 16.

Entries must be addressed to "Holiday Story, Meccano Magazine, Binns Road, Liverpool," and sent to reach this office not later than 30th September. Overseas closing date, 31st December.

Home Results

31st Photo Contest

The re-introduction of the photo contests proved extremely popular and the support accorded amply justified the move. The number of entries was a record. The names of the successful competitors are as follows:—First Prizes: Section A, G. R. Grigs (Crowborough, Sussex); Section B, G. M. Lane (Wakefield). Second Prizes: Section A, J. R. Seafinch (Bourne End, Bucks.); Section B, F. C. Smith (Birmingham). Consolation Prizes:—G. E. Owen (Bristol); D. J. Barres (Merton Park, S.W.19).

May Crossword Puzzle

The Overseas Section now having closed we append the solution of the above puzzle.

D	O	U	B	L	E	T		D	O	M	I	N	I	E
I		R		A	N	D		O	R	E		O		N
S	O		H	I	T				B	A	G		P	I
S		A		D	R	Y		A	I	L		L		G
E	R	N	E		Y	A	S	H	T		C	A	L	M
N	O	T	E	D		M	P	S		P	I	C	E	A
T	E		L	A	G		A		A	R	T		A	S
				V	E	S	T	I	G	E				
A	Y		F	I	T		U		O	S	F		W	E
S	A	V	E	D		P	L	A		S	A	B	A	L
S	K	I	N		T	E	A	R	S		T	A	R	E
U		M		R	U	G		T	H	O		N		V
A	M		E	A	R				A	R	M		H	A
G		H		V	I	A		O	V	A		H		T
E	M	I	N	E	N	T		R	E	L	I	E	V	E

Short Story Competition

The number of entries to this competition surprised our optimistic Competition Editor, who did not dream even for one moment that we counted so many literary aspirants among our readers. Many of the solutions supplied were exceedingly good, and there was very little to choose between the first half-dozen entries. One boy arranged for Jack to be arrested as an absconder from a reformatory; another placed him in the hands of a group of forgers upon whom he accidentally stumbled while they were discussing the best method of disposing of counterfeit banknotes, while still a third got Jack mixed up with a band of train robbers. Another very ingenious solution had all the elements of a murder plot but eventually resolved itself into a highly entertaining farce. In the space available this month we are unable to give our own solution, and, in any case, it would be preferable to keep this unpublished until the close of the Overseas Section.

The prizes were awarded as follows:—1. J. W. L. Forge (Weybridge, Surrey); 2. G. R. Grigs (Crowborough, Sussex); 3. J. Boswell (Stony Stratford, Bucks.); 4. H. Appleton (Cathcart, Glasgow). Consolation Prizes: J. W. Broadley (Batley, Yorks.); D. Caulkin (Solihull, Birmingham); F. H. Culverhouse (Sheffield); J. S. Hobbs (Devon); F. W. Scott (Hull).

In the past we have found our overseas readers particularly ingenious and we await the arrival of their entries with more than usual interest. Boys in the East think differently from those in the West and some remarkable solutions illustrating this difference in outlook should be forthcoming.

23rd Drawing Contest

Our artist readers found here not too easy a subject. In addition to providing a distinct change from the customary type of drawing subject, the joke to be illustrated called for more than what might be termed the "obvious" illustration. The necessary humorous touch could best be secured by subtle treatment. Nevertheless we received a large entry and some really first rate drawings. The lack of space precludes a detailed review, but in a future issue we hope to give one or two illustrations from the prize winning efforts.

The prizes were awarded as follows:—First prizes: Section A, A. G. Glenn (Ipswich); Section B, H. E. Tomlinson (Northwich); Second Prizes: Section A, J. Ashton (Manchester); Section B: J. Bragg (Solihull); Consolation Prizes: P. R. Poole (Newport, Mon.); R. C. Drinkwater (Banbury).

With the Secretary

Meccano v. The Cinematograph

A debate of unusual interest took place recently at a meeting of the Sea Point Meccano Club, Cape Town, South Africa, on the educational value of Meccano as compared with the cinematograph. The result was noteworthy, for after quite strenuous arguments on both sides the vote went in favour of Meccano.

The debate was conducted more or less on Parliamentary lines, each boy representing a constituency and addressing the Chairman as " Mr. Speaker." Mr. G. E. Barrett, the President of the Club, acted as Prime Minister and the Vice-President was Leader of the Opposition.

Mr. Barrett based his case largely upon the utility of Meccano in teaching its users to observe accurately and quickly and in giving them a thorough grasp of mechanical principles of all kinds. He added that the Superintendent-General of Education had expressed himself in favour of Meccano and that three schools in the Peninsula had established Meccano Clubs. Even more interesting was the news that several boys who had been members of the Sea Point Club were now doing very well in the engineering world.

The Vice-President in reply urged that the cinematograph should not be judged by its sensational and " blood and thunder " films, but by the immense power it possessed to teach such widely different subjects as nature study, geography, industrial processes, history, music, science and physical culture.

Before the debate the members of the club had decided which side of the " house " they would support and each boy was called upon to express his views. Opinions were freely and confidently put forward, and many of the parents present were obviously surprised at the ability of these orators of from 10 to 15 years of age. One of the best arguments brought forward in favour of Meccano was that " at the cinematograph you sit and watch things being done, but at the Meccano Club you do them yourself."

At the conclusion of the debate Mr. Barrett announced that the Governor-General had expressed a desire to see some of the models made by the boys.

Guild Progress in France

The progress of the Meccano Guild in France during the past two years has been very remarkable. For some time the Meccano Club idea did not seem to appeal to French boys, but gradually they began to realise that they were missing a great deal of the interest and fun to be obtained from the Meccano hobby. As a result, clubs began to spring up in towns and villages, and to-day there are about 40 fully constituted and well-established clubs with memberships varying from half-a-dozen to 50. In addition to these regular clubs there exist in some 70 towns small bands of Meccano enthusiasts who meet at regular intervals for the purpose of building Meccano models, or for sports, rambles, etc., but who have not yet formed themselves into fully constituted clubs.

From the reports I receive it is evident that the French clubs are doing excellent work and that the members are keen and enthusiastic. As an instance of this I quote the following letter, dated 27th July, 1927, received from Mr. Henry Graffeuil, Secretary of the Meccano Club at Boulogne-Sur-Seine in the district of Châtellerault :—

" After giving several demonstrations with my Meccano Electric Tractor, which I entered for the great Meccano Model Competition, I received an invitation from Messrs. Gaudin and Penot, agents for the Fordson Tractor, to exhibit my tractor on their stand at the great Annual Fair of St. Roch at Châtellerault. The tractor will be used to drive a miniature sawmill that I have built with Meccano parts. I am sending you this news to show you what a great success Meccano is in this town, due to the Meccano Guild and the Meccano Club, whose model exhibitions in shop windows give a great impetus to the development of the hobby."

Guild Literature

The first Winter Session is now close at hand and club secretaries will shortly be requiring Membership Cards, Subscription Cards, Report Forms and supplies of Guild Application Forms, etc. In order to enable me to despatch these various items without delay I shall be glad if secretaries will let me know at the earliest possible moment their probable requirements. The beginning of a new session is an ideal time for carrying out a little extra recruiting, and I shall be glad to send supplies of the leaflet that explains the objects and organisation of the Meccano Guild.

A Note to Leaders

I shall be glad if the Leaders of all affiliated clubs will let me have their recommendations for Special Merit Medallions, for the session just closed, as soon as possible. These Medallions may be awarded for good work of any kind and need not necessarily be connected with the reading of papers.

I should also like to remind those Leaders who have promised to send me a photograph, to be reproduced in the series of Meccano Club Leaders, that these photographs should be sent along at the first possible opportunity.

* * * * *

In an interesting account of the annual exhibition of the Napier (New Zealand) Meccano Club, the New Zealand paper "*Everybody's Weekly*" says :—" The energetic and enthusiastic boys, under the Leadership of Mr. F. Drew, would seem to get more fun out of life than the average and, withal, a good training in engineering principles, ingenuity and dexterity."

Proposed Clubs

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

BUCKHURST HILL M.C.—Denis Mason, Lyndale, Palmerston Road, Buckhurst Hill.

LINDEN M.C.—W. B. Berry, 116a, Queen's Road, Battersea, London, S.W.8.

SINGLETON (AUSTRALIA).—Bill Warburton, Wyoming, William Street, Singleton, N.S.W., Australia.

TEDDINGTON M.C.—Alec M. Dale, 7, The Causeway, Teddington, Middlesex.

CLECKHEATON M.C.—John D. Buckley, 3, West View, Scholes, Cleckheaton.

CASTLE M.C.—Walter Lawrence, 48, Newbridge Road, St. Annes Park, Bristol.

ENDCLIFFE M.C.—Kenneth Stacey, 157, Rustlings Road, Endcliffe, Sheffield.

CATFORD, S.E.6.—F. B. Graves, 133, Bromley Road, Catford, S.E.6.

BRIXTON HILL M.C.—G. Morton, 17, Ostade Road, Brixton Hill, London, S.W.2.

ST. HELENS M.C.—F. Ripley, 214, Greenfield Road, St. Helens.

DEWSBURY M.C.—Eric Saville, 816, Huddersfield Road, Ravensthorpe, Dewsbury, Yorks.

WORCESTER M.C.—Reginald G. Price, Springdale House, 36, Sansome Walk, Worcester.

Exeter M.C.—The excellent record of the club's two football teams was celebrated recently when medals were presented to the boys by Mrs. M. Barracutt and the Rev. E. J. Tozer. Mrs. Barracutt also presented her own shield. Competing in Division II of the Exeter Choirs League, the Meccano New XI obtained first place and the Meccano Old XI second place. An excellent musical programme was rendered by Mr. H. Squires and his "*Merrie Makers.*" The proposal to establish a Girls' Section of the club has been definitely turned down. The membership is still increasing and now numbers over 300. Leader: Mr. M. C. Hodder, 60, Elmside, Exeter.

