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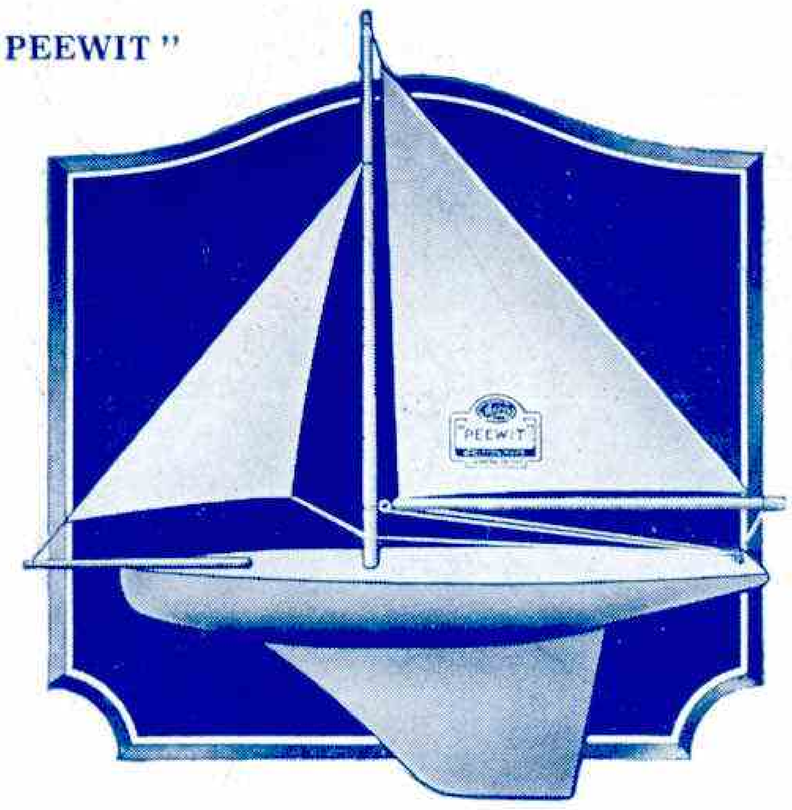
MECCANO MAGAZINE



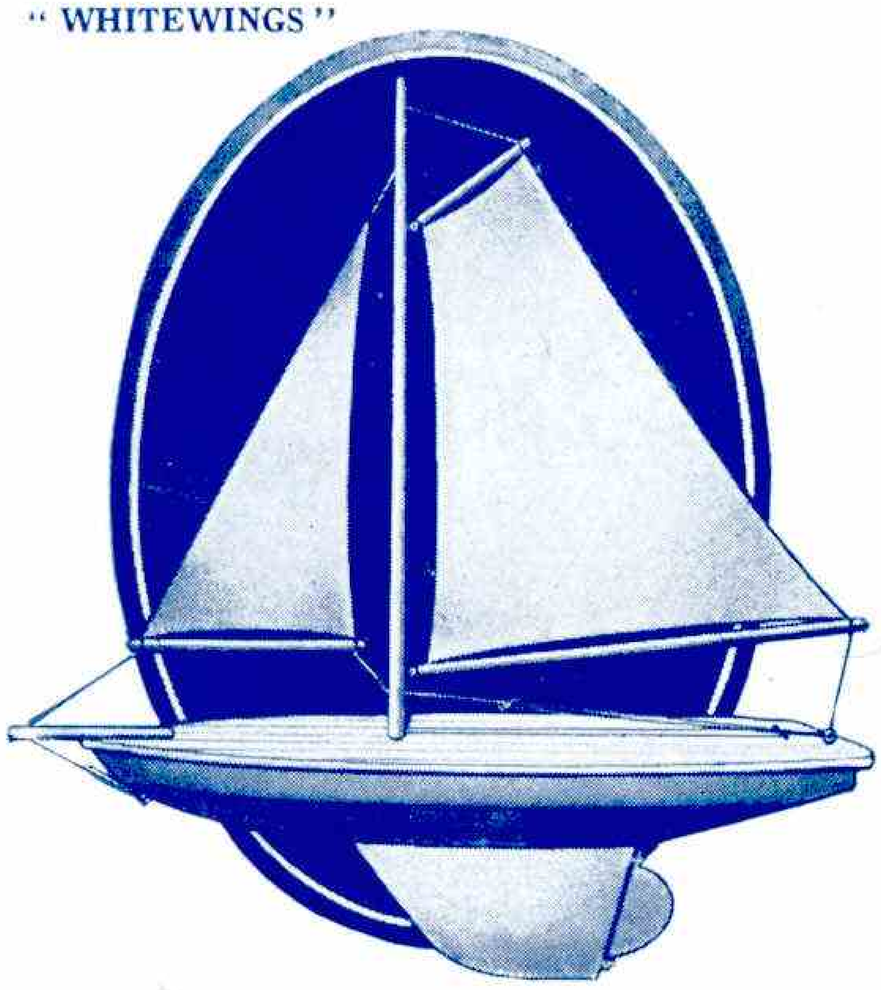
THE ECLIPSE OF THE SUN
(See page 482)

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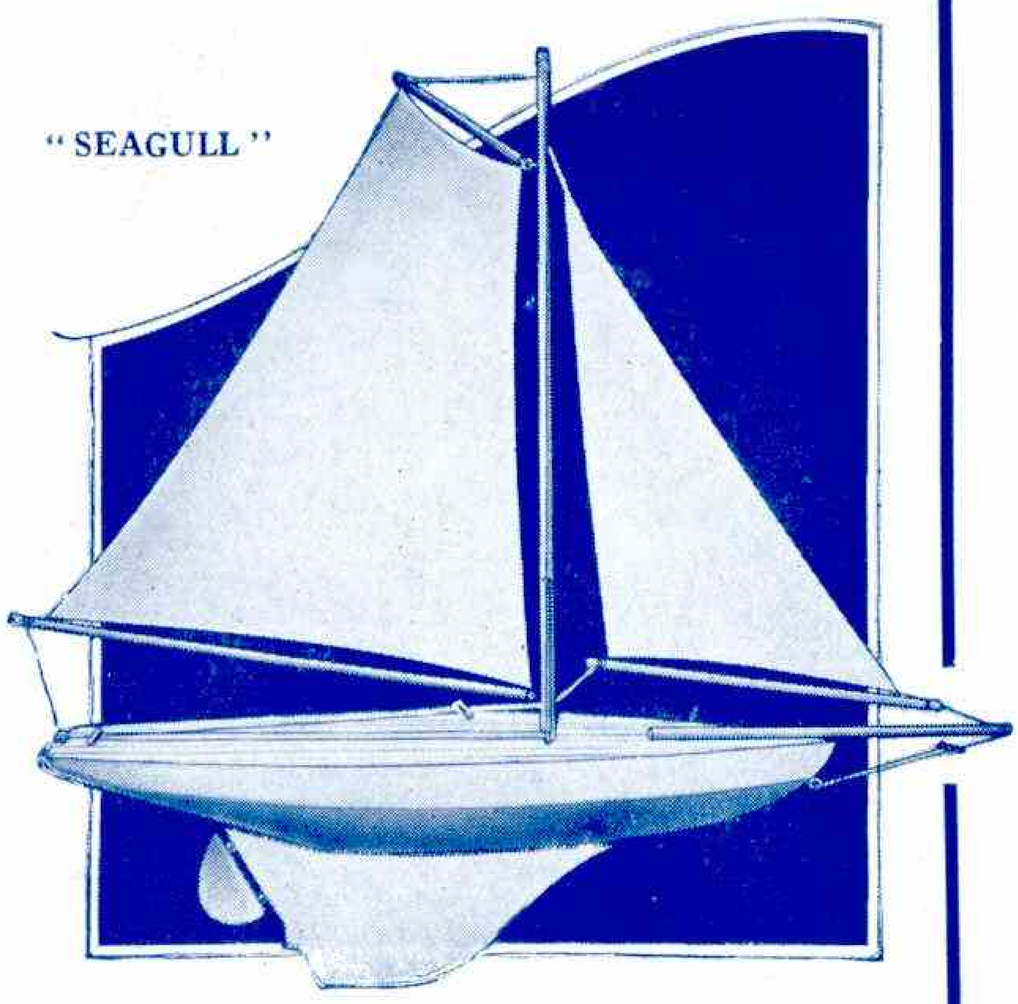
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MECCANO MAGAZINE

Editorial Office
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Vol. XII No. 6
June, 1927

With the Editor

Superiority of British Aero Engines

Articles in recent issues of the "*M.M.*" described the manufacture of "Jupiter" aero engines, and it will be of interest to our readers to learn that the great success of these engines is constantly commented on in the French press.

The Paris newspaper "*Liberté*" recently printed a leading article entitled "*How England Controls Our Aviation,*" and commented on the widespread adoption by the French authorities of the "Jupiter" engines under the heading of "*La Scandale Jupiter.*" French industry, it is stated, originally specialised in water-cooled engines, while English industry was in favour of air-cooled engines. "Up to 1924 our military aviation followed the French point of view, and nearly every machine was fitted with a water-cooled engine. All this was suddenly altered, however, when a revelation enlightened official circles. Previously they would have nothing but water-cooled engines. Now they wish to hear no more of them—they must have radial air-cooled engines. . . . Our Naval Air Force has given all its orders for air-cooled engines and a third of the engines required by our military machines are of the same type. Everyone should know it. . . . Our own people print hundreds of circulars that are sent to all foreign Governments and air lines and prospective customers all over the world." These circulars, it is added, conclude with the sentence: "The French Government recognise, therefore, the crushing superiority of the Jupiter."

All this makes very interesting reading, and there could be no more convincing testimony of the superiority of the British-built "Jupiter." May it long continue!

Irrigation and Malaria

A surprising statement—which, if true, will require further inquiry—was made recently. This is that a considerable increase of malaria fever has been noted in those areas that are artificially watered by irrigation schemes. It has been observed in Bengal, for example, that malaria is practically negligible in the eastern districts where the rice fields are watered by natural inundations. In the central and western districts of the province, however, where the making of dams and river embankments has deprived the land of natural inundation, malaria is rife.

Investigations seem to show that the explanation may lie in the fact that the food values of the rice in common use in India vary considerably. Possibly when the crops are grown on land that is artificially watered, the food values of the rice deteriorates, and the people who consume it have their vitality lowered so that they are thus rendered less capable of resisting attacks of malaria. If this is proved to be the case, the advisability of raising rice on land irrigated by artificial means will have to be very carefully investigated.

Rain, the Natural Water

We all know the difference between tap water and rain water, and every gardener would prefer to have his plants watered by the rain than watered with water from the tap—apart altogether from the saving in labour.

In the first place, rain water contains much oxygen and it acts slowly on the soil. Water from a canal does not contain nearly as much oxygen, and watering by flooding destroys the texture of the soil. In oriental countries the rainfall is a most important factor in the successful production of crops, and when there is plenty of rain at the correct season of the year there will be good and abundant harvests. It has been the aim of recent years to prevent a drought and to regulate the waters required for the cultivation of the crops by developing irrigation schemes. In this matter the engineer has responded to the demands made upon him by building huge dams and countless miles of canals. Whether this work will continue or not remains to be seen, but it may be remarked that in addition to the malaria question mentioned above, it is also stated that artificial means of irrigation are rendering land barren in the course of a few years. As an example of the correctness of the statement we are referred to the district watered by the Nira Canal in Bombay, where the soil has become a vast tract of desert land on which vegetable life cannot be supported.

I am sure those large numbers of my readers who have interested themselves in the Assouan and Sennar Dams, and in the great irrigation schemes now going forward in India, will hope with me that means will be found to overcome the difficulties that seem to be arising, and that science will lend her aid so that the engineers may not have laboured in vain.

Good Advice of 300 Years Ago

In our articles on Arctic Exploration mention has been made of the Muscovy Company, a company of British merchants who conceived the idea that they could build up a profitable trade connection with Russia and other foreign countries. The foundation of the Muscovy Company not only marked the beginning of England's Russian trade, but led to the development of our foreign commerce and consequently to the rise of our vast Mercantile Marine.

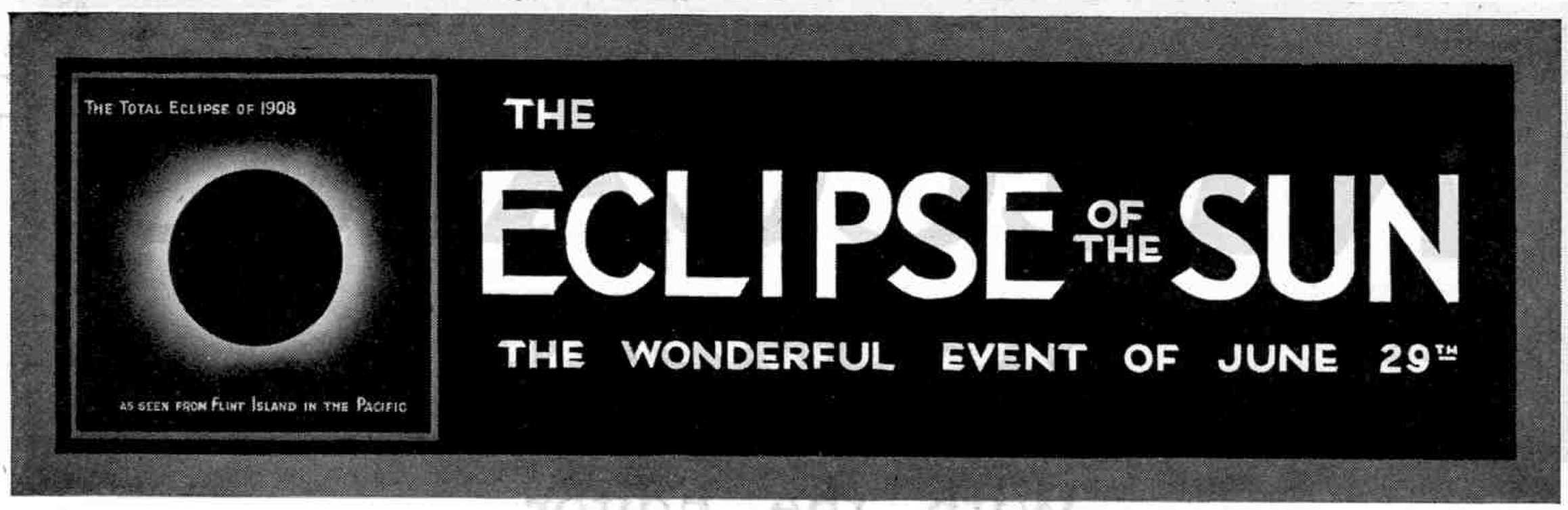
In reading of the early exploits of these daring explorers I came across a quaintly-worded message, the application of which is as true to-day as on the day it was written, over 300 years ago. This is what the Governor of the Muscovy Company wrote in his command to Thomas Edge, captain of the "*Elizabeth,*" which, with the "*Mary Margaret,*" set sail in 1611 from the Port of London for Spitzbergen:—"Inasmuch as industrie and diligence are two principall steps to atchieve great enterprises, and negligence and idlenesse are enemies to the same; we would have you, in this charge committed unto you, to imbrace the one, and to avoide the other; and to shew that example of paines taking to the rest of the company of your ship in your owne person, as well in setting them on work as in putting your owne hand to the businesse when neede requireth, as that there be no idle time spent, but that every one be employed in some businesse or other."

This excellent charge might with advantage be adopted by all who desire to "get on" and to rise on the ladder of fame.

This Month's Great Event

I hope that, as far as possible, all my readers will take advantage of the opportunity on the 29th of this month to view the total eclipse of the Sun. A total eclipse is not only Nature's most wonderful sight, but it is an event of historical importance that will not occur again—as far as this country is concerned—until 1999. The articles dealing with the eclipse published in our last three issues, have, I hope, made everything clear.

In this connection I would draw the attention of my readers to the special competitions (announced on page 531 in this issue) for drawings, descriptions and photographs of the eclipse. I have no doubt that these Competitions will result in a large number of entries, and in each section I hope to publish the winning results and any others of special merit. Owing to the fact that the printing of the "*M.M.*" commences about the middle of the preceding month, the July Magazine will be actually printed off before the eclipse takes place. The results of the Competitions, and an account of the eclipse cannot therefore be published any earlier than in our August issue.



HOW TO SEE THE ECLIPSE

LAST month's article in this series told the story of eclipse experiences in many parts of the world and concluded with a fuller account of the proceedings of the party under Sir Norman Lockyer that observed the eclipse of 1898 from the old fort of Viziadrug in India.

During the present century interest in eclipses has been maintained and further expeditions have been undertaken with great regularity. As a matter of curiosity it may be mentioned that the conditions of 1883 were repeated in 1908, when two parties found it necessary to establish themselves on lonely Flint Island in the Pacific Ocean, not very far away from Caroline Island, the scene of the activities of 1883 referred to in last month's article. On the way to Flint Island an American expedition stayed a few days on Tahiti, and here a native chief said to one of the members: "My people are disappointed with your astronomers. We expected to see wise old bearded men and you are just young fellows, like steamboat clerks!"

The American informed him in return that he came from a land where the Great Bear never set, where the rain fell solid, and where people walked freely on the water, upon which the native sardonically remarked that his people also could tell big stories!

As a result of the steady work carried on by eclipse expeditions we now have a fair idea of the nature of the prominences and of other phenomena on the Sun, but there still remain many unsolved problems connected with the electrical and temperature conditions of the Sun and with the composition of the corona.

The discovery of helium in the prominences by the aid of the spectroscope has been referred to in the previous articles in this series, in which it was explained that its recognition as a chemical element was due to the discovery of a brilliant yellow line in the spectrum of the prominences. Similarly a brilliant green line was discovered in the spectrum of the corona as long ago as 1869 by a well-known American, Professor C. A. Young. This line is not always seen during an eclipse and is never seen at any other time. All attempts to assign an origin to it have so far failed. As in the case of helium, therefore, it has been suggested that the corona contains an element entirely unknown on Earth, for which the name "coronium" has been proposed. This element remains problematical, of course, and will do so until history repeats itself and "coronium" is discovered in some more accessible place.

The case is more doubtful than was that of helium, for it seems probable that coronal light is largely sunlight reflected from the fine dusty material surrounding the Sun, whereas there was no doubt whatever that the prominences in which helium was discovered were actually the source of the light containing the famous D3 line.

Eclipses have been of great value in many ways not directly connected with the Sun or the Moon. For instance the only time when bodies very close to the Sun can be seen or photographed is during an eclipse, for it is only then that the light reflected from them is not overpowered by the brilliant sunlight. Use has been made of this fact in the search for a planet that was suspected to exist between Mercury and the Sun.

Mercury is the nearest planet to the Sun, its average distance being 36 million miles. At certain times, however, it approaches within 28½ million miles of the Sun, while at others it recedes to a distance of 43½ million miles. Its orbit or path round the Sun is thus a very definite oval or ellipse, but if this path is very carefully marked out it is found that the ellipse does not close up exactly. In other words, we may regard the ellipse itself as rotating round the Sun as centre. This rotation is not rapid, and Newton's law of gravitation explains it as being due to the attraction of Mercury by the other planets. Unfortunately the whole of the rotation cannot be explained in this manner, for the ellipse moves round through an angle of 43 seconds more in a century than is calculated in accordance with the law.

This rotation also happens in the cases of the other planets, but with them there are no unexplained differences.

Approximate Time-Table of Eclipse Events

Summer time is given and the times will vary slightly in different places. The numbers in brackets refer to the pages in the April "M.M.," in which the phenomena are described in full.

5.30 a.m. FIRST CONTACT with Sun made by Moon's Shadow. Light begins to fail, at first slowly. During the next 50 minutes watch should be kept for :—

SHADOW BANDS (p. 293) and for SUN IMAGES under trees (p. 294), BAILY'S BEADS or the DIAMOND RING effect (p. 294).

These phenomena may be visible immediately before the onrush of CENTRAL SHADOW at the speed of more than 1,000 miles per hour (p. 294), the coming of which marks the beginning of totality.

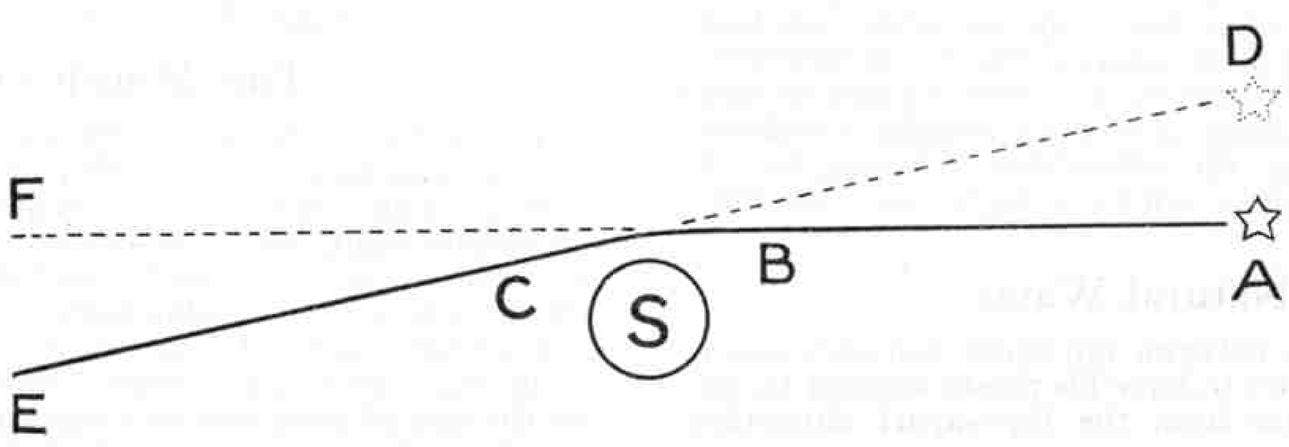
6.24 a.m. BEGINNING OF TOTALITY, which will last for varying periods up to 24 seconds. The light and heat of the Sun are completely cut off. The chief features of interest during this period are :—

THE CORONA (p. 294) and THE PROMINENCES (p. 295).

Immediately following the end of totality BAILY'S BEADS or the DIAMOND RING effect may be seen once more.

As the proportion of the Sun's disc uncovered increases SHADOW BANDS and SUN IMAGES under trees are again formed.

7.21 a.m. LAST CONTACT. With the final passing of the Moon's shadow full daylight is restored.



The diagram shows how a ray of light from a star in position A is bent in passing near the Sun S so that from the Earth E the star appears to be at D

An Undiscovered Planet near the Sun?

This may not seem a very large difference considering that a right angle is about 7,500 times larger than the unexplained portion of the angle through which the ellipse turns. The precision of the measurements of astronomers is now so great, however, that the explanation of even this small difference is regarded as a serious problem.

Many attempts have been made during the past century to explain the difference. The most favoured theory was that between Mercury and the Sun there was another small planet and that the gravitational attraction of this for Mercury was the cause. Some colour was given to this idea by the discovery that irregularities in the path of the planet Uranus were capable of explanation by the hypothesis that an undiscovered planet existed beyond it. Mathematical calculations indicated where such a planet would have to pursue its lonely course, nearly 3,000 million miles from the Sun, in order to produce the observed disturbance of the path of Uranus, and a search made for it actually led to the discovery in the calculated position of the planet now known as Neptune!

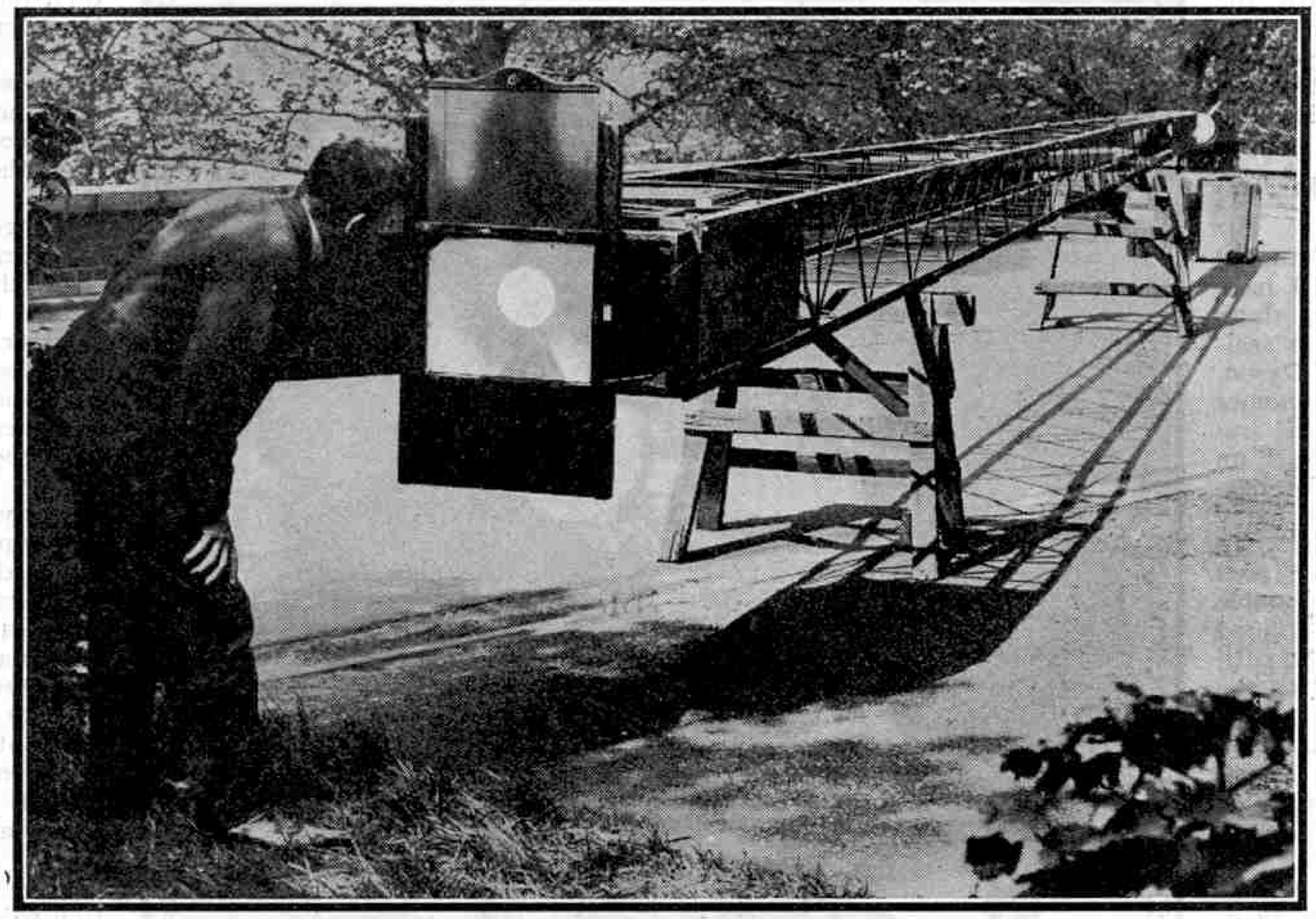


Photo [*P. & A.*

Our photograph shows the giant 45 ft. camera that is to be erected at Giggleswick to photograph the Sun at the forthcoming eclipse. The image of the Sun, reflected by the mirror into the camera, is clearly visible on the focussing screen, where Mr. C. Davidson, Assistant Astronomer Royal, is examining it whilst making the final adjustments to the apparatus at Greenwich before removing it to the eclipse station

The calculations in this case were made independently by two astronomers, Adams in England, and Leverrier in France, and it was chiefly Leverrier who supported the theory that similarly a small planet near the Sun was the cause of the irregularities in the case of Mercury. Certain observers even went so far as to claim that they had seen the supposed new planet, and so sure were some astronomers of its existence that the name "*Vulcan*" was given to it.

Now Mercury is not very easily seen owing to its proximity to the Sun, and therefore it is hardly to be expected that "*Vulcan*" would be easily visible except during an eclipse. Accordingly special watch has been kept for such a planet at eclipses for many years. If it really exists it would almost certainly have been detected by this time, particularly at the eclipses of 1900, 1901, 1905 and 1908, at which very careful watch was kept by members of expeditions from the famous Lick Observatory with the best telescopes and cameras available.

Within the last few years an explanation at once unexpected and quite satisfactory has been found for the 43 seconds that have given astronomers so much trouble. This is based on the new theory of relativity that has aroused so much interest in the scientific world of late years.

Those who cannot claim familiarity with Einstein's theory of relativity have at least the knowledge that Einstein has proposed a theory of gravitation that differs fundamentally from that of Newton, which has been accepted for some 200 years. According to this new theory the rotation of Mercury's orbit is exactly as it should be. There is no necessity, therefore, to seek for any further cause as there are no irregularities of any magnitude left unexplained. It was the accepted Newtonian theory that was not sufficiently near the truth.

Light Rays not always Straight

It is a coincidence that the most conclusive proof of the correctness of the theory of relativity, which put an end to the search for "*Vulcan*," also had to wait for an eclipse. Einstein suggested that gravitation would act upon light in exactly the same manner as it acts upon a stone. It is obvious to everybody that a stone thrown up into the air falls towards the centre of the earth, but it seems hardly credible that light acts similarly. It has been believed for ages that light travels in straight lines only, not in curves.

A consideration of comparative speeds shows that it would be impossible in the ordinary way to detect any fall of light towards the centre of the earth. During the first second the distance fallen by any body is 16 ft. This fall would be easily detected in the case of a stone thrown into the air, with a velocity of a few feet a second, but it must be remembered that in one second light would be 186,000 miles away, and to detect a fall of 16 ft. in these circumstances is practically impossible.

Soon after the introduction of the theory of relativity it became a matter of the greatest importance to obtain experimental proof of the fall. It was obvious that any experiments to detect it must be made on a huge scale and that the laboratory chosen for the test must be nearly the whole universe. It was necessary to wait until a star millions of miles away was in such a position that the light that we received from it passed very close to the Sun. If the light fell towards the Sun in passing, then the star would not appear to us in its true position, but would be displaced outward, or away from the Sun.

How the Bending of Light is Revealed

A glance at the diagram on the previous page makes this clear. A ray of light from a star at A proceeding in the direction of B would normally pass straight on towards F. If the Sun is in position S, close to the path of the ray, then the ray in passing will fall towards the centre of the Sun along the curve BC. After reaching the point C the influence of the Sun diminishes and the ray travels in a straight line once more to E. An observer on the earth at E would thus see the star as if it were in the position D.