Northwood M.C.—Cricket and Tennis are prominent features of the syllabus. Unfortunately the Leader has been obliged to resign for a short time, but his position is kindly being taken by Mr. Whiddington. A Camp has been arranged and a large tent has been secured. Club roll: 15. *Secretary*: F. C. Brown, 27, Hallowell Road, Northwood.

Elm Road M.C.—A Mock Trial proved highly amusing, the prisoner being tried for neglect of duty and wasting time. A Suggestions Competition was a success, the winning model being a Tank with Machine Gun and Searchlight. A Club Magazine has been suggested but nothing definite has been decided. Club roll: 16. *Secretary*: Colin W. Price, 52, Queen's Road, Beckenham.

Plymouth M.C.—The Annual Exhibition was held at the Business Science School and was a great success. The models exhibited were very good, and the judges, Miss Flawn and Mr. Zannazi, had a hard task in deciding the prize winners. A Horizontal Steam Engine loaned from Headquarters proved a great attraction. The membership shows a steady increase. Club roll: 40. *Secretary*: Kenneth Wills, 8, Beechwood Avenue, Mutley, Plymouth.

Westbury M.C.—Members recently enjoyed a visit to London. Many places of interest were visited, including Buckingham Palace, St. James' Palace and the Houses of Parliament, and a most interesting day was spent. Regular weekly meetings are now being held and new members will be welcomed. Club roll: 20. *Secretary*: Eric Moye, 24, Burnell Rise, Letchworth.

Middlesbrough M.C.—Cricket is still a popular feature and meetings are devoted to matches. The Winter Session is to commence with a Recruiting Campaign and it is hoped that by this means many new members will be enrolled. The Club Magazine is to be revived in a new and improved form. Plans are being made for an Exhibition, and several Concerts and a Party are to be held. Club roll: 47. *Secretary*: A. Bradley, 95, Deepdale Avenue, Marton Grove, Middlesbrough.

Holy Trinity (Barnsbury) M.C.—The outstanding feature of the past session was a Concert which was one of the best the Club has ever held. The Model-building Competitions have produced some first-class work and the club room on the occasion that the models were being judged almost resembled an exhibition. The club rules, including regulations for the Outing Fund, Savings Bank, Games and Library, are to be issued in printed form as a club handbook. Other items include visits to Bryant & May's Match Factory at Bow; London General Omnibus Works at Chiswick; the Royal Mint and the Headquarters of the London Fire Brigade. A warm welcome has been given to the Club's new Patron, the Reverend T. G. Mohan. Club roll: 44. *Secretary*: Frederick W. Johnson, 23, Market Street, Edgware Road, London, W.2.

Albert Village M.C.—Good progress is reported and several new members have been enrolled. Cricket matches have been played against neighbouring teams and these proved quite an attraction. The Stamp Section is very popular and has aroused keen interest among members. Club roll: 17. *Secretary*: L. C. Adey, 239, Occupation Road, Woodville, Burton-on-Trent.

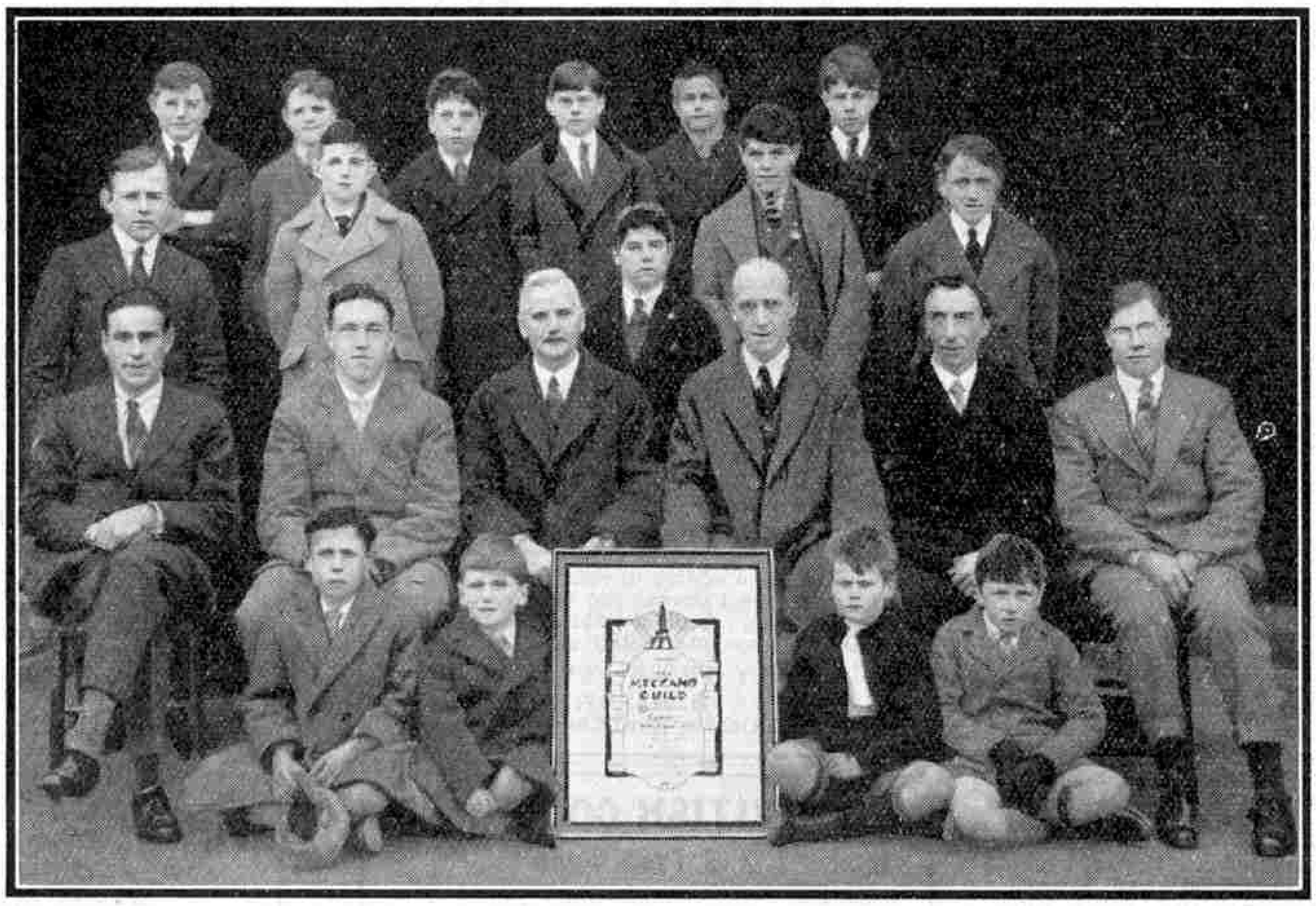
Hastings Central M.C.—Successful meetings have been held and the club has secured a Hornby Layout which is run in conjunction with Meccano Models made by members. The club room has recently been re-decorated by members and looks quite fresh and attractive. It is interesting to note that nearly all the members have joined the Meccano Guild. Club roll: 19. *Secretary*: W. V. Veness, 9, Earl Street, Hastings.

Withington Kim M.C.—Cricket has been the most popular feature recently. A Games Night is to be held shortly. One "Good Turn" is done by members every month, and recently this took the form of delivering a number of circulars in the district for a local Church. Club roll: 11. *Secretary*: Cyril Ball, 45, Davenport Avenue, Withington, Manchester.

Willingham M.C.—An Exhibition was organised at a Garden Fete and was a great success, the proceeds being given to the fund for lighting the Church. Meetings are well attended and future arrangements include Cycle Runs, Rambles and Swimming. It is greatly regretted that Mr. D. E. G. White has to relinquish Leadership on account of leaving Willingham. Fortunately a successor has been found in Mr. Albert Allen, and there will be no break in the club's activities. Club roll: 13. *Secretary*: R. W. Huckell, Short Lane, Willingham, Cambs.

Weston M.C.—The event of chief interest was a visit to Avonmouth Docks, where members were shown over a liner. Most of the time on board was spent with the Engineer-in-Charge, who carefully explained every detail of the two 7,000 h.p. Triple Expansion Engines. The Wireless Cabin was explored and the Compass explained. Members were particularly delighted by being "imprisoned" in the stern by the closing of one of the automatic doors! The outing was voted one of the best during the session. First Aid classes are still being held and keen interest is taken in them. Club roll: 22. *Secretary*: R. B. Nichols, "Little Combe," The Shrubbery, Weston-Super-Mare.

Tenterden Meccano Club



The Tenterden Meccano Club was established early last year by Mr. H. Clare, who has acted as Leader throughout its career. Exhibitions of models built by the members have aroused a great deal of local interest and have resulted in a steady increase in membership. Lectures form a prominent and popular feature of the club's programme.

Withington M.C.—Rounders and Cricket have been very popular. A Garden Fete was held quite recently and was a success. Among the attractions were Hoop-la, Darts and Skittles, and a Tuck Shop was well patronised. The Meccano Stall attracted much attention and many good models were exhibited, including an Aeroplane, two Tram Cars, a Roulette Wheel and a Battleship. Competitions and races were held during the afternoon and the proceeds were given to the club funds. Arrangements for the future include Rambles and First Aid. Club roll: 12. *Secretary*: K. Cradduck, 36, Mauldeth Road, West, Withington, Manchester.

Ashburton School M.C.—A recent Battlefield Evening proved a great success. A table was laid with large stones under a green cloth to represent hills and rocks and glass was used for rivers. Sides were taken under two "Generals" and the object was to set up Bridges and build Machine Guns, Tanks, etc. The side having the most formidable equipment on the field at a given time was declared the victor. A "Towers Evening" was also successful, the winning model being one of the Control Tower at Croydon Aerodrome, fitted with electric light. Club roll: 22. *Secretary*: Miss P. Davison, 125, Anerley Road, S.E.20.