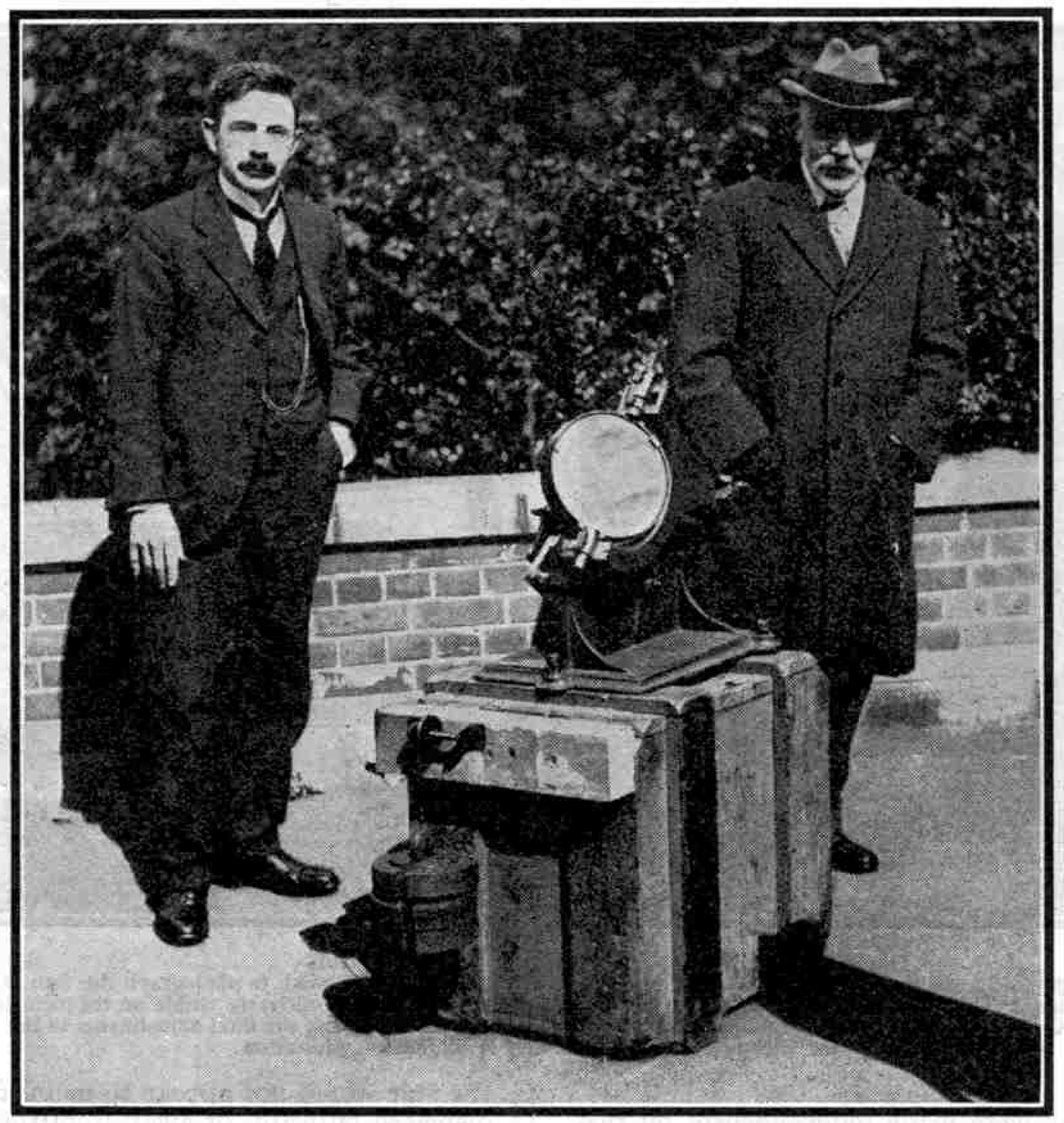
The diagram exaggerates the angle through which a light ray is bent, as the actual angle is too small to show in a drawing of this kind, although the gravitational attraction of the Sun is far greater than is that of the Earth—how much greater can best be realised by the fact that a man on the Sun's surface would weigh two or three tons!

The greatest bending takes place with a ray of light that just grazes the Sun's limb, and according to Einstein's theory the angle of bending in this case will be 1.75 seconds. If on the other hand the older ideas of Newton are true the bending will be only half of this. These are not very large angles. The larger is about the same size as that presented by the width of a telegraph wire at a distance of half a mile, but astronomers are quite capable of measuring even these small angles with sufficient accuracy to distinguish between the two theories of gravitation.

The method finally decided upon was to photograph a group of stars twice, first when the Sun was directly in front of it, so that the light from at least one of the stars passed very close to the Sun, and then when the Sun was elsewhere. By careful and accurate measurements of the positions of the stars close to the Sun it is possible to detect any change in the apparent position due to the bending of the light rays and hence to calculate the angle of bending. The second of the two photographs required is easily obtainable at night. A photograph of the group when the Sun is in front of it is only possible during an eclipse.

The most suitable day in the year for an experiment of this

kind is 29th May, as the Sun is then situated in front of the patch of bright stars known as Hyades. These are not among the brightest of stars, yet they are easily found. The great constellation Orion is the best guide. On the right of this group of stars, and almost in a line with the three prominent stars of the Belt in its centre, is the giant reddish-hued star Aldebaran. The Hyades are the seven fainter stars forming a V-shaped string on Aldebaran's immediate right. The name Hyades means "rainy," and was given to these stars by the Greeks in accordance with the belief that rain would fall when they rose with the Sun. It is somewhat unfortunate that the group is invisible in June, but it may easily be seen earlier and later in the year.



Our photograph shows the Coelostat, or specially prepared mirror that revolves so accurately that the apparent motion of the Sun through the sky is counteracted. The Coelostat reflects the Sun's image into the giant camera shown on the previous page. On the right of the instrument is Sir Frank Dyson, the Astronomer Royal, and on the left Mr. C. Davidson, Assistant Astronomer Royal, under whose supervision the camera has been prepared

British Expedition to Test Einstein Theory

By a fortunate chance a total eclipse in 1919 happened on this very date. The opportunity was realised by Sir F. W. Dyson, the English Astronomer Royal, and it was immediately decided that an expedition should be despatched in order to carry out this experiment. To ensure good weather conditions as far as possible the expedition was divided into two portions. The path of totality is marked on the map on page 195 of the March "*M.M.*," from which it will be seen that Brazil and the west coast of Africa offered the best places for observation. Professor Eddington and Mr. E. T. Cottingham went to Principe, a small island in the Gulf of Guinea, while Dr. Crommelin and Mr. C. R. Davidson established themselves at Sobral, in the north of Brazil. Both places are practically on the Equator and the duration of totality therefore was as long as possible. This, too, was favourable, as the eclipse was one of the series already mentioned as noteworthy on account of their length, totality lasting six minutes in this case.

Similar arrangements were made in both cases. Telescopic cameras were arranged horizontally and the image of the Sun was reflected into the aperture by a mirror. This is a good plan in many ways. The camera can be kept rigid, while the only part of the apparatus to be driven by the clock to keep the image of the Sun in place is the mirror, which is much lighter than a telescope. At Principe the weather on the day of the eclipse was unfavourable and the sky cloudy. The entire programme, however, was carried out at the appointed time. The plates in the cameras were changed at intervals, the exposures being made with the aid of a screen held in front of the object glass, instead of with the shutter in the cameras. This was done to avoid possible distortion to the image by the shaking of the telescope.

Astronomers Have No Time to see Eclipse

Professor Eddington gives a very vivid description of the events that took place in the dim light :—

"For in and out, above, about, below,
'Tis nothing but a Magic Shadow show,
Played in a Box whose candle is the Sun,
Round which we Phantom Figures come and go.

"Our shadow-box takes up all our attention. There is a marvellous spectacle above, and, as the photographs afterwards revealed, a wonderful prominence flame is poised a hundred thousand miles above the surface of the Sun. *We have not time to snatch a glance at it.* We are conscious only of the weird half light of the landscape and the hush of nature, broken by the calls of the observers, and the beat of the metronome ticking out the 302 seconds of totality."

The prominence flame referred to by Professor Eddington is the one illustrated on page 295 of the April "*M.M.*"

A similar programme was carried out at the Brazilian station at Sobral. The plates were developed and the negatives showed the stars constituting the Hyades group as black dots. Photographs of the same group of stars had been taken with the same cameras and telescopes when they were visible at night, and the two plates, one of which showed the effect of the Sun, were clamped together, film to film, so that the corresponding images of stars fell close together. Measurements of the various distances between corresponding images were then made with the aid of the microscope, from which it was possible to determine whether any of the stars had apparently been displaced when the light from them passed near the Sun.

Altogether three sets of photographs were taken with three different telescopic cameras. Of the existence of the bending there was no doubt whatever and the final result of the measurements showed that the displacement was caused by the bending of the rays of light through the larger of the two angles, as predicted by Einstein. The actual final measurement of the angle of bending for a ray of light grazing the Sun's limb was 1.98 seconds, which agrees very well with the prediction of Einstein. Thus was confirmed the theory of relativity as applied to gravitation.

It is hardly an exaggeration to say that this eclipse expedition of 1919 was the most important of the whole series. The apparently simple experiment just described meant that the ideas of the force of gravitation that had been entertained for more than 200 years were not correct. As the results were of such tremendous importance there was some hesitation in accepting them, but repetition at a later eclipse has fully confirmed them. An American party from the Lick Observatory made measurements in Australia in 1922, taking every possible precaution to secure accuracy. The positions of no fewer than 90 stars were measured and the final value was 1.78 seconds for the angle of bending, a result almost in exact accordance with the theory of relativity.

The Weight of Light

A point of great interest, which will be regarded with some astonishment, is that we are compelled to regard light as possessing weight! Until the last few years it has been generally agreed that light is simply vibration or wave motion in the ether of the same kind exactly, except as regards wavelength, as wireless waves. It seems hardly possible that a wave in the ether can have any weight and it has been suggested that the light given out by, say the Sun, is really a stream of very small particles of some kind shot out with enormous velocity.

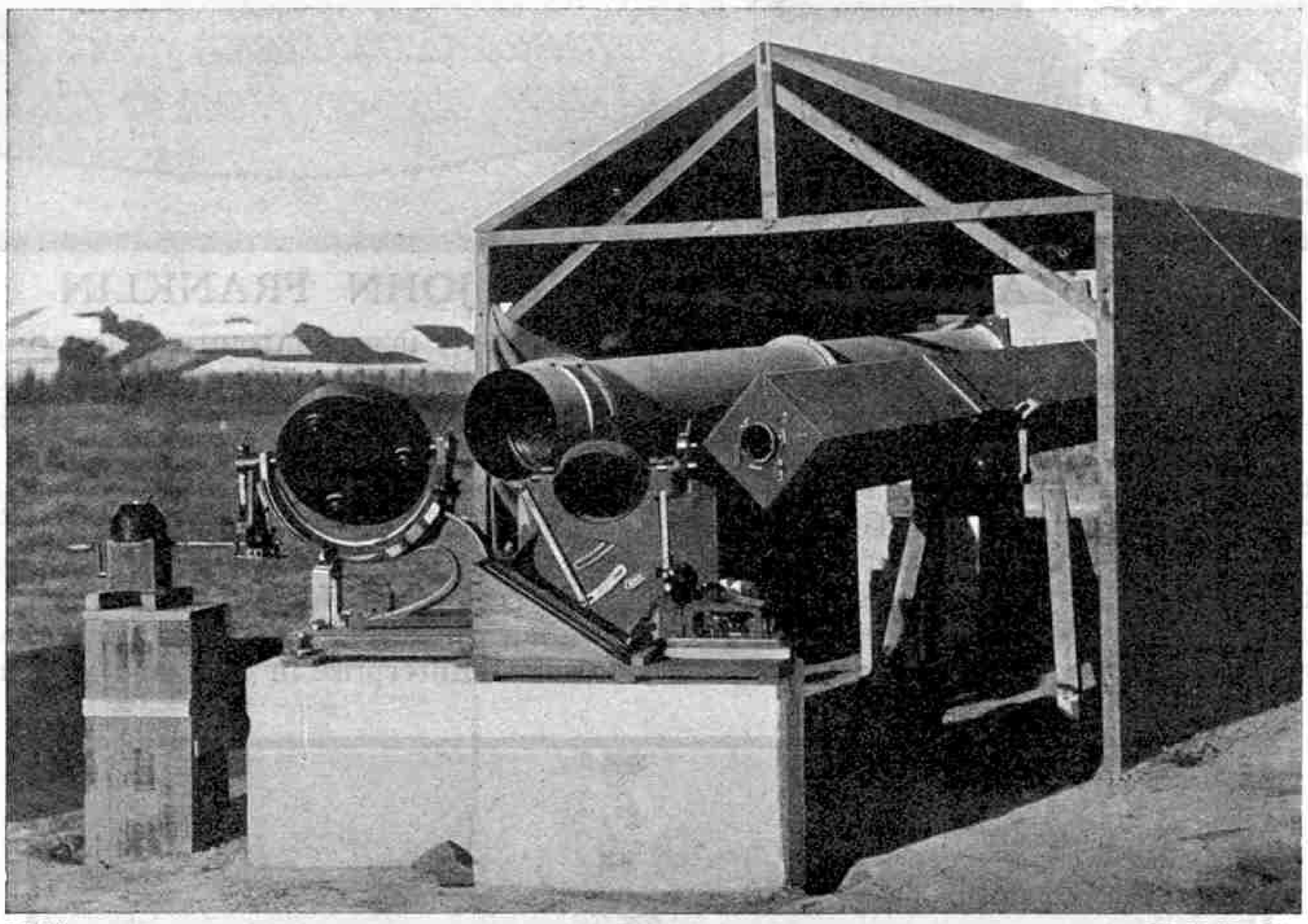
In this manner the Sun loses a few thousand tons of light daily, of which about 1,600 tons fall upon the Earth. This seems quite a large amount, but when it is remembered that the Earth weighs ten thousand million million million tons it can be seen that it does not amount to very much after all. Further, as the Sun weighs 300,000 times as much as the Earth, it will be a long time before the effect of the daily loss will be obvious. At any rate the Sun will last out our time!

A better idea of the magnitude of the effect we are discussing may be obtained by considering a terrestrial source of light. The glowing wire inside an electric light bulb loses weight as it shoots out light particles, but if an electric light company charged by weight instead of taking 3d. per unit it would have to demand payment at the enormous rate of £140,000,000 per pound! Luckily

an ounce, or nearly £9,000,000 worth, goes a very long way. It would supply the light requirements of the average family for more than half a million years, and the weight of light used in one year in Great Britain is of the order of 1 lb. only!

This theory explains, among other things, the fact that light exerts a pressure on any surface on which it falls. The tail of a comet, for instance, is always turned away from the Sun and this is attributed to the pressure of light from the Sun upon the very thin dusty material of which the comet is composed.

There are many difficulties in the way of accepting this explanation of the nature of light, but it is worth noting that it is no new idea, but is actually the revival of ideas held by Newton over 200 years ago and subsequently abandoned in favour of the familiar wave theory. The latter has so thoroughly established itself that any suggestion that it is not true comes as a great shock, and further experiment and research will be necessary before this most valuable theory is abandoned. At the present moment, in fact, it looks as if the solution will be found in some new idea that will reconcile the old and new theories.



Photo] [*C. R. Davidson*

This photograph, from "Space Time and Gravitation" by Professor Eddington, M.A., M.Sc., F.R.S. (University Press, Cambridge), shows the eclipse instruments used at Sobral on the famous expedition described in this article

Giant Camera to Photograph Eclipse

Between Southport and Hartlepool there will be four well-organised parties of English astronomers, while one party will proceed to Norway, where a site was chosen last September. In all cases, photographs will be taken and observations made with spectroscopes and other instruments. At Greenwich Observatory a camera 45 ft. long to suit a lens of long focal length is being prepared to photograph the corona on plates that measure 15 in. by 12 in. This giant instrument will be taken to Giggleswick in Yorkshire about a fortnight before the eclipse. As already mentioned, it is necessary with cameras of this kind to provide mechanism to keep the Sun's image exactly central during the whole exposure. This will be done at Giggleswick by using a mirror driven by falling weights, as shown on page 484.

The question remains of what can be done by amateur observers. In view of the very short time available the most important thing is to know exactly where to go and what to look for! Readers of these articles should be well equipped in this respect, as both questions have been fully treated. If a suitable position as near the centre line as possible is chosen it will then only be necessary to have a clear sky in order to see and enjoy the wonderful spectacle to the full. The weather is, of course, the great uncertainty. The possibility of cloud should not prevent arrangements being made to see the eclipse in the best possible manner, as the risk of seeing little or nothing is well worth taking in view of the long time that must elapse before such another opportunity occurs.

How to Watch the Sun Safely

Except during the period of totality, some means for reducing the glare of the Sun is necessary. By way of warning it may be mentioned that Plateau, a Belgian scientist, lost his sight as a result of gazing at the Sun for 20 seconds in an attempt to see the markings on it without optical aid. With protection for the eyes there is no danger whatever.

The simplest method is to cover a piece of glass with a thin layer of soot by holding it in the upper part of a candle flame for a few seconds, and using this as a screen through which to look at the Sun. Using a smoked glass is a somewhat dirty business, and for those who prefer unblackened noses various substitutes are available, such as blue glass, smoke-coloured celluloid or best of all, an over-exposed photographic plate or film. This should be prepared beforehand by exposing a plate or film to light and subsequently developing it in order to secure one that is dark enough for protection and still sufficiently transparent. If an ordinary smoked glass is used it is best to cover the smoked surface with another piece of glass and clamp the two firmly together. This will avoid all risk of rubbing off the soot film by accident.

During the eclipse careful watch should be kept for the prominences and the chromosphere in view of the fact that the apparent diameters of the Sun and the Moon are nearly equal. The principal thing to watch for is the corona, the great feature of a total eclipse, and readers should endeavour to make a sketch of it. This is best done on a sheet of cardboard about 1 ft. square on which a black disc 2 in. in diameter is drawn to mark the scale. The colour and structure of the corona should be noted carefully and an attempt should be made to estimate its brightness as compared with that of the full Moon. This is of some importance, as the eclipse is occurring at a time of great sunspot activity, when the general brightness of the corona may be comparatively great although the streamers may not be very striking. The best results are obtained if the observer's eyes are shielded from the direct light of the Sun for some time before totality.

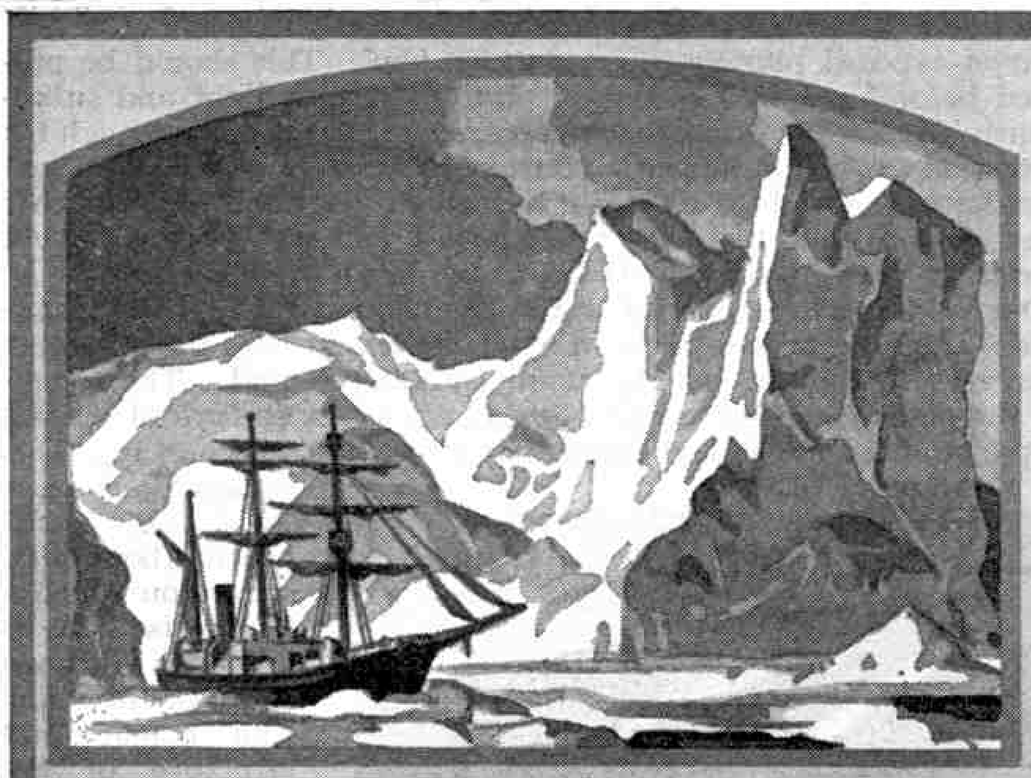
If any stars are visible their number should be counted and if known their names noted. It will be remembered that observers in 1898 found that more stars were visible immediately before totality than when the Sun was completely eclipsed, and it will be interesting to notice if the same effect is observed on this occasion.

Photographing the Eclipse with an Ordinary Camera

Many amateurs no doubt will desire to photograph the eclipse. As already explained, astronomers make use of telescopes and special cameras in order to obtain a larger image, but an amateur with an ordinary camera is only able to secure a photograph on a small scale. By taking a few simple measures the size of the image may be slightly increased and an enlargement of the resulting print made possible.

A lens of long focal length should be used. A telephoto lens is the best, but possessors of double lenses such as an anastigmat lens with the shutter between the components will get better results by using only half the combination. This will necessitate racking out the bellows of the camera to the full extent, or even the construction of a special extension at the rear of the camera. A rather slow plate or film of fine grain and a small stop should be used with a view to subsequent enlargement, and the plates must be backed to prevent halation. Films are in general immune from this trouble. The time of exposure will depend upon the light conditions during the total phase, but an exposure of very nearly the whole of totality will probably be required in most cases if an impression of the corona is to be obtained. During this time the position of the Sun and the Moon will have changed slightly but the effect will hardly be noticeable with ordinary cameras, although it would be ruinous with the delicate photographic apparatus of the astronomer.

Interesting photographs may also be secured a minute or two before and after totality, when a small crescent-shaped portion of the Sun's disc is visible. For this a much shorter exposure is necessary and this may be as low as 1,000th of a second. If this exposure is not provided for in the camera used, then the least exposure possible and a small stop should be used. Experiments prior to the eclipse will show whether it is advisable to interpose a screen to reduce the intensity of the light.



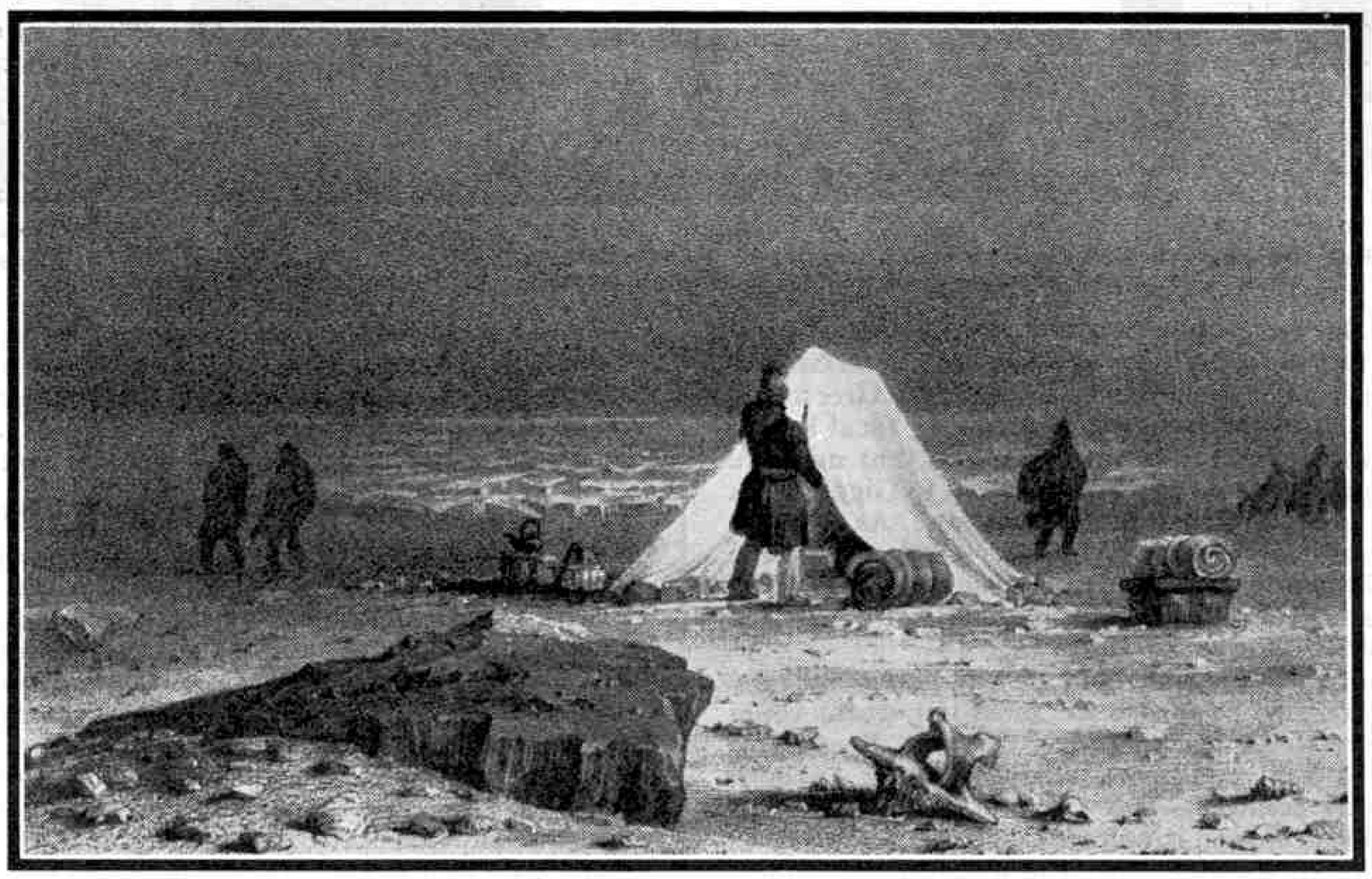
EXPLORING THE ARCTIC

Famous Explorers and their Attempts to Reach the Pole.

X.—CAPTAIN BACK AND SIR JOHN FRANKLIN

WE continue our story from last month, when Franklin and his party were left at Winter Lake whilst Back made a voluntary journey to Fort Providence for supplies. Having sent Belenger forward with letters and ammunition, Back himself remained at Fort Providence until the Great Slave Lake was frozen over. He left on the 7th December, sledging across the Lake for the northwest fort on Moose Deer Island, where he picked up five packages of supplies and was joined by two Eskimo interpreters, who were on their way to Franklin.

He was informed that at Fort Chippewyan no supplies could be spared and that goods had never been transported so far at the winter season. He was also told that the same dogs could not perform both the outward and return journeys; and that by having to walk constantly on snow shoes, he would suffer a great deal of misery and fatigue. He had a stout heart, however, and—unperturbed by any of these pessimistic forebodings—he started out on the journey with a Canadian and Indian with the goods on dog sledges. The weather was exceedingly cold; the dogs suffered from sore feet; and with his own legs and ankles so swollen that it was painful to drag his snow-shoes after him, Back continued to press forward. Reaching Fort Chippewyan on the 2nd January, he learned that both himself and the whole of Franklin's party had been reported killed by Eskimos. He waited a month and then, with only part of the goods he wanted, he set out on the return journey and subsequently arrived at Fort Enterprise in March, having travelled more than 1,200 miles on snow-shoes in a temperature sometimes as low as -50°. Often he had been without food for two or three days at a time, and at night he had only a blanket and a deer-skin for protection against the intense cold.



A Camp in the Arctic near Mount Barrow

The whole expedition, twenty persons in all with two large canoes and several sledges, left Fort Enterprise on the 14th June to cross Point Lake on the way to the Coppermine. Before leaving, it was arranged with an Indian Chief that a supply of food should be deposited at Fort Enterprise in case on the return another winter should have to be passed there. Often they had to traverse tracks of barren ground and to carry the canoes, so that it was not until the 1st July that they were able to finally launch their craft on the Coppermine River. They paddled down the river, taking all the rapids on their way, for another fortnight and from a hill they obtained their first sight of the sea on the 14th July. Within a week they were at the mouth of the river and their canoes were afloat on the Arctic Ocean.

Sailing and paddling, they proceeded to the eastward to perform the work the expedition had originally been sent to carry out. The survey of the lofty and rocky coast was no easy matter, however, for the sea was rough and the weather stormy. The canoes were lightly built and as they were only intended for river-work, they were in constant danger of being destroyed by the motion of the sea, so that altogether it was a most risky enterprise. Nevertheless, they were able to trace the shore of Coronation Gulf and following the indentations of the coast, they made accurate charts and named all the principal capes and bays. Eventually

they reached Point Turnagain on the 16th August 1821, having sailed and paddled 555 geographical miles and completed a voyage that ranks among the most memorable achievements of exploration.

At last, when their stores did not permit of them going further nor even of their returning to the Coppermine, and having failed to obtain food from the Eskimos, Franklin decided to turn back to Fort Enterprise by the quickest possible route by way of Hood River, which they reached on the 25th August. They proceeded up it for three days and then had to abandon it, as it turned too far to the west and away from the direction in which they wished to travel. Leaving the river, they struck off across country to the southwest, having first broken up the large canoes and built them into smaller craft that could more conveniently be carried.

They struggled overland to Point Lake, across the Barren Grounds, during which time for days on end they had nothing to eat but lichens, leather, burnt bones and skins. They were so weak that when a herd of reindeer passed they had not sufficient strength even to shoot at them. It was bitterly cold, densely foggy, and their belongings were frozen stiff, there being no means of making a fire.

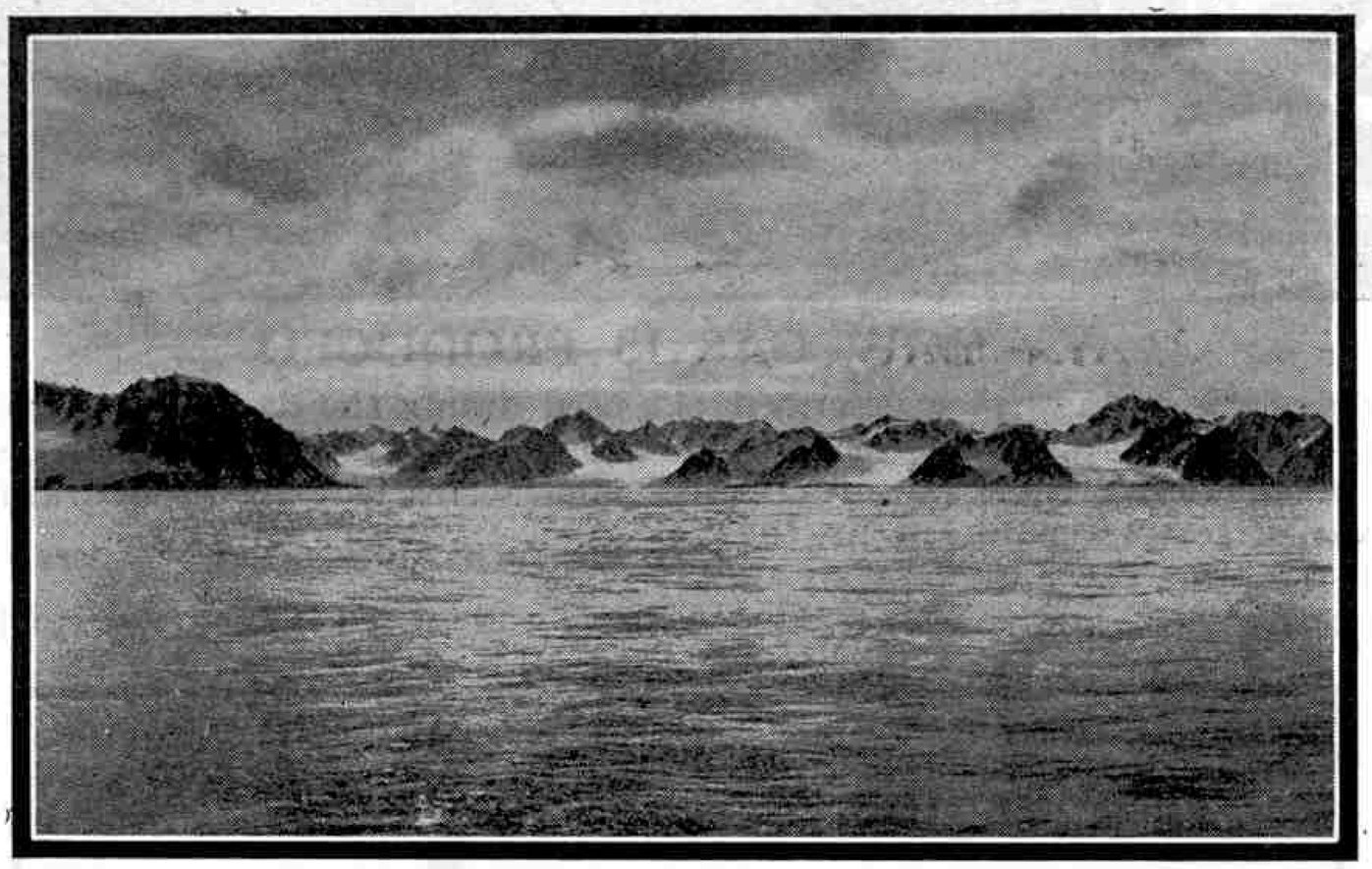
In this terrible state they struggled on, sometimes through snow a foot in depth; at other times across swamps and marshes, through streams and over hillsides strewn with large boulders. The men carrying the canoes were often hurled headlong by falling on the slippery stones, and more than once they were actually blown over by the violent wind.