Barrow M.C.—Has been rearranged and new officials have been elected in addition to a new Committee. The Leader is endeavouring to arrange visits to the "*Barrow News and Mail*" office, the Post Office and Vickers Shipyard. The Swimming Section is popular and fortnightly visits are paid to the public Swimming Baths. Club roll: 22. *Secretary*: Wm. Eric Kelly, 157, Abbey Road, Barrow-in-Furness.

Hessle M.C.—Has been fortunate in winning two recent cricket matches with a good score. The weekly meetings are held out of doors whenever possible. Stamp Collecting is still a popular feature. Club roll: 22. *Secretary*: T. A. Fillingham, "Red Lea," Marlbro' Avenue, Hessle. (*Continued on page* 832)

THE ELEPHANT ON STAMPS

OUR last stamp article dealt with some curious birds of the Southern Hemisphere; this month we are going to deal with what is undoubtedly the most impressive figure of the whole animal kingdom of to-day—the elephant.

There are only two known species of elephant living to-day, the African and the Indian, the latter being found in several parts of Asia. The two species differ somewhat in appearance and size, the African elephant averaging approximately a foot taller than the Indian elephant of similar age. A big height for an Indian bull would be 9 ft. 6 in., while 10 ft. would be exceptional. The corresponding African elephants would range from 10 ft. 6 in. to 11 ft.

The Indian elephant has comparatively small ears and tusks; indeed in the case of the female the tusks are so small that they hardly protrude from the jaw. The African elephant, on the contrary, has very large ears and very large tusks in both sexes, and an excellent idea of the size of these is gained from the 10 fr. stamp of the Belgian Congo issue of 1923 reproduced here. An African elephant in full charge is an awe-inspiring sight, for with its trunk thrown aloft and its ears widespread it measures from 8 ft. to 9 ft. from ear tip to ear tip across the forehead. The vast size of one of these creatures is well shown in the Liberian $5 stamp of the 1921 issue. This stamp shows the elephant advancing peacefully, but it needs only a slight effort of imagination to picture his appearance when enraged! The 5c. stamp of the Liberian 1897 issue, also illustrated here, aids the visualisation.

The Indian elephant intensely dislikes the heat of the sun and during the daytime will retreat into the shady depths of the forest, venturing into the open only in the cool of the night. The African elephant does not appear to share this aversion to heat. Both species are almost exclusively vegetarian in their diet, but while the Indian lives chiefly on grass and the fresh shoots of trees, the African eats roots, tubers, bulbs and branches. The tusks, by the way, are used by the African elephant for rooting in the ground in search of food and water.

It is sometimes said that the elephant possesses a brain of low thinking power and has not the intelligence popularly assigned to it; its tricks in captivity being attributed solely to its imitative faculty. Against this, however, there can be set numerous instances of wild elephants displaying ingenuity of no mean order. On one occasion a "rogue" elephant—an outcast from its herd—roamed close to a native village and when attacked by two natives turned upon them and forced them to take to a tree. Desperately the animal sought to reach the men. First it butted the tree with its forehead. Then, finding that ineffectual, it endeavoured in vain to uproot the tree with its tusks. Presently it spied a heap of logs piled ready for carting away. Trumpeting shrilly, as though in triumph, it seized log after log, piling each on the other at the foot of the tree. Then, mounting the pile, it again endeavoured to reach the men. Unfortunately for the success of this undoubtedly clever scheme, the elephant came sufficiently close to enable one of the "treed" men to get home a shot in a vital part.

The strength of the elephant is enormous, and on this account it is greatly in demand for heavy work in India. In this sphere the elephant displays the extraordinary powers of his trunk, which is said to contain nearly 40,000 separate muscles, and as a result has a wonderful range of flexibility. By means of its trunk an elephant can pick up a huge baulk of timber or a pin. The trunk is not used for carrying purposes, however, save in the case of very light objects; it is far too delicate an instrument. The huge baulks of timber are balanced across the tusks and some really amazing weights are carried in this manner.

At one time the animals were used in time of war and in the forefront of the battle they presented an imposing array. Great wooden "howdahs" capable of holding 32 archers were fastened on their backs and from the cover of these the fighting was conducted. But the elephant in battle was very easily rendered uncontrollable. An injury to its trunk was enough to cause it to run amok and probably do more damage to its own side than to the enemy!

The illustration of the stamp of the Perak 1895/7 issue shows three elephants, accompanied by one young elephant, engaged in transport work. The centre animal is carrying a howdah of the type used by sportsmen when hunting big game in the Indian and Malayan forests.

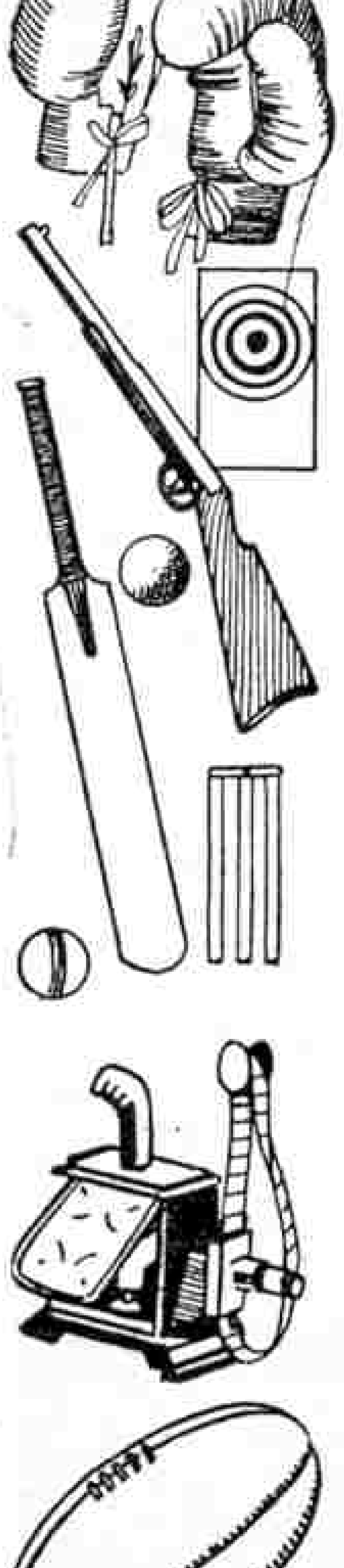
Elephants have been employed for labour and transport in Asia for many hundreds of years, but as they rarely breed in captivity, new animals can be obtained only by the capture of wild ones. Whole herds are secured at once by constructing in the depth of the forest a huge corral, with an opening on one side only. A vast army of beaters is thrown around the area in which elephants are known to be present and, frightened by the terrific din created by the beaters, the animals gradually move forward. To lessen the chances of escape by breaking through the ring of beaters, fires are lit at frequent intervals.

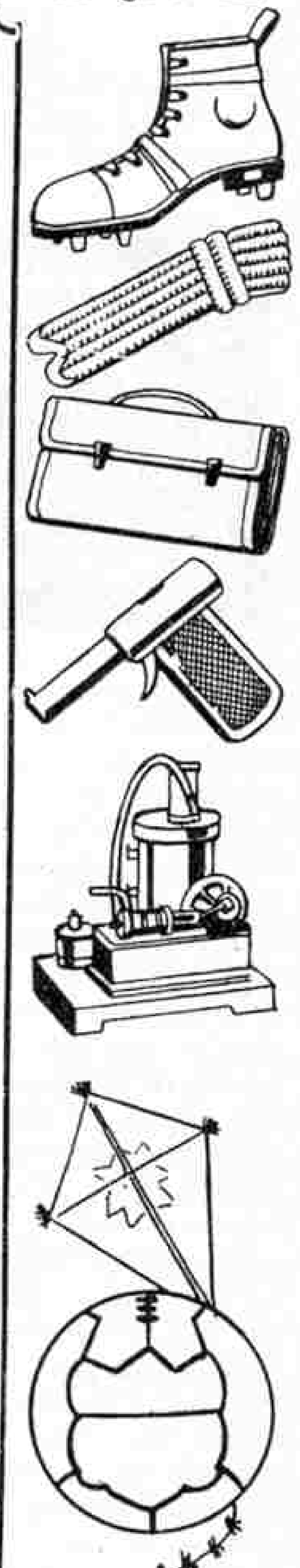
When the signal is given for the final onslaught, the beaters, brandishing lighted torches, close in upon the elephants, which, seeing no way clear save that in the direction of the corral, dash into the trap. Immediately the entrance is securely barricaded against the blows given by the infuriated animals as they rush round and round seeking a means of escape. At length, exhausted and cowed, they gather in the centre of the corral, too frightened to exert further resistance. Several tame elephants, each bearing a "mahout" or driver, then enter the corral and mingle with the captives. The sense of security thus given

(*Continued on page 829*)

The Store that Specialises in Boys wants GAMAGES

In this page we try to convey but a faint idea of our gigantic stock of good things. For we have made a special study of the needs of the Modern Boy and are the Greatest Store in London that caters for Boys in their every Hobby, Sport and Pastime. Write to us about it and we will send you post free full particulars of "Your Wants."