They were fortunate enough to kill a musk-ox and having had no food for three days they ate the intestines raw on the spot. The flesh sufficed for three days, after which they were again reduced to eating lichens. Two more deer were killed and again they were saved from starvation, but by the 21st September they were once more in sore straights, from which they were relieved by finding the remains of an animal killed and partly eaten by the wolves during the preceeding spring.

By the 26th they had reached the banks of the Coppermine River and were now within 40 miles of Fort Enterprise. Both the canoes had been damaged so as to be useless, however, and eventually they made a raft of willows. They were unsuccessful in crossing the river, however, and Dr. Richardson, having volunteered to swim the river with a line, nearly lost his life in the attempt.

Snow commenced to fall and for three days more the party, still at the far bank, continued to exist on scraps of leather and lichen. Finally they built a canoe of canvas stretched over a rough wooden framework, and in this crazy craft one by one they were drawn across the swollen waters of the Coppermine.

The men were all extremely weak, however, and Franklin realised the party could never reach Fort Enterprise. He therefore sent Back ahead with three Canadians to obtain help and to return with all possible speed with some of the food that they had arranged was to have been deposited there by the Indians. Back left on this mission and the others continued to make what progress they could towards Fort Enterprise. One by one the men collapsed, however, and were sent back to Dr. Richardson, who had been left with Hood. Finally, Franklin was left with four companions, the party still existing on lichens and leather. After five days they managed to struggle into Fort Enterprise, only to find it empty of food, the Indians having failed to keep their promise to deposit supplies. They found a note from Back saying that he had arrived, found no food, and that in consequence he had gone on to Fort Providence from where he promised to send food to them.



Photo] [*Scientific Illus. Bureau*

The desolate regions in the Arctic: A view of the great ice barrier that guards the Pole

In an outhouse, Franklin found some rotting deerskins left from the year before and by eating these he and his men endeavoured to ward off starvation. They were in a terrible state, however, and so weak that they could not move more than a few yards at a time. Their eye-balls were dilated; their mouths raw and bleeding; and their limbs hideously swollen. Nine days passed in utter misery, Franklin meanwhile terribly anxious for the safety of Richardson and the other men. At length Franklin himself started off with two men to try to reach Fort Providence, but was obliged to return owing to the breaking of one of his snow-shoes. Another week passed, the men getting weaker and weaker until they were so feeble that they could not even leave their beds in search of food. On the 27th October, Franklin recorded in his journal "I have this day completed 21 years in his Majesty's service and exposed to many hardships in my professional career, but was never placed in such a melancholy and affecting situation as at present. However, with sincere praises to Almighty God for His past goodness and protection, I will humbly confide in His gracious mercy and hope for deliverance from the severe trial."

On the 29th, Richardson and one of the men unexpectedly staggered into the fort, being the only survivors of the party who had either been left behind or had turned back. They told a ghastly story of their sufferings, including the news that Hood had been shot through the head by one of the Indians whilst Richardson was out searching for food. Sad as this news was, it was at least satisfactory to know that Richardson avenged Hood's death by himself shooting the murderer on his return. By the 3rd November the party at Fort Enterprise—which then consisted (*Continued on page* 558)



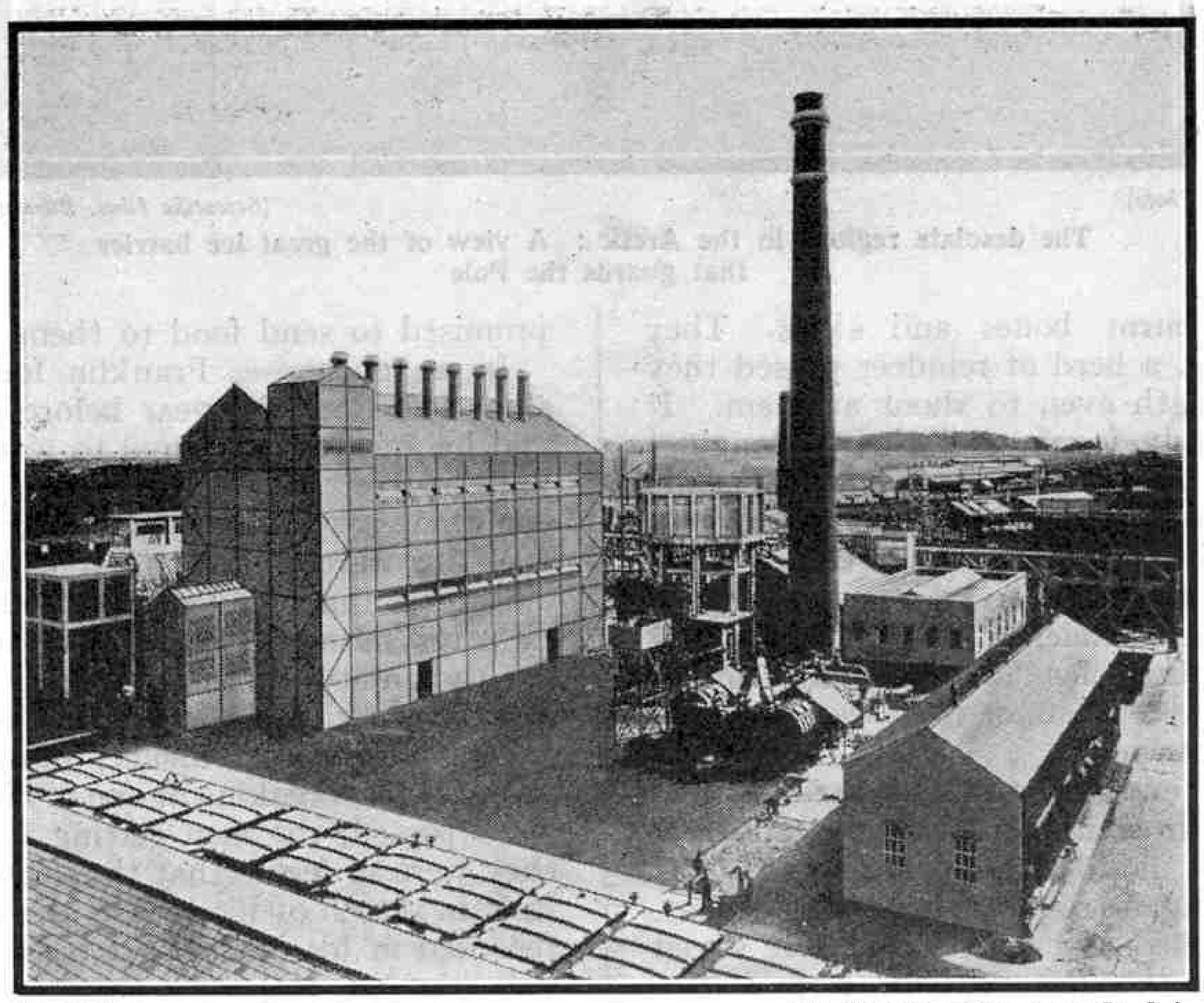
THE STORY OF COAL

V.—HOW GAS IS PRODUCED

IN the preceding articles of this series we have described the origin of coal and the present-day methods employed in coal mining. We come now to the consideration of the varied services rendered by this wonderful mineral. Of these the two most familiar are unquestionably its use for domestic fires and for making coal gas. The former needs no explanation, but comparatively few people, other than those associated with the industry, know how the coal gas used in thousands of homes and workshops is made.

Sometimes when watching a coal fire one sees a small jet of smoke come out of the side of a piece of coal and burst into flame. In that little jet of smoke there is coal gas.

One of the first to discover coal gas was a Scottish mechanic named William Murdock, who was employed in Cornwall erecting steam engines for the Birmingham firm of Boulton and Watt, as related elsewhere in this issue. Murdock in 1794 heated coal in a closed iron pot having an open pipe through which the inflammable gas given off during distillation was emitted. To the pipe he connected a short tube that led to a bladder and thus he collected the coal gas that otherwise would escape. When full the bladder was disconnected and a thimble fitted on to the free end of the short tube. A hole through the thimble provided for the passage of the gas from the bladder, and when ignited at the thimble the gas gave a flame much superior to that of the candle or oil lights then exclusively used. After lighting the jet Murdock thrust the thimbled pipe end up through a hole cut in the bottom end of a lantern and fastened it securely. This curious contrivance he used during the dark winter evenings to light his way home when crossing the bleak Cornish moors from some mine to his lodgings at Redruth.



Courtesy [*West's Gas Improvement Co. Ltd.*

General view of Vertical Retort Installation at a Modern Gasworks

Murdock Amazes the Villagers

By attaching a long pipe to his iron pot, or retort, Murdock was able to lead the gas into his front office and there use it, to the amazement of the people of the village who nightly came up to view it. No one had believed it possible that an illuminating flame could be obtained without using a wick, and as time went on and the news of his achievement spread people began to come great distances to see for themselves this new miracle.

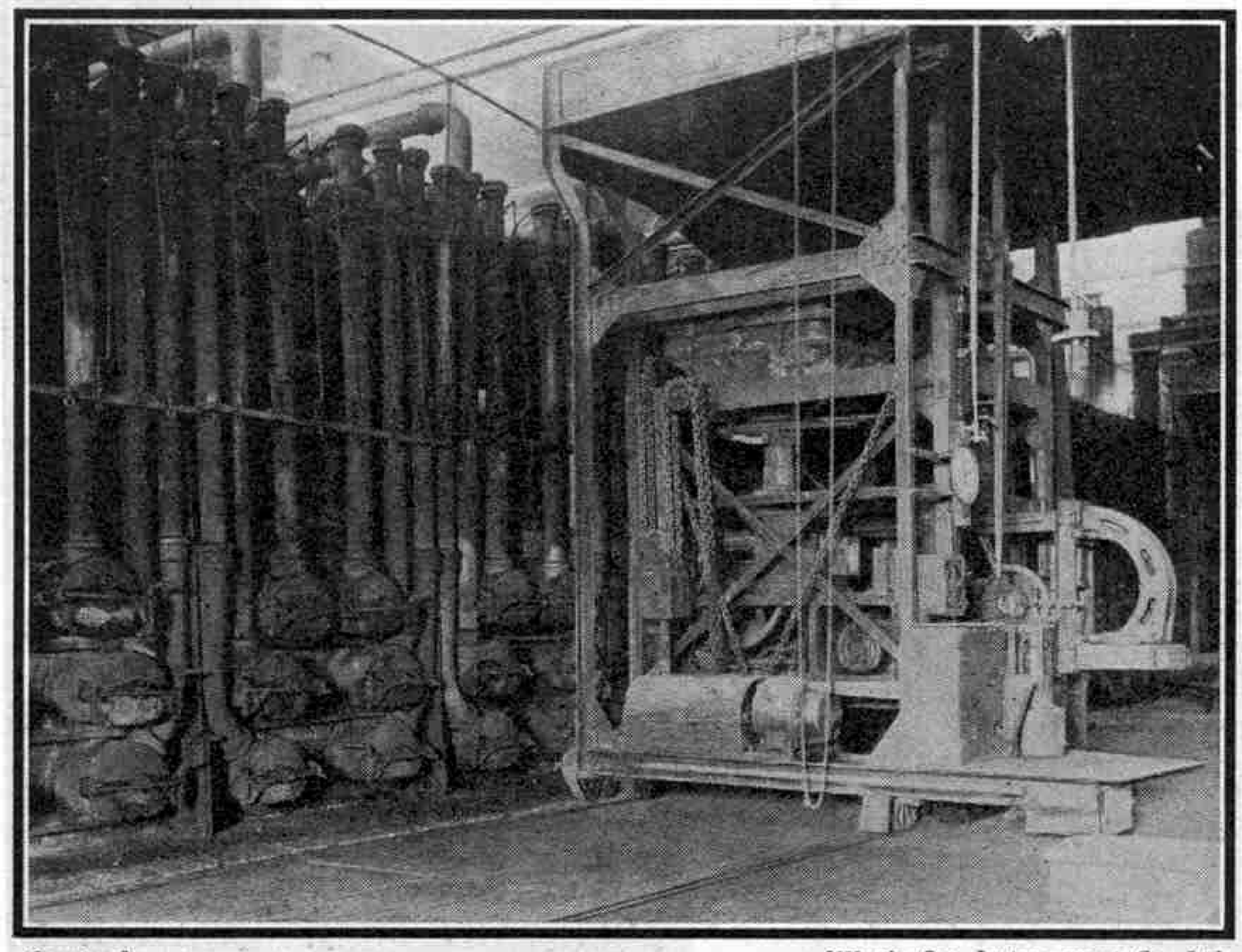
An interesting experiment that illustrates in a simple way the principle of Murdock's contrivance can be carried out by any "*M.M.*" reader. Take a clay pipe and fill the bowl with some very small pieces of bright coal. Cover the top of the bowl with a piece of clay and then place the bowl in a hot part of the fire or over a gas burner. In a short time a little greenish-brown smoke will come out of the stem and, if a light be applied to it, will burn. The substance that is burning is coal gas. This simple experiment also clearly shows how wasteful it is to burn coal in an open grate or kitchen range, because a great deal of the gas and most of the by-products pass away through the chimney.

At Birmingham some years later Murdock continued his experiments and successfully built a plant for manufacturing and purifying gas in large quantities. A great event was his brilliant illumination of the front of

Boulton and Watt's works at Soho in 1802, to celebrate the signing of the Peace Treaty between Britain and Napoleon at Amiens, on 27th March of that year.

First Gas Company Formed

In 1812 or 1813 the first gas company in this country was formed and a gasworks erected in Westminster, but such was the public prejudice against lighting by gas that the company was compelled to build strong high walls around the gas holders. When the illuminating by gas of the House of Commons was decided upon the architect stipulated that the pipes must be kept not less than four inches from the walls, lest the heat of the flame, which he believed passed through the pipes, should set fire to the House! Even when the safety of the new system of lighting was proved, Members were seen approaching the pipes very cautiously with their gloved hands, fearing to be burned by the heat!



Courtesy [*West's Gas Improvement Co. Ltd.*

Horizontal Retorts and Charging Machine

During the century that has passed since those days the use of coal gas has become universal, and the processes of manufacture have developed from the simple methods of Murdock and others to elaborate modern systems whereby various by-products then lost are now collected during the making of pure coal gas. But despite the ingenious machinery now used in gas making the principle remains the same.

Origin of Word "Gas"

The word "gas" was first used by a Dutchman named van Helmont in the seventeenth century, who derived it from the Greek word that has also given us the word chaos, meaning without form. It is obviously an apt word to describe the nature of the invisible substance obtained from coal by the process known as "destructive distillation" or "carbonisation."

Carbonisation must not be confused with combustion, for the latter is the process that ensues when coal is burned in an open grate or a furnace with a full supply of air, while in the former process air is excluded. Coal burned with a full supply of air undergoes chemical changes which result in the formation of carbon dioxide and the oxides of the other elements present in the coal. Usually, however, combustion is incomplete and the smoke that passes up the chimney contains carbon and tarry matter which are deposited on comparatively cool surfaces in the form of soot.

The chemical changes that take place during carbonisation are much more complicated. The material breaks down into a complex series of compounds of carbon, chief among which are various hydrocarbons, or compounds of carbon and hydrogen. Some of these are gaseous while others are liquid or solid at ordinary temperatures. All, however, are easily vaporised by heating, so that they distil out from the retorts in which the process is carried on. The final residue in the retorts is coke, which is practically pure carbon with a small proportion of mineral ash, the amount of the latter depending on the type of coal used.

The actual process of carbonisation is carried on in vessels known as retorts, which play the same part on the industrial scale as did the pipe bowl in the simple experiment already described.

Process of Gas Making

The retorts of early gasworks were semi-circular cast iron tubes of between 6 ft. and 7 ft. in length, and 1 ft. in width. They extended, curved side uppermost, over the furnaces, and care had to be taken not to charge them to the full, as sometimes considerable swelling of the coal took place during the carbonisation. Had no allowance been made for this the rising mineral might have burst the retorts.

As the melting point of cast iron is about 1094°C. the temperature of the retorts was raised only to about 760°C. and this comparatively low heat for a retort somewhat prolonged distillation, so that this took from six to eight hours.