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O.	7 ,,	4 ,,	...	**28/6**
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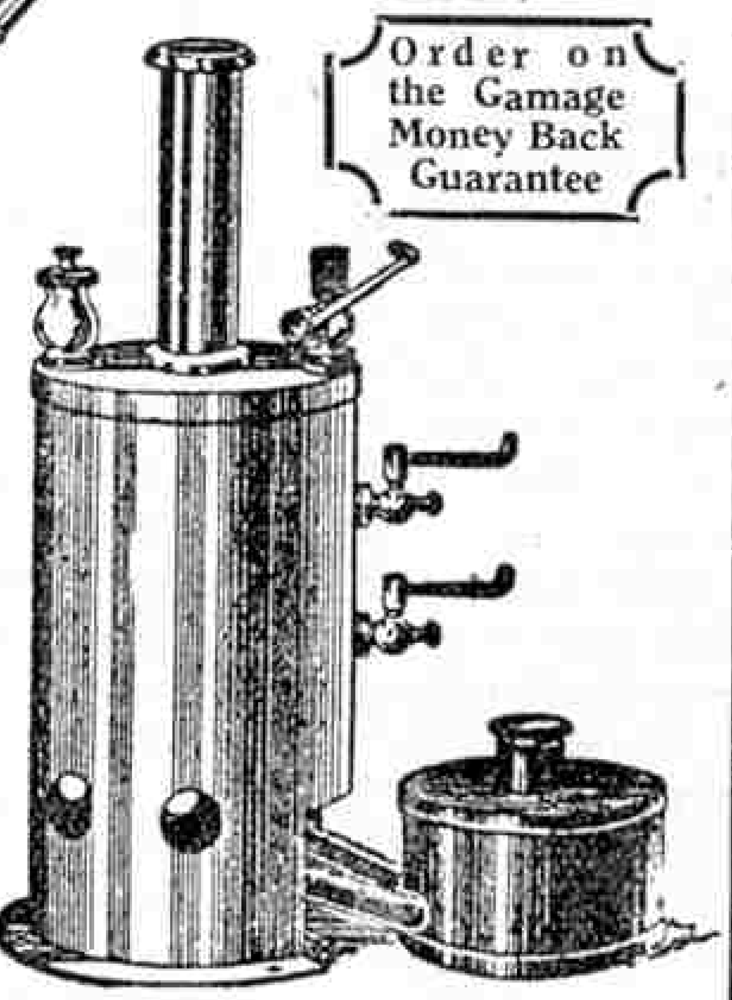

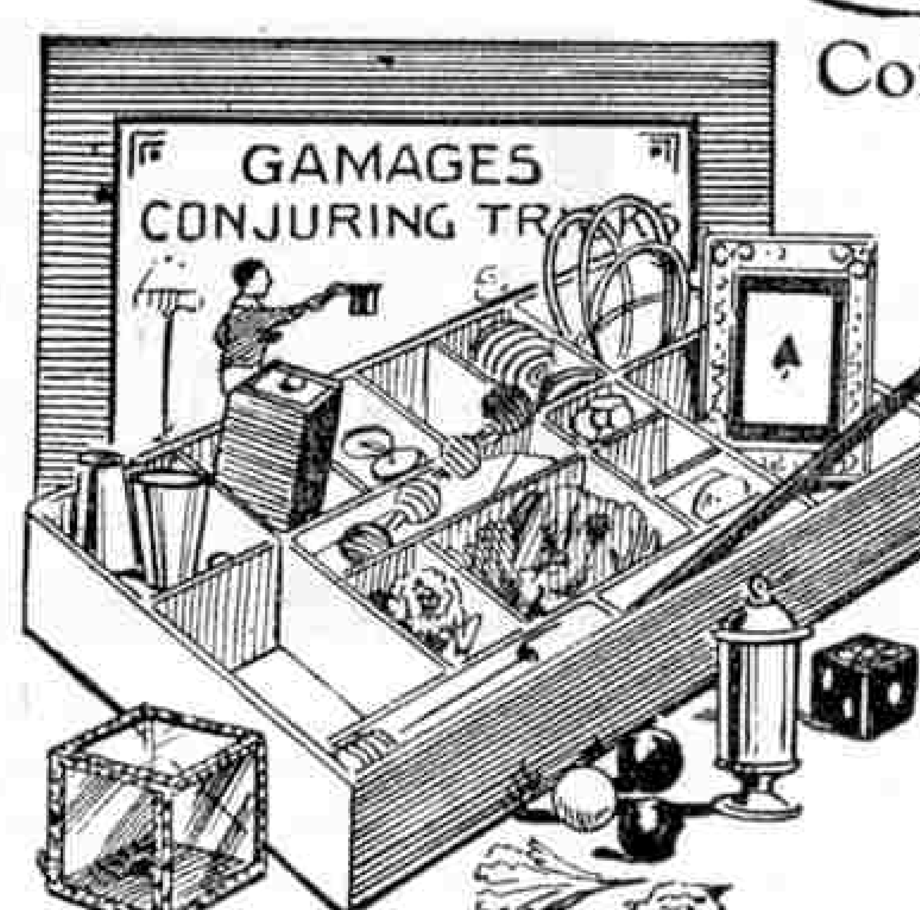

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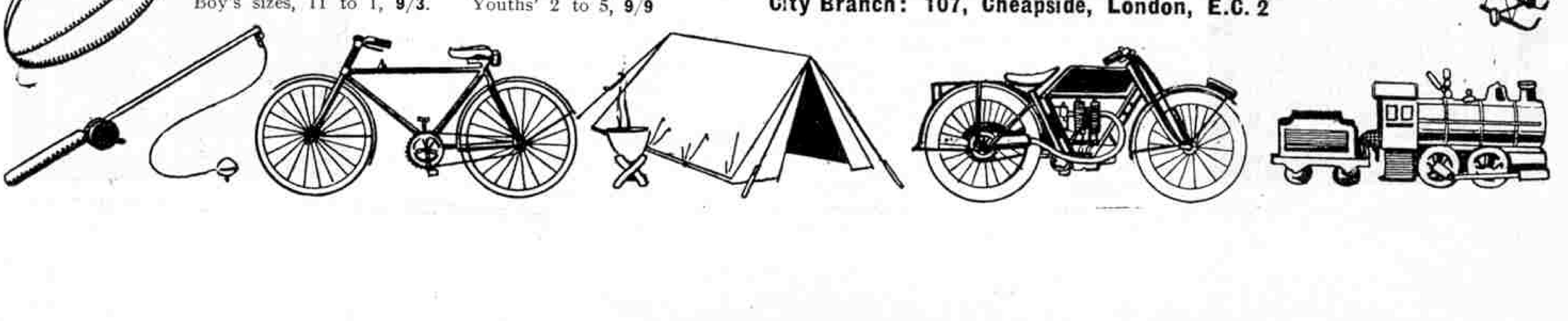


Further Stamp Adverts. on page 840

throws the captives sufficiently off their guard to permit of nooses being put over each of their legs, and with these the captives are securely roped to the trunks of stout trees.

Training then commences. Kindness and severity both play their part in this process, which occupies only a short period, often barely two months. The captive is then sufficiently tamed to allow a howdah to be placed on its back, and, after three or four months it can be put to work.

There are on record many thrilling episodes of elephant hunting for sport. Shooting the beasts from long range is comparatively useless, and close range work is—to say the least—exciting! The elephant, despite its bulk, can move quickly, and once it has made up its mind to attack its assailants it is relentless. The elephant hunter therefore must possess nerves of steel, powers of instant decision and complete mastery of his weapon. Even at fifteen paces the elephant's hide will turn all bullets save those aimed directly at its vulnerable spots. These may not be accessible to the hunters at first, and a preliminary "tickler" to cause the elephant to turn and face the guns may be necessary.

Elephant hunting is not always a one-sided affair, as the following story shows. A British ex-officer, while a member of a big game shooting expedition in Africa, lost his way in the jungle when taking a short cut to rejoin his friends, from whom he had separated temporarily. As he was crossing a small clearing close to a river bank he heard cries from his native servant, and on turning saw five elephants charging from the jungle directly towards him and not 200 yards away. Realising that the beasts were in flight from his friends, and knowing that an ineffectual shot from his position in the centre of the clearing would serve only to focus attention upon himself, he slipped quickly to one side out of the elephants' direct path. Had he been unobserved, his ruse would have been successful, but, to his horror, the infuriated beasts changed direction and bore down upon him.

There was now only one thing for it—to seek the shelter of the rocks on the further side of the river. The effort was unavailing, however, for before he had got within 50 yards of the river the elephants were barely 20 yards away. The hunter turned and, in spite of the apparent hopelessness of his position, took aim at the largest beast, a big female. Unsteadiness of aim resulted in the bullet only grazing the animal's head, and with a great trumpeting she charged upon the luckless hunter. Down he went, struck by her trunk. Fortunately a savage jab with her single tusk—the other was a broken stump—missed its mark, though only by inches. Again the trunk came into action and hurled him on to the ground between the beast's great forefeet. Down pressed a foot on his chest with so great a force that, he related afterwards, he felt his breast bones bend under the strain.

Throughout this terrible ordeal the hunter retained consciousness and, remarkable to relate, a clear, cool head. Twisting and turning, he managed again and again to evade the full force of the pounding feet. Once the elephant trod on his arm, but that happened to be lying absolutely flat upon the ground and beyond a crushed muscle no serious harm was done. Shortly afterward two of the hunter's companions arrived on the scene and drove off the great beast. To their amazement their colleague staggered to his feet, bleeding profusely, but otherwise practically unharmed!

From a commercial standpoint, the greatest value of the elephant lies in the ivory of its tusks. At one time England alone imported 1,200,000 lb. of ivory annually. This involved the sacrifice of the lives of not less than 30,000 elephants, and in order to keep pace with the world demand at least 100,000 animals were slain each year.

So extensive has been the depletion of the herds owing to the depredation of ivory hunters that the British and other Governments have passed laws prohibiting the killing of the beasts in various parts of their territories. In the game preserves thus created it is hoped that the elephant will re-establish itself and be preserved from extinction.

Some idea of the size of tusks is conveyed by the illustration of the Mozambique stamp. It will be seen that the tusks depicted are considerably taller than the native, but it must not be assumed that every tusk grows to this size. The record is held by a specimen now housed in the American National Collection. This tusk weighs 226½ lb. and is 11 ft. 5½ in. in length!

There are two grades of African ivory, hard and soft, the former coming from the west coast and the latter from the east. The hard ivory is particularly suitable for carving and delicate statuary, while the soft variety, owing to its elasticity, is used principally in the manufacture of billiard balls.

Some of the stamps reproduced have not been referred to specially in this article. Two of them, however, the 5c North Borneo of 1909 and the Sirmoor (Indian Native State) of 1895/99, illustrate interesting points. The former gives a very clear idea of the height to which an Indian elephant grows. The animal illustrated is a big one and, assuming his mahout to be of average stature, will be over 9 ft. in height. With the designer of the Sirmoor stamp we have a quarrel. The tusks of the elephant are shown projecting horizontally. Actually an elephant's tusks grow from its mouth along a straight line drawn down the forehead and the upper portion of the trunk.

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.

TO BURY TWO

A famous K.C., who in early life had a hard struggle to make both ends meet, was once asked by an acquaintance to subscribe ten shillings towards the funeral of a man who had died penniless.

" What was he ? " asked the K.C.

" A bailiff, sir," replied the applicant.

The K.C.'s eyes lit up with memories. He went to his desk and returned with a note which he thrust into the man's hand, saying : " Here's a sovereign. Bury two of them ! "

* * * *

Little Johnny, a city boy in the country for the first time, saw the milking of a cow.

" Now you know where the milk comes from, don't you ? " he was asked.

" Sure ! " replied Johnny. " You give the cow some breakfast food and water, and then drain the crankcase."

* * * *

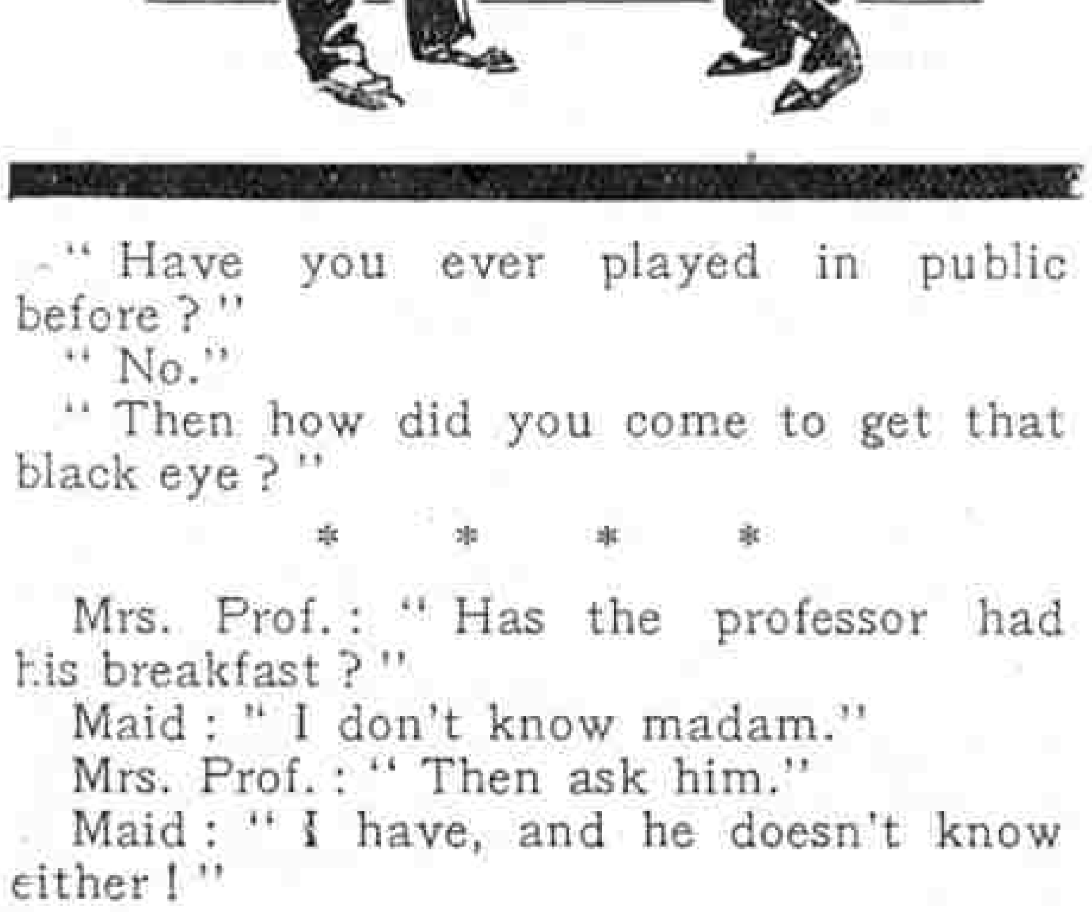
Old lady : " Guard, I hope there won't be any collision."

Railway Guard : " Oh, no fear of that, madam."

Old lady : " Well, I want you to be very careful. I've got two dozen eggs in this basket ! "

* * * *

AN AWARD OF MERIT



" Have you ever played in public before ? "

" No."

" Then how did you come to get that black eye ? "

* * * *

Mrs. Prof. : " Has the professor had his breakfast ? "

Maid : " I don't know madam."

Mrs. Prof. : " Then ask him."

Maid : " I have, and he doesn't know either ! "

THE MAN WHO KNEW

An engineer, while explaining the operation of a machine in a factory, got so annoyed at the interruptions of a certain man that he refused to continue, and walked away.

" Who is the fellow who pretends to know more than I do about that instrument ? " he asked another man.

" Oh, he's the man who invented it ! " was the answer.

* * * *

THE EXPLANATION

Old Salt : " The surgeon said to me, ' I'm sorry, but there's a sponge missing, and I believe it's inside you.' ' What's the odds,' I said, ' Let it be,' and there it is to this day."

Gullible Old Gent : " Bless my heart."

Old Salt : " I don't feel any particular pain from it, but I do get uncommonly thirsty."

* * * *

THE IN-LAWS

A man was one day visiting a lunatic asylum and while walking in the grounds he met a patient to whom he said :

" Well, how did you get here ? "

The man replied : " Well, sir, you see, I married a widow with a grown-up daughter, and then my father married my wife's daughter, that made my wife the mother-in-law of her father-in-law, and my father became my step-son. Then my step-mother, the daughter of my wife, had a son, and that boy, of course, was my brother, because he was my father's son ; but he also was my wife's step-son, and therefore, her grandson, and that made me the grandfather of my step-brother. Then my wife had a son, so my mother-in-law, the step-sister of my son, is also his grandmother, because his step-sister is his wife. I am the brother of my own son, who is also the son of my step-grandmother. I am my mother's brother-in-law, my wife is her own child's aunt, my son is my father's nephew, and I am my own grandfather. That's one reason I am here, sir."

HOW TO DO IT

It was in the early days of American railways on a small loop line, and the engine would not run. Jenkins was ordered to repair the engine and put it back in commission.

" It can't be done," said Jenkins to the superintendent.

" You know what orders on a railroad are," said the superintendent, " it must be done."

But Jenkins was not convinced, so he sat down to indite a letter to the management, and this is what he wrote :—

" Dear Sirs,—The only way your locomotive can be repaired and made to run is to jack up the whistle and build a new engine round it ! "

* * * *

Freddy : " Dad, what does a kangaroo do with its pouch ? "

Dad (absorbed in book) : " When the kangaroo is being pursued he gets inside it, my boy ! "

* * * *

The Commanding Officer hurried up to Pat in the trenches and asked anxiously : " Pat, can you reach headquarters ? "

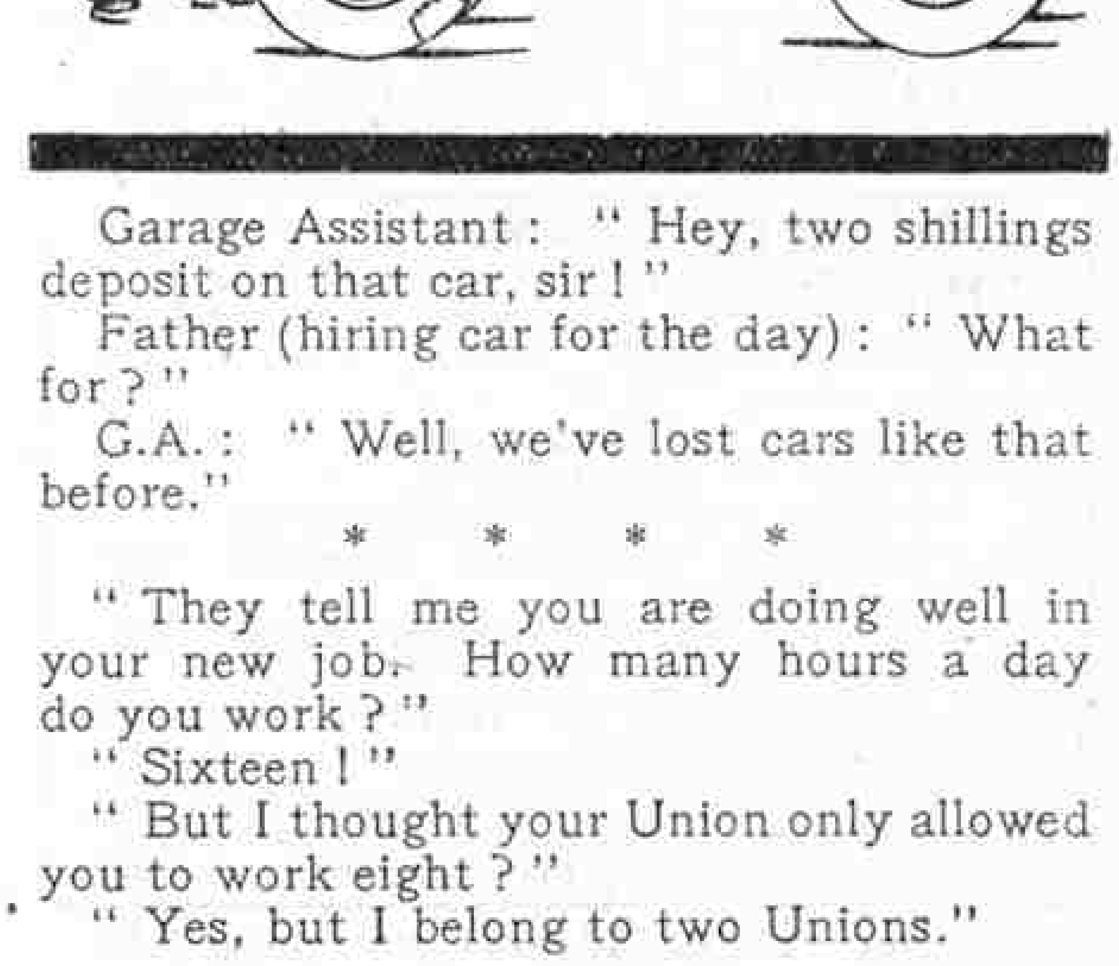
" I'll try, sir," said Pat.