When the inflammable gas had been driven off, the residue, consisting of solid carbon and ash in the form of coke, was raked out to make room for a fresh charge of coal. The process engendered frequent renewal of the cast iron tubes and ultimately they were given up in favour of fireclay retorts.

The fireclay used has to be capable of resisting intense heat, and certain shales found in coal measures, containing only a small percentage of oxide of iron, magnesia, lime, soda and potash, and a high percentage of alumina and silica, have proved most suitable for the purpose. The temperatures during working, in gas-making retorts built of this material, range from 1100°C. to about 1300°C.

During the past few years, fireclay retorts have been giving way gradually to silica retorts, which are not only capable of withstanding higher temperatures but in addition are more durable.

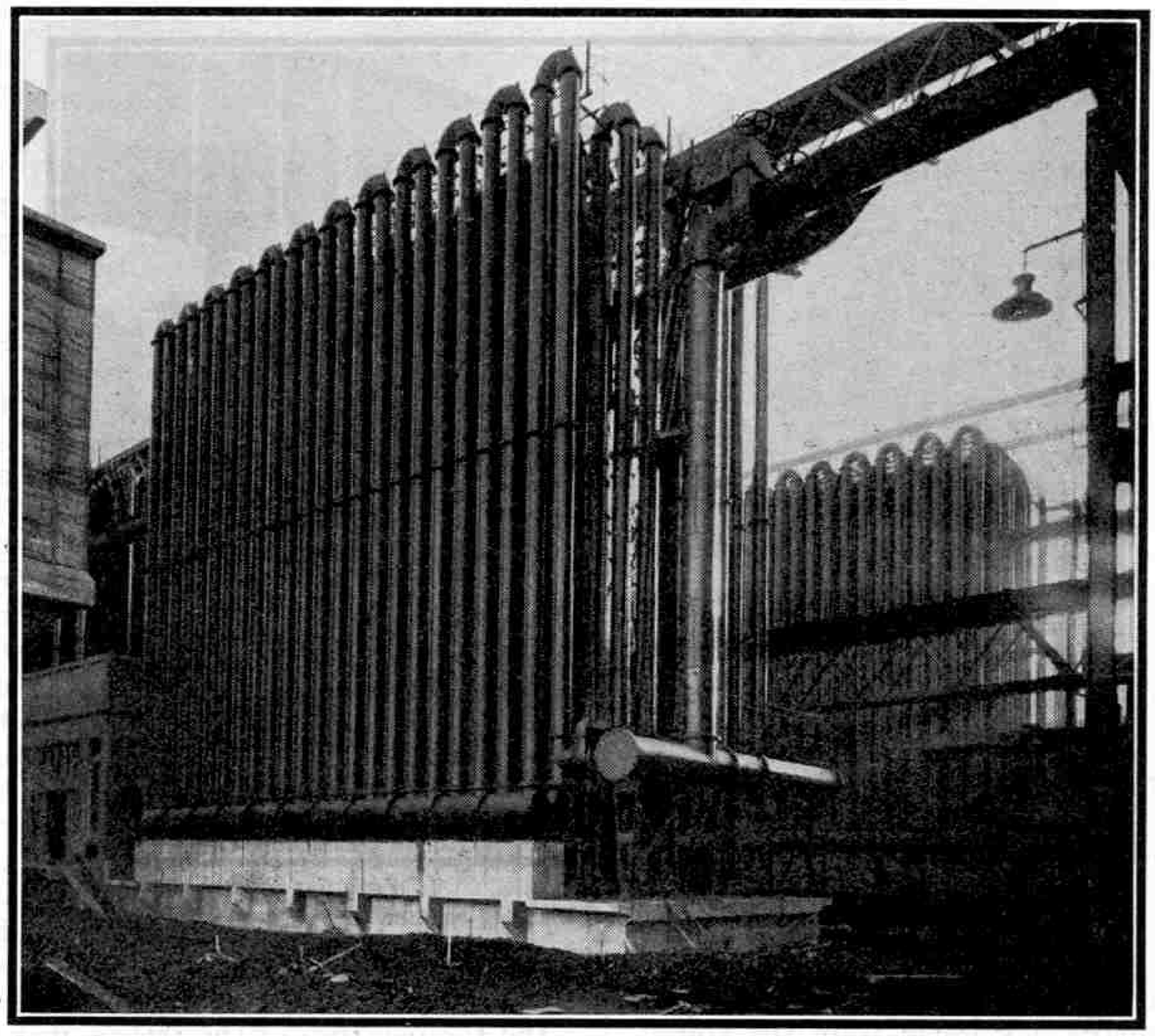
Retorts may be erected in either horizontal, inclined or vertical fashion according to the type of retort adopted. Some horizontal retorts are each about 10 ft. in length internally by 21 in. by 15 in., and are built up in sets, as many as ten retorts being, in some instances, heated by one furnace. Sometimes this class of retort is built in double sets, the individual sets being placed back-to-back, but the general practice to-day in the large works is for the retorts to be 20 to 22 ft. in length, open at both ends and arranged in sets

of eight to ten retorts heated by one furnace. A cast iron mouthpiece is provided at each open end, fitted with an iron hinged lid, made tight by an eccentric fastener. There may be as many as 120 " through " retorts in one bench. A 10 ft. retort is loaded with about 3 cwt. of coal per charge, but some of the 20 ft. retorts will take one ton of coal.

Charging Retorts by Machinery

In the early days of gas making the charging of retorts and ovens was done by hand. The task of pitching the first shovelfuls of coal to the back of the hot retort was very arduous, and great care had to be taken to load the coal into the retort in an even layer to ensure equality of carbonisation.

When the 20 ft. retorts with open ends, mentioned above, were first introduced, they were charged at both ends simultaneously by means of two long scoops. At each mouth two men lifted the point of a scoop into the retort and a third man pushed it along and turned it over, laying an even charge of coal. It required two or three such scoopfuls to charge the retort. The subsequent withdrawal of coke was likewise done at both ends at the same time. Nowadays in all large gasworks these hot and strenuous operations are effected by mechanical means. In fact, in a thoroughly up-to-date gasworks, practically everything is now done by machinery, and manual work is more and more being reduced to mere supervision of the plant.



Courtesy] [*Ashmore, Benson, Pease & Co. Ltd.*

Air-cooled Condenser Sets

A retort charging machine is a huge affair moving majestically along a wide track laid in front of the wall, or " bench," of retorts. The coal supply is received from a mechanical overhead conveyor that discharges its load into a line of hoppers capable of holding sufficient coal to last 48 hours. From these hoppers the coal required for a charge is drawn automatically through hopper doors by pins on the stoking machine, and passing down an enclosed chute it is fed into the conveyor of the machine.

Two lines of parallel plates, placed wide apart, hold the coal in place as it is pushed along the retort by push plates, hinged so as to swing upwards when the conveyor is withdrawn. The discharge of coke is effected simultaneously, the front push plate acting as a ram. The side plates, jointed in short lengths, are wound round a large wheel to which driving power is applied. Another machine receives the hot coke and conveys it away for quenching.

Both charging and discharging machines are operated by electricity, generated by gas engines. A machine can cope with superimposed retorts whereas manual labour could not, and it is usual for horizontal retorts that are fed mechanically to be erected in four or five rows, one above the other. These retorts are so set in the brickwork that the gas and air required to heat them can pass around them from below.

Inclined retorts slope downward from the mouthpiece so that the coal fed to them passes down the length of the chamber by gravitation. To remove the coke remaining on completion of carbonisation, a door is opened at the lower, or rear end of the retort.

Vertical gas making retorts are now featured in large up-to-date gasworks, and are either of an intermittent or continuous working type. The latter represents a British improvement upon the intermittent vertical retort perfected years ago by German engineers, who experimented at Dessau. Various patterns of continuous working vertical retorts are now manufactured.

In the Glover-West system coal broken to suitable size if necessary, is elevated to overhead bunkers of 48–hours' capacity, situated immediately above the retorts. At each retort coal is fed from the relative bunker at intervals of three hours through a gas-tight rotary coal valve to an intermediate coalfeed hopper, which is in direct communication with the retort. From this hopper the coal flows at a constant speed regulated by the speed of a mechanical coke extractor at the base of the retort.

An Ingenious Coke Extractor

The coke extractor is an ingenious contrivance consisting of a sort of spiral chute revolving in a cast iron casing in which the base of the retort is socketed. It is driven by machine cut worm gearing enclosed in an oil-retaining dust-proof gearbox. The gearing is actuated by a reciprocating rod system and ratchet gear with adjustable masks, the speed of rotation and therefore of coke discharge being determined by the number of teeth in the ratchet wheel engaged by the pawl in each reciprocation. The rate of reciprocation of the whole system is also adjustable by means of the speed regulation gear of the main drive.

The coke from each retort is discharged into a massive cast iron chamber from which it is emptied into a conveyor or telpher-skip at intervals of two hours through a self sealing dry-lute door. The residue of coke left in the retort equals 10 cwt. to 12 cwt. for every ton of coal heated in the retort.

The heat required in modern gas making is obtained by the aid of " producer gas," a combustible gas given off by the coke that is used to feed the adjacent furnace. This fuel gas is led to combustion chambers that are situated in the brickwork or " setting " of the retort bench, and to which secondary air previously heated by the waste gases of combustion is also conducted by a separate flue. The products of combustion pass upward from the combustion chambers within the setting.

In horizontal retorts the closed doors prevent the newly formed gas from escaping and its only means of egress is by way of the vertical pipe that passes up the front of the retort. This is appropriately called the " ascension " pipe, for under pressure of progressive distillation in the retort, the gaseous matter, laden with tarry and aqueous vapours, is forced up this pipe, and so passes into the long enclosed tank above, which is partly full of water. Into this tank dip the top ends of the pipes from the different retorts, and the gas has therefore to bubble its way through.

The water acts as a trap and effectually prevents any gas from flowing back to the retort when the flow up the ascension pipe is intermittently stopped. This water is continually being renewed, and care is taken to see that it is maintained at an even level. As the gas progresses through the water it decreases in temperature and begins to shed its tar and ammoniacal liquor and these latter fluids are drawn off and passed to the tar and ammonia tank.

From the water tank, which extends over the whole bench of retorts, the gas passes down to the foot of the condenser or cooling plant. This is generally of an air-cooled type, and a typical group of such condensers is illustrated on this page.

The Condensers

The condensers consist of long pipes of zig-zag formation built up in the form of columns. At the base of the line of columns is a long residual tank. A pipe passes up the centre of each column,

enabling a current of air to pass through and so apply interior cooling to the columns in addition to the ordinary exterior cooling by the atmosphere. During hot weather the pipes are cooled externally by cold water.

The long journey of " ups and downs " through the extensive course of piping brings the temperature of the gas down to roughly 19°c., the minimum low temperature permissible at this stage of purification being 17°c. The aqueous vapour condenses into water, which is considerably charged with ammonia, and then absorbs sulphuretted hydrogen and carbonic acid from the gas. The heavier tarry vapours, or heavy hydrocarbons, condense into tar. The water charged with ammonia, sulphuretted hydrogen and carbonic acid is drained off into one underground tank and the tar into another, this being rendered easy by the fact that tar is much heavier than water.

Water-cooled condensers consist of lofty four-sided towers containing numerous vertical tubes about 1¼ in. in diameter and filled with cold water. Gas is led into a tower and on coming in contact with the cold tubes rapidly cools. Gas tar and napthalene condense and, together with the liquefied tar, are deposited in a tank at the base of the tower.

The gas is drawn through the condensers, whether air-cooled or water-cooled, by powerful rotary pumps termed " exhausters," placed between the condensers and the scrubbing tower to which the gas is subsequently passed. Modern exhausters can pass as much as 250,000 cubic feet of gas per hour. Free running turbo-exhausters are installed in preference to rotary pumps at some large gasworks. The exhausters relieve the retorts of back-pressure set up by the friction of the gas ahead as this flows on through various pipes and purifying plant to the gasholder.

" Scrubbing " the Gas

The " scrubbers " that receive the gas as it is passed on by the exhausters are cylindrical towers about 50 ft. in height and 10 to 20 ft. in diameter. A scrubbing tower is divided into four compartments or storeys by perforated trays, and each compartment is filled almost to its roof with coke. Water is continuously sprayed down upon the successive levels of coke from a specially adapted pipe at the top of the tower.

As the gas led in at the base of the scrubber passes upward, it comes into contact with the extensive wetted surfaces of the coke. The water percolating through the layers of coke reaches the bottom of the tower charged with some of the ammonia, sulphuretted hydrogen and carbonic acid, and is drained off to the tar and ammonia tank to be treated later for the extraction of these valuable by-products. The entrance in the base of the scrubbing tower, whereby the gas gains admittance, is protected from the descending water by a raised cover somewhat like an inverted saucer.

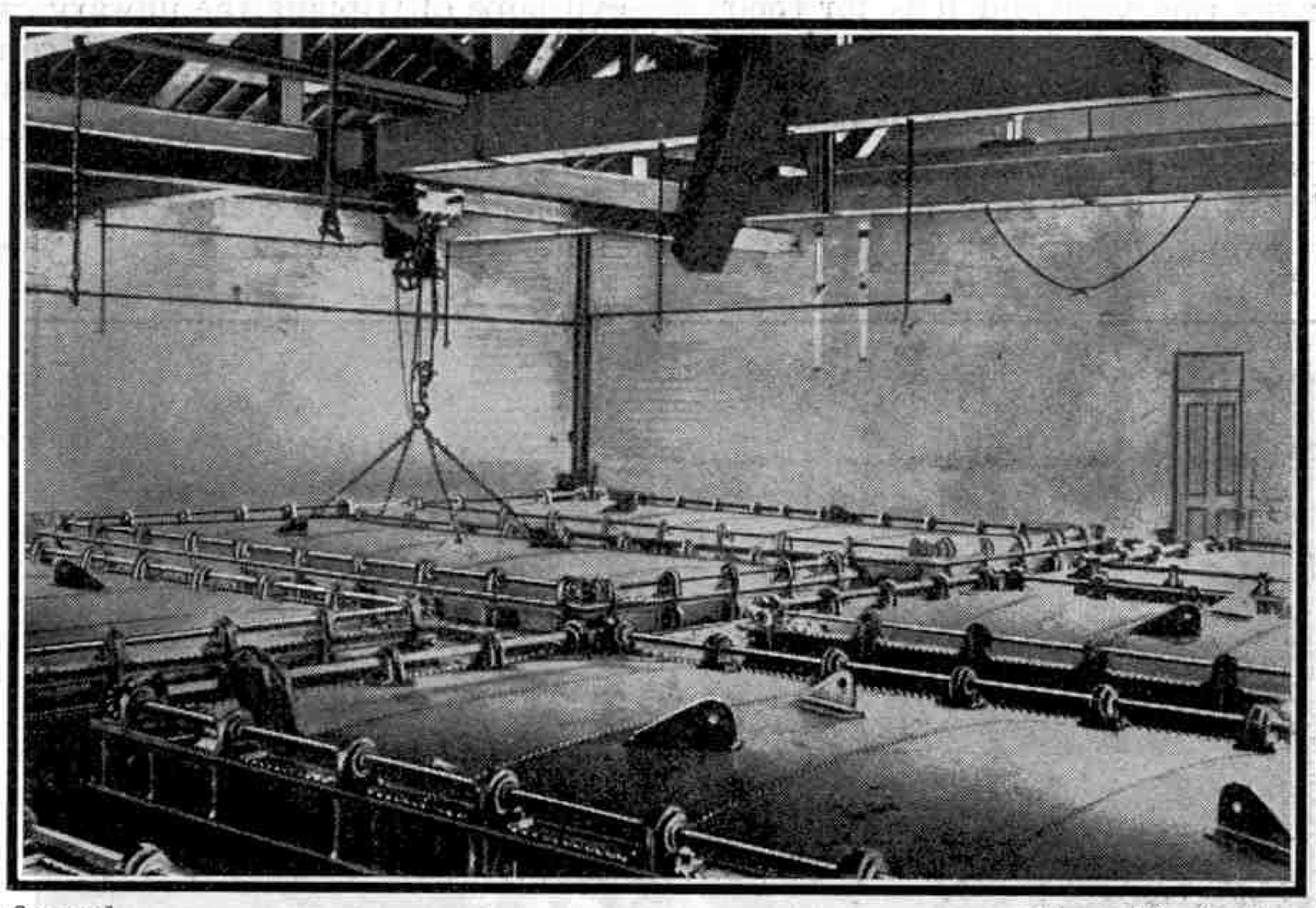
Further cleansing awaits the gas when it is led off from the top of the scrubber and, passing down an external main, is conducted to the gas washing plant or washer-scrubber. These are short cylindrical vessels each mounted horizontally on four cast iron feet. Each vessel is made up of four or five cast iron sections, assembled somewhat like the familiar tube railways. The vertical inner plates that divide each cylinder into compartments are also of cast iron and have a projecting rim to which the cylinder casing sections are flanged. The central portion of each inner partition is cut away, leaving ample room for the axle that passes through the ' heart ' of the cylinder, and to which rotative motion is conveyed by a small steam engine.