" Well, tell them that the Germans are advancing on the left flank, and ask them to send reinforcements."

Pat reached headquarters some time later and, although nearly breathless, managed to gasp : " Germans are dancing on a wet plank—send three-and-fourpence!"

* * * *

NOT A 1927 MODEL



Garage Assistant : " Hey, two shillings deposit on that car, sir ! "

Father (hiring car for the day) : " What for ? "

G.A. : " Well, we've lost cars like that before."

* * * *

" They tell me you are doing well in your new job. How many hours a day do you work ? "

" Sixteen ! "

" But I thought your Union only allowed you to work eight ? "

" Yes, but I belong to two Unions."

HOW HE SCORED

A man who was always singing to himself was persuaded by his friends to take the thing up seriously.

After much trouble they succeeded in persuading a concert manager to give him an audition.

The manager listened to a song or two, and then said, " Yes, not bad, but I should like to hear an ' h ' or two."

The man winked. " You don't catch me that way, guv'nor," said he. "I know there ain't no 'igher note than 'g.' "

* * * *

" When are you going back to school, Willie ? "

" I'm not going back, because the teacher's gone mad ! "

" Gone mad ? "

" Yes. One week she tells us four and one make five ; now she says three and two make five."

* * *

The owner of a popular brand of car was having trouble in starting his engine.

After watching for ten minutes the man's wrestle with the starting handle a little boy asked his father :—

" How far will it go after he has finished winding it ? "

* * *

Patient : " Why does a small cavity seem so large to the tongue ? "

Dentist : " Just the natural tendency of the tongue to exaggerate, I suppose ! "

* * *

" Hey ! " cried the carpenter to his apprentice, " didn't I tell you to notice when the glue boiled over ? "

" Yes," answered the boy. " It was just a quarter past ten."

ONE BETTER

Two small children, the daughters of ex-soldiers, were hotly discussing the merits of their fathers. At length one of them said fiercely :

" My father has heaps and heaps of medals, and he has a Victoria Cross, and the King pinned it on with his own hand."

" That's nothing," retorted the other ; " my father has dozens and dozens of Victoria Crosses, and he has a wooden leg, and the King nailed it on with his own hand ! "

* * * *

" Why is a black hen cleverer than a white hen ? ' asked the little boy as he sat at the breakfast table with his father.

" Don't know, my boy," said the father. "That's a puzzler, I think ! "

" Oh, no ! " cried the child triumphantly, " it's because a black hen can lay a white egg, but a white hen can't lay a black egg."

THE COMMA

The school inspector began to question the pupils on punctuation, when the local Mayor, a pompous individual, who was visiting the establishment, interrupted him. " It is foolish," he said, " to bother about commas and such like."

This made the inspector angry. He turned to the class and told a boy to write on the blackboard, " The Mayor of Cheesington says the inspector is a fool."

That was done.

" Now," said the inspector, " Put a comma after Cheesington and another after inspector ! "

* * * *

" Can any little boy," asked the new teacher, " tell me the difference between a lake and an ocean ? "

" I can," replied the small boy who had evidently had experience in both ; " lakes are nicer to swallow when you fall in."

* * *

" I called to make an appointment with the dentist."

" He's out just now."

" Ah ! When do you expect him to be out again ? "

* * *

Hopeless Golfer : " I have a brother in Australia, who is very good at this game."

Caddy : " Well, keep on going sir, you'll soon dig him up."

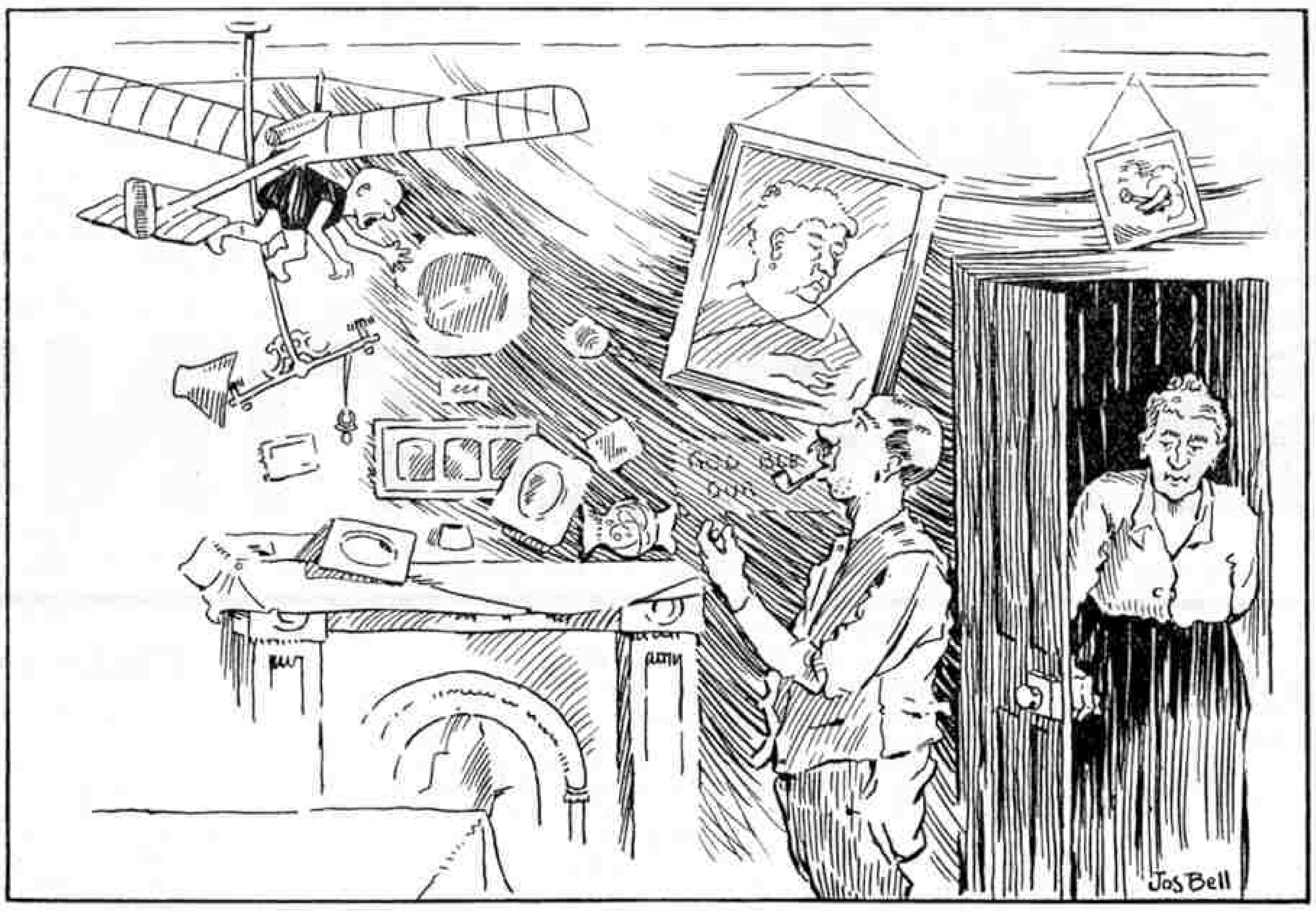
* * *

Teacher : " Do you know anything worse than a giraffe with a stiff neck ? "

Pupil : " Yes, sir."

Teacher : " What ?"

Pupil : " A centipede with corns."



Courtesy] [The Gloster Magazine

An enthusiastic Member of the Model Aeroplane Club tries Passenger Carrying

* * * *

It was close on closing time in a city park, and the park-keeper approached a tramp who was sleeping on one of the seats. " Hey, you ! " he shouted. " I'm going to close the gates now." " Good on yer, old man ! " said the tramp, rubbing his sleepy eyes. " I thought there was a draught somewhere ! "

* * * *

IN THE FLESH

School was about to break up for the Christmas holidays, and the inspector had chosen this great day to look in and make things uncomfortable.

" Now, boys," he said, " we will take a lesson in reading. Let us take the ' Spectre of Brocken,' " he continued, turning to the reading book. " But, first of all, which of you can tell me what a spectre is ? "

There was a dead silence for a few moments, for the point was one on which the lads had not been informed. Then up went the hand of the smallest boy in the class.

" Well, my lad," said the great man, " what is a spectre ? "

" P–please, sir, you are one ! " was the little fellow's answer.

American : " Your trains go slowly. Why, some of ours go at the rate of 200 miles an hour ! "

Englishman : " That's nothing ! Once I took a first-class ticket to Birmingham and went in a second."

* * * *

Teacher : " Can any boy tell me what comes in like a lion and goes out like a lamb ? "

Billy (aged 9) : " Please, sir, I know."

Teacher : " Well, Billy, what is it ? "

Billy : " The landlord, when father pays the rent ! "

* * * *

SOME MISTAKE HERE

Black : " Charlie, did you hear that joke about the Egyptian guide who showed some tourists two skulls of Cleopatra—one as a girl and one as a woman ? "

Brown : " No ; let's hear it."

* * * *

Sarah, an old coloured cook, was moaning around the kitchen one day, when her mistress asked her if she was ill.

" No ma'am, not 'zackly," said Sarah, " but de fac' is, I don't feel ambition 'nough to get outer me own way."

The doctor's son was entertaining his friend in his father's den, and they were looking with awed admiration at a skeleton in the cupboard.

" Where did your father get it ? " asked the small guest in a whisper.

" Oh ! he's had it a long time. Maybe that is his first patient," said the medico's son, hopefully.

* * * *

EASY THINGS AT FIRST

Farmer : " Now, come along, and I'll teach you to milk the cow."

Extra Hand : " Seein' I'm new at it, mister, hadn't I better learn on the calf ? "

* * * *

In a railway carriage on the way to London, a youth very much disturbed and enraged the other passengers who wished to read their morning papers, by loud and silly remarks to his companion during the greater part of the journey. As the train passed a well-known lunatic asylum he said : " I often think how nice the asylum looks from the railway."

" Some day," growled the man in the opposite seat, " you may probably have occasion to remark how nice the railway looks from the asylum."

Club Notes

(*Continued from page* 825)

Cranham M.C.—New members are urgently needed and will be given a hearty welcome. Any boy in the district wishing to join the club should communicate with the secretary, who will be pleased to give full particulars. Games Evenings are popular and nature study visits to a local pond have been recommenced. *Secretary* : J. G. Cheshire, Post Office, Cranham.

Whipton M.C.—Table Tennis tournaments have been arranged and are very much enjoyed. Model-building is not neglected, and recent efforts include a Racing Car and a Tram. A Cycling Section has been formed and several enjoyable outings have already been organised. A Boating Section also has been formed. Club roll : 13. *Secretary* : N. H. S. Martin, 30, Whipton Road, Exeter.

St. Albans M.C.—Two carts were decorated for the local Hospital procession and they aroused a great deal of interest, one being arranged as a Dockyard and the other as an Aerodrome. Cycle runs to various places of interest have been arranged, with Cricket for boys who do not possess bicycles. An outing for the whole club is to be organised during this month. Club roll : 22. *Secretary* : H. M. Upward, 19a, Worley Road, St. Albans.

Stotfold Pioneer M.C.—Cricket has been the most prominent feature of the syllabus and various matches have been played. Preparations are on foot for a Display of Models in connection with the Hospital Day procession. Club roll : 13. *Secretary* : E. Ray, Stotfold House, Stotfold, Nr. Baldock.

Sittingbourne Baptist M.C.—Excellent progress is reported and an assistant Leader has now been secured in Mr. B. White, who is the fortunate possessor of a No. 7 Meccano Outfit. Several interesting Lectures have been given. A Contractors' Night proved highly successful the contract being to build a viaduct across a busy road. Meetings are now being held fortnightly. *Secretary* : Donald L. Thorn, The Anchorage, Addington Road, Sittingbourne.

Bentcliffe (Pendleton) M.C.—An interesting talk on "*The Making of Guns and Shells at Woolwich Arsenal*" was delivered by the Leader, Mr. J. Chappell. A paper entitled "*Safety at Sea*" was given by F. Dewhurst and greatly enjoyed. A Hornby Night was a success and it is proposed to organise an Exhibition, for which a model is to be loaned from Headquarters. A silver medal has been given by a patron of the club and is to be presented to the member having the highest number of marks at the end of the session. Club roll : 14. *Secretary :* Edward Shorrock, 27, Trafalgar Road, Pendleton, Manchester.

South Africa

Clifton (Johannesburg) M.C.—The first Exhibition of Meccano Models proved a great success and was followed by a Concert. Many good models were on view, including several loaned from Mr. A. E. Harris. Members of the Malvern M.C. were present in full force and spent an enjoyable evening. The Concert passed off splendidly and a considerable sum was realised. An Exhibition will now be held every year. A Football Match with Malvern M.C. resulted in a win for the latter. Club roll : 36. *Secretary* : Hermann Jacobsen, 169, Loveday Street, Clifton, Johannesburg, Transvaal, South Africa.

Australia

Hampton M C.—The Exhibition was a great success and quite a large sum was raised. First Aid lessons are to be introduced and members are looking forward keenly to them. A Social and Anniversary Night has been arranged. The activities of the club are numerous and include Stamp Evenings, Hornby and Meccano Evenings, Physical Exercises, and " Hare and Hounds," by way of a Saturday afternoon diversion. *Secretary* : F. G. Wallis, 9, Kerford Street, Hampton, Victoria, Australia.

Waverley M.C.—Good progress is reported and several new members have joined recently. The club now has a good cash balance to its credit. Model-building is very popular and the Library is about to be re-opened. Several new books have been purchased and new games have been bought for the use of members on club evenings. Victor Worstead has resigned from his position as secretary and J. Brown has been elected in his place. *Secretary* : J. Brown, 82, Victoria Street, Waverley, Sydney, Australia.

New Zealand

Napier M.C.—The Annual Exhibition recently held proved extremely successful. It was opened by Dean Mayne in the presence of a large gathering of parents and friends. On the many green tables were displayed examples of the Club's Model-building activities. A Meccano Theatre complete with a trio of performers attracted a great deal of attention and among other popular models were a Concrete Mixer, a Roundabout, and a weird reproduction of a prehistoric animal of the Diplodocus variety. An elaborate railway system was laid out at one end of the room and was quickly discovered by the model railway enthusiasts present. The club is now in a thoroughly sound position, financially and otherwise. The subscription is half-a-crown per annum and meetings are held weekly. *Secretary* : Loxley Pickering, Shakespeare Road, Napier, New Zealand.

Clubs not yet Affiliated

Silverdale M.C.—Good progress continues to be made but the club is greatly handicapped by the fact that a Leader has not yet been secured. The secretary will be very glad to send full particulars to any gentleman in the district who is willing to help the club. *Secretary* : Henry Storrer, Ecclesbourne, 23, West Side, Wandsworth Common, London.

Teddington M.C.—Has been concentrating its efforts mainly on Model Railway Building and an efficient track has now been completed. A recent Sports Evening proved very successful. Among the most exciting events was a novelty entitled " Greyhound Racing." In this event one boy is chosen as hare and travels away as fast as he can on all fours while the others, also on all fours, give chase. Unfortunately the Leader has resigned but strong efforts are being made to secure the services of another Leader as soon as possible. *Secretary* : J. R. Woolford, Harley House, Gloucester Road, Teddington, Middlesex.

Leytonstone M.C.—An adult Leader has not yet been secured and any assistance in this direction will be greatly appreciated. The secretary will gladly send full details to any gentleman who is interested in this scheme. The membership is gradually increasing. Club roll : 12. *Secretary* : G. L. Twelvetree, 52, Richmond Road, Leytonstone, London, E.11.

Finchley & District M.C.—The first meeting of this club was held at the home of the secretary and was very successful. It is hoped to secure a good Leader in the near future. It was decided to divide the club into two sections, one for Meccano and Electricity and the other for Model Railways, each section to be under the control of a sub-Leader. An entrance fee of 6d. is to be charged and the weekly subscription is 2d. It has been arranged to hold a Stamp Evening once every three or four weeks. New members will be very welcome. *Secretary* : D. P. China, 18, Hilton Avenue, North Finchley, London, N.12.

Limerick M.C.—The membership is steadily increasing but an adult Leader has not yet been secured. Members would be very grateful for assistance from any gentlemen in the district who are interested. *Secretary* : V. O'Connor, Garrymore Mount, Vincent View, Limerick.

Barrow-in-Furness M.C.—Members are fortunate in having the loan of an excellent club room over the Waverley Hotel. For this they are greatly indebted to Mr. and Mrs. Sansom, whose son in addition has placed at the disposal of the club a cinematograph and many films, with which jolly evenings are spent. Members hope to visit the Exhibition of the Barrow M.C. *Secretary* : Len Martin, 147, Greengate Street, Barrow-in-Furness.

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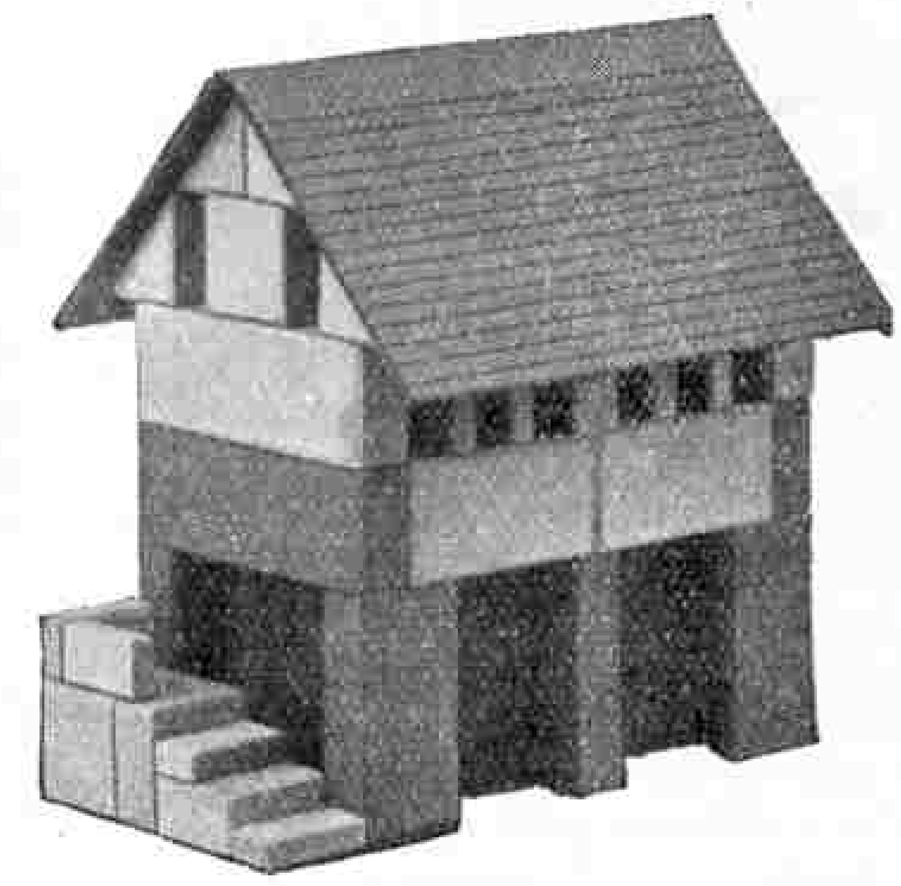

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The indispensable adjunct to all users of "Meccano" Construction Sets and Miniature Railways: your little screws and small sections do not roll away and get lost the moment you put them down if you dab them on a slab of Plasticine, that alone is worth all the cost of the "Rainbow" which is only 1/- post free. There are dozens of other things you can use it for too!