In each compartment are many thin wood laths ranged close to each other and made up almost exactly to fit the section. All the laths are connected to the axle and thus rotated, and the lower part of the vessel contains water so that the rotating laths are continually wetted. The gas enters the washer-scrubber close to the axle and travels in and out of each compartment, leaving the vessel at the opposite end by a main near the axle.

The strong affinity that water has for ammonia—it is capable of absorbing as much as 780 times its own volume—results in the prolonged washing to which the gas has been subjected freeing it entirely of ammonia, while further sulphuretted hydrogen and carbonic acid are also deposited in the scrubber. The water in the washer-scrubber is replenished as it becomes charged with impurities from the gas, and the foul water run off and passed to the tar and ammonia tank.

The Final Cleansing

The next and final stage in the cleansing of the gas is carried out in large rectangular boxes called "purifiers." These vary in size according to the magnitude of the gasworks plant, but may be from 20 ft. to 50 ft. in length by 20 ft. to 40 ft. in width and about 6 ft. in depth. They are of cast iron and erected on brick or cast iron columns in order to allow room for the gas to be conducted to the box and enter it from the underside. Around the upper part of the vessel is a narrow channel formed by making the purifier with a double side-casing about 3 ft. in depth. The channel thus formed is kept filled with water and by preventing any escape of gas effectually seals the tank.



Courtesy [*Liverpool Gas Company*

A view inside a " Purifier " House

Each purifier contains one or more perforated wooden trays, on each of which a layer of iron oxide is spread. Hydrated peroxide of iron, to give it its full name, is found in the bogs of Ireland as bog iron ore and is also imported from the marshes of Holland. It is also obtained as a waste product of various processes of the manufacturing chemist.

The gas, on entering at the base of the tank, is evenly spread under the lowest tray by a raised cover over the pipe inlet that prevents the gas from taking a preferential and short course straight up through the oxide. Thus the gas passes upward over the whole area of the trays and at the top is led down a side passage to a pipe exit, whence it passes to the next purifier. In this manner the gas is conducted through four or six purifying tanks linked up in series by piping.

As the gas passes up through the successive trays the oxide of iron absorbs the remaining sulphuretted hydrogen and other substances and becomes sulphide of iron. A small percentage of air is admitted periodically with the inflowing impure gas, and on contact with the air the sulphide of iron takes up oxygen and deposits free sulphur in the mass, and can then be used again. This admittance of air and the chemical action it brings about is known as " re-vivifying " the iron oxide, and is repeated at intervals until the latter contains about 50 per cent. of sulphur.

A series of valves beneath the purifiers enables the flow of gas to be cut off or diverted as is necessary when the purifying material on the trays is exhausted and requires renewal. As will be seen from the illustration shown above, hoisting gear in the purifier house enables the cover of a tank to be lifted off by means of the four holed flanges on the lid. After the lifting of a lid the trays are cleaned of their load and fresh layers of iron oxide laid. The material removed is later sold to the manufacturing chemist for the value of its sulphur content.

The cleansed gas passes through a meter on its way to the gasholder. The meter registers the amount of gas made and is not a very complicated piece of apparatus. Within its large revolving drum are several twisted metal blades which the gas rotates as it passes through the drum, and this rotating motion is conveyed to the measuring apparatus or clock by gearing.

Very few of the people who are familiar with the sight of the lofty steel gasholders of a gasworks are aware that the towering structure they see is bottomless! This (*Continued on page* 555)

Camping in Comfort

An Old Hand's Advice to Meccano Clubs

By W. T. Palmer

FOR the first time in their lives many of our readers will go under canvas this year and it is for their guidance and particularly to help many of our Meccano Clubs which are making their first bid for an annual camping adventure, that these notes are written.

Camping is the greatest of outdoor fun when all runs smoothly but it can also produce the most miserable of conditions if things go wrong. But, why be gloomy?

Attention to a few simple precautions beforehand can eliminate the possibility of every mishap beyond those unexpected little happenings that are the very life and soul of days under canvas. In my own frail canvas cottage I can live out almost any weekend in the year and enjoy it, provided I find a sheltered cove in the hills, on the edge of timber or by the coast.



A happy group of members of the Weston Meccano Club at their Whitsun (1926) Camp in the Mendip Hills

Thus it is clear that an enjoyable camping holiday calls for a small amount, at least, of preparation beforehand. Equipment must be thoroughly overhauled and everything unnecessary eliminated. There is nothing so disconcerting as a pile of absolutely useless impedimenta. The abandonment of unnecessary gear also plays a large part in keeping down expenses, an important point, for although a camp cannot be maintained for nothing, the capital outlay after the first season need only be small. The tent is the heaviest item and with care that can be made to serve for many years.

A good second-hand army bell tent can be purchased for about £3 10s. 0d. and will include a pole and all necessary guy ropes, pegs, mallet and canvas valise. A tent such as this will be approximately 13 ft. 9 in. diameter and will provide sleeping accommodation for ten to twelve boys. Storage for the same number of boys' personal belongings would also be possible in the same tent.

Personally, I have a rooted objection to the bell tent. To my mind it is heavy, cumbersome, lets the rain through and in a strong wind is of little or no use. It is not easy to erect, and requires a comparatively enormous number of pegs to hold it down. As a natural sequence, it requires an equal number of ropes which, on a dark night, seem to have an appalling habit of stretching themselves for a few yards with the deliberately evil hope of tripping the unwary camper. The amount of head room provided is not commensurate with its bulk. No! The bell tent provides a very nice sleeping apartment but a poor home in the day time.

Now to my mind, the essence of a tent is that it should be a home and a Meccano Club that houses itself in tents of the type known as "Half Patrol," sold by Messrs. Camp & Sports Co-operators, will find the comfort much higher and the routine work reduced. The floor space provided by this tent is 6 ft. 6 in. in length and 4 ft. 6 in. in width, and its cost, including the ground sheet and blanket, tent poles, pegs and kit bag, is just under £5. For small clubs, and particularly where it is intended to camp principally at weekends, an ideal tent is offered by Gamages Ltd. This tent's dimensions are 6 ft. × 5 ft. ×4 ft. and it provides sleeping room for 3 to 4 boys or 2 adults. Its cost, including ropes, pegs, mallet, jointed poles and valise is 30/-. As a matter of comparison, a good ground sheet for a bell tent would cost as much as the price I quoted for the tent itself.

What should each member of the party take to camp? Mothers quite naturally are interested here and their questions concerning blankets and the risk of damp are perfectly reasonable. Let me dispose of the more important point—damp—immediately. With a good tent, ground sheet and common-sense, there is no risk at all. Persistent rain may spoil tempers when the club is confined to its quarters, but it will not make the boys ill. A ground sheet or some other protection against the damp ground is essential, however.

Many tents are fitted with wooden floors and in these the boys need no more than a blanket apiece plus the comfort afforded by a mattress that can be stuffed with straw. The covers can be made at home quite easily and I possess some that are simply old disused window curtains sewn together. For an average boy the cover need only be in the form of a sack 5 ft. in length, 2½ ft. in width and 3 in. in depth.

Some mothers may prefer their boys to have a sleeping bag rather than simple blankets. Personally I prefer

the latter for the sleeping bag is very difficult to dry in camp should it happen to be wetted by any mischance. Fit a pair of blankets with press studs and clips; the result is just as efficient as a bag and considerably more convenient. Soldiers, by the way, have their ground sheets eyeletted so that they can turn a pair of blankets into a sleeping bag. A small bag constructed in the same way as a mattress makes an excellent pillow when stuffed with straw and those boys who like a high pillow are recommended to place their boots under the pillow. Ordinary pyjamas and an extra large pair of bed socks comprise the ideal sleeping attire and thus equipped the boys should sleep very snugly. Sleep in camp is almost more important than food and it is significant to note that experienced campers make elaborate preparations for sleeping although their feeding habits may be very casual. Just a word to the camp leaders. If the boys do not settle easily to sleep on the first night, don't worry; seasoned campaigners often have a wide-awake night at the opening of each season, but after that nothing short of a crick in the neck and cold toes will keep sleep away and the precautions I have advised will prevent those two bugbears of the hard floor.



An Ideal Camping Ground

Having thus taken the principal steps toward providing bodily comfort, we can proceed to examine the site for the camp. If it is not close to home, it is best to pay a preliminary visit to select the location of the tents, and discover all that is to be discovered re supplies of food and water.

The selected field should either be level or possess a gentle slope, thus preventing any possibility of suddenly discovering that rains may flood or produce a water-logged marsh in the middle of the camp. I have had both these experiences in quite unexpected places.

The aspect of the site is important. Always face south; a few points to the east or west will not affect the matter to a great degree however. Also endeavour to place the camp so that it is sheltered from the prevailing winds. I remember well an incident that occurred many years ago. A few of us with the aid of a pony hauled a bell tent into a cove on a lonely mountain-side; that evening I had to return home, but a few nights later the others found that a strong blast up the dale had swept the tent away and left them lying, exposed to a merciless rain, with nothing but the clouds between their faces and the stars.

Having ascertained that there is an efficient water supply, the arrangement of food contracts must be considered. If the party numbers twelve or less it is not worth while to arrange for a local caterer to supply and the major portion of what is required should be brought from home. The essentially fresh food, milk and eggs, must be bought locally and arrangements must be made in advance. Fish and fruit usually is hard to get but much will depend upon the season in which the camp is held. Fresh meats should not be worried about and apart from the articles mentioned the best foods to take into store are potatoes, oatmeal for porridge, bacon, cheese, rice and cabin biscuits. It will be found that catering is not the easiest task in camp but once the numbers are arranged, favourable local conditions will decide the success or otherwise of the commissariat. Still, the average boy worries little about his fare, except to offer the usual camp grouse "not enough!"

With all these points now settled the date of our camp comes nearer and we must give attention to the arrangements for transporting our kit and equipment onto the site.

The railway companies treat camping clubs with comparative generosity and grant favourable concessions in fares. Leaders in charge of parties (in the proportion of one to every ten boys), and boys of from 16 to 18 are charged single fare, while boys under 16 pay half-single fare, for the double journey. The tickets are available for return at any time within two months. The railway companies' interest in the camper does not cease, however, with the mere offer of reduced fare facilities. Several of the lines have taken the trouble to collect information concerning suitable camping sites on their systems. The London & North Eastern Railway, for example, issue a booklet in which are given particulars relating to over 550 camping sites in England and Scotland. Coupled with the names of the respective owners of the sites are details of the water supply, distance from station and, where available, general notes on the suitability of the site. Every would-be camper should apply to his nearest L.N.E.R. office for a copy of this booklet.

In these days of motor travel, the transport problem can readily be solved by motoring the whole way. This ensures that the equipment arrives with the party, an important consideration though necessarily involving considerably more expenditure. In the case of long journeys the motor proposition may not be practicable and the equipment should then be sent by rail in the charge of an advance party whose job will be to have the tents erected and a meal prepared against the arrival of the main party. In any circumstances, should the party number some forty or more boys, the provision of an advance party is essential. It is no use expecting a big party of healthy lads to be patient after a long railway journey. In any case, however, insist on every boy taking with him sufficient to provide his first meal on arrival. That meal may prove worth its weight in gold in preserving unfrayed tempers should the arrival be accompanied by a roaring wind and rain.

With the camp pitched and the boys allotted to their sleeping quarters, the fun may be said to begin. That is to be taken literally and metaphorically, and my strongest recommendation to the would-be camper who cannot see the humorous side of things is "stop away!"

There are certain routine duties that are essential to the smooth functioning of the camp and if these have not already been apportioned, the boys should be detailed to their respective duties as soon as they arrive. Cooking, cleaning, washing and tidying up must be carried out to a timetable and, of these, (*Continued on page 503*)



Air News of the Month

New All-Metal Monoplane

A new all-metal monoplane of German design is being built for the Air Ministry at Glasgow. Two years have been spent on its construction and it is probable that it will be completed this summer. This machine will have a 170 ft. wing span and a deep narrow fuselage. On completion it will be sent to an English experimental station. Accommodation for 15 passengers and a crew of three, two pilots and a wireless operator, will be provided. Three engines of 600 h.p. each will drive the machine.

An all-metal flying boat with a single wing is also under construction at Glasgow.

* * * *

Climbing Alps by Aeroplane

An interesting use of aeroplanes is to be made in Switzerland. An aerial service up the Alps is to be operated by special D.H. "Napier" air liners with a view to saving passengers several hours' climb before embarking on a ski-run down the mountain side. The air liner will accomplish in a few minutes a climb that now takes a lengthy period. Probably the first service will operate at hourly intervals from the lake at St. Moritz and the Maltiz Marie Glacier to a height of 10,000 ft.

* * * *

First Provincial Airport

The rivalry for the distinction of opening the first airport in the provinces is becoming keener. Leeds, Liverpool, Glasgow, Nottingham, Sheffield, Bristol and other centres are making efforts to gain this position. Imperial Airways appear willing to co-operate with Liverpool, but they have made it a condition that one of the latest type flying boats must be purchased and the personnel provided by the city. Although this keenness is very promising from the point of view of commercial flying it is to be noted that, even if all the centres mentioned put down aerodromes, Germany will still have a considerable lead. No fewer than 60 German cities are concerned in the German commercial air service and each contributes to the general subsidy in proportion to the distance flown.

* * * *

London-Pekin Air Route

The Luft Hansa, in conjunction with the German-Russian Deruluft Company, are to run a new line from Moscow to Peking. London and Moscow are already connected by air.

London to Palermo by Aeroplane, Train, and Flying Boat

A combined aeroplane, night train, and flying boat service now connects London with Rome, Naples and Palermo. The first stage of the journey is by means of an Imperial Airways liner leaving Croydon each weekday at 7.15 a.m., and, flying by way of Paris, reaching Basel, Switzerland, at 2 p.m. The sleeping car express for Italy is caught at Basel and, after passing under the Alps, the passengers are disembarked at Genoa. The last link is by flying-boat, leaving Genoa at 8 a.m. Rome is reached at 11.30 a.m., Naples at 1.30 p.m. and Palermo at 4.15 p.m. on the day following departure from London.

A return service is available also, the passengers departing from Palermo at 7 a.m. each weekday, and arriving at London at 6.30 p.m. on the following day.

* * * *

Safety in the Air

During 1926 a total distance of 5,271,000 miles was flown by British civil aircraft with the loss of only four passengers' lives. In actual commercial air transport there were no accidents resulting in either death or injury, although the services carried no less than 16,775 passengers and 679 tons of goods.

* * * *

Nansen's Arctic Flight

As we have stated previously, a dirigible with a lifting capacity of 19 tons and a gas capacity of 1,756,500 cu. ft. is being constructed for an Arctic exploration by Dr. Fridtjof Nansen. The plans for this flight have been prepared and the route will be from Leningrad to Murmansk (in Lapland), then to Alaska, crossing the North Pole, returning along the North Siberian coast line.

* * * *

Policing the Air

Aeroplanes were used in tracking robbers who held up and rifled a train near Limon, Mexico, towards the end of April. This band of thieves was composed of 500 revolutionaries and succeeded in derailing the train, killing nearly 100 passengers and stealing £30,000 in gold. Eight Government aeroplanes were called to the scene of the attack to help to round up the bandits.