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Cameras Free. Not a competition. Stamped envelope for particulars.—Panograph Co., 61, Waring St., Belfast.

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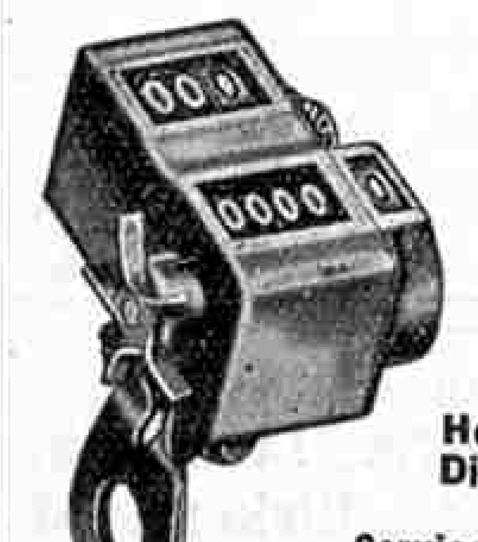

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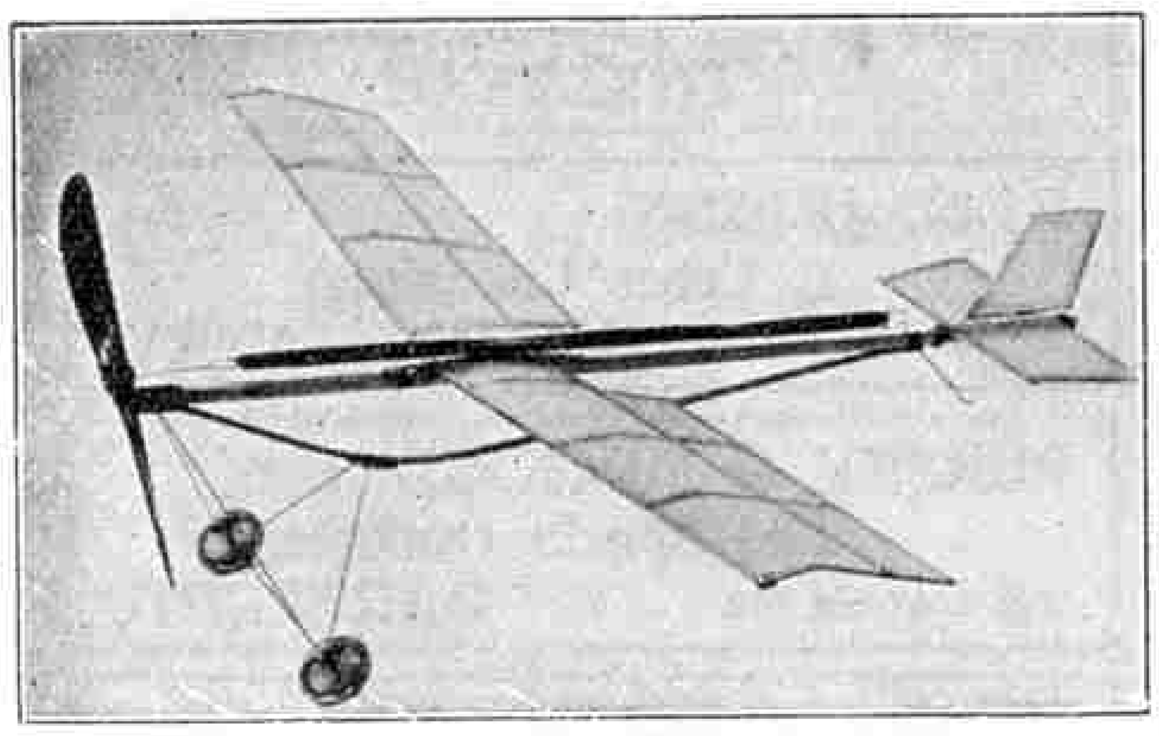

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179, Dickenson Rd., Rusholme. Tel. 2241.

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Good optical effects, best models from 8/6. Films. How to make Aeroplane, components included. Conjuring Tricks, Clockwork Trains, Chemistry Sets. Lowest bargain prices. Send for illustrated Catalogue free.

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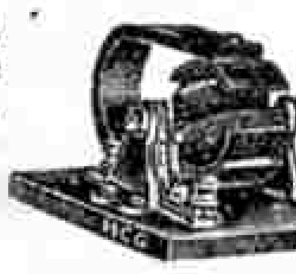

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Your Magazines may be kept clean and tidy by enclosing them in one of the special binders we supply. Two sizes, price 3/- and 3/6 post free, from Meccano Ltd., Binns Rd., Liverpool.

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Complete mould ready for work 2/6.
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The Super Pea Pistol. New heavy model, best black finish, 50 shots at one loading, each in box with ammunition, post free 2/9.

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Stuart Mill Engine and Boiler with usual fittings, hand-feed Pump. Cost £4. What offers?—Lane, 8, Lansdown Parade, Cheltenham.

Wanted. "Meccano Magazines," Nos. 1 and 2. 2/- each given.—Tomlinson, Hildenborough.

Sale. Gilbert Erector Sets, 2 (2/6); 4, (15/-); 6, (12/6); separate, or lot, 27/6 before October. What offers? Post Card for particulars.—Thomson, 184, Newhaven Road, Leith.

Sale. 2 Blank Cartridge Revolvers, 10 and 8 chambered resp., 10/- and 5/-.—R. Senior, 1, St. Nicholas Place, Hull Road, York.

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Sale. First three Volumes, unbound, of "Lands and Peoples," 15/-.—Brown, Rectory, Ascot, Berks.

Sale. Cinematograph with 500 ft. film. Machine alone cost 36/-. £1 or nearest.—H. Bennie, Loans, Troon, Ayrshire.

STAMP ADVERTS.—(*continued from page 829*)

100 DIFFERENT STAMPS FREE.—Send for ½d. approvals.—Cox, 135, Cambridge Road, Seven Kings.

FREE. 1927 S. Africans. Write for approvals.—Chaytor, Leeswood, Waterloo Park, Liverpool.

100 Different Stamps Free. Request cheap approvals, ½d. upwards.—Williams, 7, Islington Rd., Towcester.

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1,000 MOUNTS FREE. Request approvals, enclosing 1½d.—O. Holloway, 28, Heyburn Rd., Liverpool, E.

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STAMPS WANTED of Australia, Canada, North and South America in exchange for South African. Write —P. Gudgeon, P.O. Box 699, Cape Town.

FREE 1/- Pictorial Jamaica, Queen Victoria Memorial. Beautiful postally used copy. To all genuine applicants enclosing postage.—J. H. Gaze, Didsbury, Manchester.

110 ALL DIFFERENT, including Fiji, Kenya, Sarawak, Honduras, Somali, Zanzibar, etc., 4d.—"Philatelic," 54, Claremont Road, Westcliff, Essex.

STAMP PERFORATION GAUGE

If you are a stamp collector you should make a point of securing one of these Perforation Gauges. It enables you to find the size of perforation of any stamp quite easily. The price of the Gauge is 1d. post free, from the Editor, "*M.M.*"

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MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES :—

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 being as above, except in the case of Australia, where the price is 1/- per copy (postage extra), and the subscription rates 8/- for six months and 16/- 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), Textile House, Von Brandis St., Johannesburg.

Tell Daddy you'd like a Fairycycle

(Regd. Trade Mark)

STILL the same safe, sturdy, jolly little cycle, well made and beautifully finished. There are no cross bars on the Fairycycle so you can mount and dismount easily and safely. Brakes are fitted to all models and give you absolute control over the Fairycycle. Tell Daddy how strongly the Fairycycle is made—how safe it is for you to ride—the lasting service it will give you ; and ask him to get you one to-day !

Remember you can become a member of the Fairycycle Association FREE if you buy a Fairycycle (Regd. trade mark) now. If you already own a Fairycycle but are not a member send 6d. in stamps for badges and card and give the dealer's name from whom you bought your Fairycycle.

No. 1. FAIRYCYCLE is fitted with ribbed tyres, tangent spoke wheels, free wheel, mudguards, and push down brake £1 : 19 : 6

No. 2. FAIRYCYCLE. Has a rim brake, stand and carrier, tangent spoke wheels with ¾" cushion tyres, plain bearings and upturned handlebars £2 : 9 : 6

No. 3. DE LUXE FAIRYCYCLE. A splendid model like a real bike with ball bearing wheels, big balloon cushion tyres, brake rim, etc., as illustrated £2 : 19 : 6

No. 4. SUPER FAIRYCYCLE. Similar to No. 3 but with ball bearings throughout. This is a cycle that will last for years. Improved tubular forks, tool bag, domed mudguards, etc., are fitted £3 : 5 : 0

Can also be supplied with pneumatic tyres.

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REGD. TRADE MARK

Look for this sign on the toys you buy.

L. BROS. LTD. LONDON ENGLAND

Regd. Trade Mark.

Obtainable at all good toy shops and stores.

Made by LINES BROS. LTD., Morden Road, Merton, S.W.19.

The Pedal Fairykar

BRITISH MADE

4a. A popular size nicely finished red, with steel disc wheels, plated handlebars, rubber grips, pedals and tyres. Folds up and is packed in a box 10/6

4b. New and fitted with big balloon disc wheels. Height to top of seat 11⅞". Light, easy to pepal but strongly made to stand rough usage. Packed in a box - - - 13/6

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