D.H. Moths in Australia

Major de Havilland, who has journeyed to Australia to organise a factory for D.H. machines, on arrival at Perth supervised the assembly of a "Moth" that had been shipped from England. After the machine had been tested he undertook an impromptu flight, following the Trans-Continental Railway by way of Kalgoorlie, the Great Victoria Desert, Port Augusta and Adelaide, and finally reached Melbourne four days after leaving Perth. Of the total 2,000 miles, 1,000 lay over desert and 600 along a dead-straight railway track inhabited only by maintenance staffs.

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R.A.F. Australia Flight

Six "Southampton" flying-boats of the R.A.F. will be flown to Australia and the East next year. This flight will be under the leadership of Group-Captain H. P. G. Cave-Brown-Cave, one of the technical chiefs at the Air Ministry. The ultimate destination of the machines will be Singapore, where they will remain to form the nucleus of the British Air Fleet in the East.

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An aerodrome is in course of erection at Hong-Kong and probably will form one of the termini for a passenger service between Hong-Kong and Chinese cities.

* * * *

Thames-Seine Air Service

The French Air Union is to operate another service between London and Paris during the summer. A new type of Liore and Olivier amphibian, carrying six passengers and fitted with Bristol "Jupiter" engines, will be used. The machines flying from this side will depart from Hammersmith and fly to Le Bourget to pass the Customs, thence continuing to Paris where the passengers will be disembarked on the Seine.

* * * *

World's Altitude Record for Seaplane

Lieut. de Vaisseau Demouget has set up a world's altitude record for seaplanes of 9,500 metres (31,065 ft.) Previous to this record, Sadi-Lecointe held the world's record with a height of 8,080 metres (26,422 ft.)

* * * *

An aerodrome is to be erected to the west of the motor racing track at Brighton. Its length in the direction of the prevailing wind will be 75 yards.

New Type of Aeroplane

A new type of aeroplane, designed to take off and land in a confined space, has been constructed in America. Two years' work has been spent on this machine by the inventor, Leonard W. Bonney. The outstanding feature of the craft is its similarity to a seagull, many of the principles of bird flight being incorporated in the new design, the details of the wings in particular being copied as faithfully as possible.

When the machine touches the ground the wings turn about their axis and present their full surface to the wind, thus acting as air brakes and causing the machine to come to rest very rapidly. When on the ground the wings can be folded along the sides of the machine, allowing it to pass into a hangar only 15 ft. in width. The wings and the tail surfaces of the actual machine have been constructed of duralumin.

* * *

Non-Stop Flight Record

While testing their machine for an attempt to cross the Atlantic, Mr. Bert Acosta and Mr. Clarence D. Chamberlain remained in the air 51 hrs. 11 min. 20 sec., surpassing by about six hours the world's record non-stop endurance flight set up in France in 1925. During the whole of this time they flew round within a 25 mile radius of Mineola, Long Island. They landed with only seven gallons of petrol remaining from their original supply of 385 gallons and less than one quart of oil, having covered a total distance of 4,080 miles. The estimated distance between New York and Paris is 3,946 miles.

* * * *

Cheaper Airships

A new type of airship is said to be 90 per cent. cheaper than one of similar size constructed on orthodox lines. The saving is obtained by applying a recently perfected method of internal rigging, stated to have the effect of distributing the strain over every square inch of the envelope, thus lessening the possibilities of the ship's back breaking. The first vessel of this new type is now being constructed and is to be propelled by four 75 h.p. "Cirrus" engines, driving four air-screws. The average speed will be about 70 m.p.h. throughout the cruising range.

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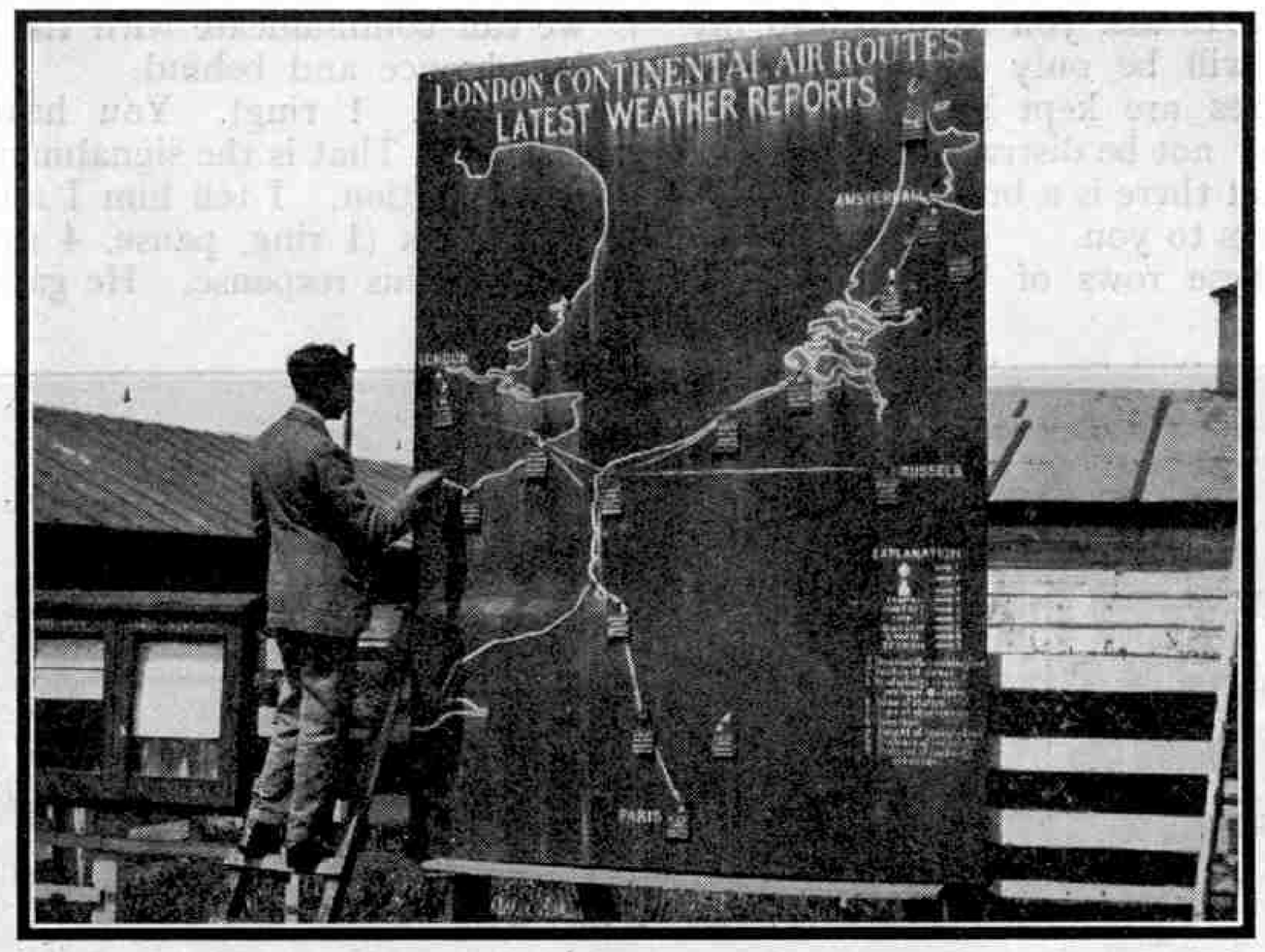
Zurich-Cape Town Record

W. Mittelholzer, the Swiss aviator, has set up a record for the flight from Zurich, Switzerland, to Cape Town, South Africa. He completed this journey in 100 hours, flying a seaplane.

Women Pilots

The Air Ministry have decided to sanction the piloting of public aircraft by women but there seems little prospect of their taking any extensive part in air taxi work. According to a statement by an official of Imperial Airways, pilots are recruited from the R.A.F., none being accepted without this experience.

"A Deep Depression . . . . .?"



Courtesy [*Imperial Airways Ltd.*

Meteorology is essential to reliability in flying and this picture shows an airway map with the latest weather reports indicated upon it

Japanese Air Transport Company

A Japanese Air Transport Company, organised on similar lines to Imperial Airways, is being formed to operate airlines in the Far East. The machines to be used are to be built in Japan under British license and will be 15-20 seater aeroplanes, each being driven by two Napier "Lion" engines. A subsidy of £1,000,000 spread over a period of ten years is expected from the Japanese Government and probably operations will begin early next year.

* * * *

Aerodrome at Nice

It is hoped that the proposed enlargement of the aerodrome at Nice will be completed this summer and so permit the inauguration of a service between London and Nice. This service would include stops at Paris, Lyons, and Marseilles. An Imperial Airways service would connect, leaving Croydon at 7.15 a.m. and reaching Nice at 6 p.m., thus bringing London within 10¾ hours of the French Riviera.

* * * *

Paris Trips

Imperial Airways are starting to-day a new excursion trip to Paris. The machines on this service will leave Croydon at 7 p.m., returning the following morning at 9 a.m. It is expected that this service will be as popular as the one-day shopping excursions started on 30th April.

Croydon Wireless Station

In the reorganisation of the Croydon air port a new and larger wireless station is to be erected by the Marconi Wireless Telegraph Company. This station will be able to transmit over much larger ranges than the one it is replacing. The masts and transmitters are to be erected two or three miles from the port itself in order to keep the neighbourhood of the aerodrome free from obstruction.

* * *

Pilotless Aeroplanes that can "See"

It is reported that an aeroplane equipment has been invented in America that gives to the land operator of a pilotless machine the same range of vision as that obtained from the pilot's cockpit. Great secrecy is being observed concerning this application of television, but it is understood that special lenses project above, below, and on each side of the body of the aeroplane.

* * *

Mile-High Air Glide

Recently a successful glide from about a mile in height in an engineless machine was accomplished by Herr Esplenlaub, at Cassel, Germany. His machine, a monoplane glider, was towed to this height by an aeroplane, the tow-rope was detached and the machine was allowed to glide down to the aerodrome. Herr Esplenlaub was accompanied by a passenger.

* * * *

New Light Aeroplane

A new light aeroplane, the Johnson Twin-60, driven by two 32 h.p. Bristol "Cherub" engines and having a maximum speed of 85 m.p.h., is being manufactured in America. The engines are placed behind the wings, leaving an unobstructed view towards the front. A tail-wheel fitted with a powerful brake is installed in place of the usual skid, and although two people can be carried for eight hours at an average speed of 60 m.p.h. the machine has a landing speed of only 25 m.p.h.

* * * *

Rotterdam-Marseilles Mail Service

Trial flights have been carried out by the K.L.M. Company with a view to establishing an air mail service between Rotterdam and Marseilles. At present connection is made by train with the mail ships sailing for the Netherlands East Indies, and mail must be handed in by 6 p.m. on Wednesday to catch the mail boat sailing on the following Friday. The journey by air takes only seven hours, however, and mail can be accepted up to 10.30 p.m. on the day before sailing. Thus 24 hours are saved by using the air route.

"My Day's Work"

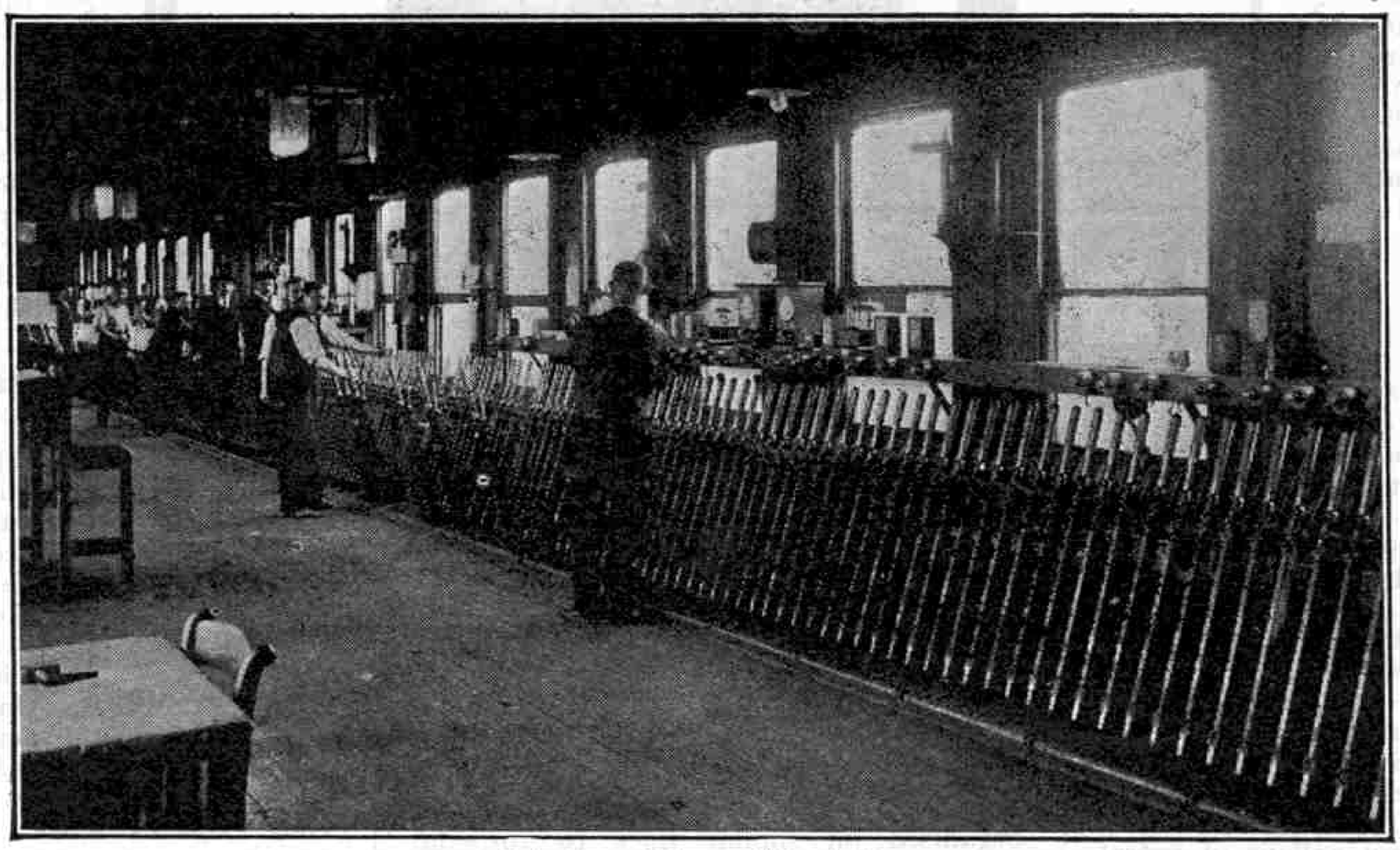


A short time ago this talk was broadcast by Mr. Jas. Eggleston of Bishop Auckland. We are able to reproduce it here by his kind permission, and that of the Editor of the "*North Eastern and Scottish Magazine.*"

TO-NIGHT I am going to ask you to step into my signal-box, but it will be only in imagination.

Actually, signal-boxes are kept strictly private, because our attention must not be distracted by visitors. You must also imagine that there is a brief lull in traffic, so that I can explain things to you.

You will have seen these rows of levers hundreds of times through the signal-box window, and also have seen us pulling them over to move the points and signal boards, but you may not know why they are painted in different colours. This is to afford a rough help to identification. Distant signal levers—that is, levers which move those boards with a little fish tail cut out of them, and which act as caution boards, warning the driver that at the next signal he may be stopped by traffic ahead—are painted green. The other signal levers controlling those signals which must not be passed until they are lowered, are painted red. The black levers are used to move the points, whilst those coloured blue work bars, or perhaps you would call them bolts, which keep the points securely locked whilst the trains are passing over them.



Interior of large Signal Box

In small boxes there may be only 10 levers, whilst in the largest English signal-box (at York) there are nearly 300.

You will notice that below the rows of levers there is a somewhat elaborate mechanism of slotted bars. This is the famous interlocking apparatus which, along with the block instruments, helps to make the British railways the safest in the world. These interlocking devices make it impossible for me to lower a signal for a train without first setting the points properly. The levers must be pulled in their proper order or they will not move.

These boxes with little pointers on coloured dials, and also the bells and gongs on this shelf above the levers are the block instruments. By means of them we can communicate with the signalmen in other boxes in advance and behind.

(Pause. 1 ring). You heard that single beat on the bell! That is the signalman in the South box calling my attention. I tell him I am listening by giving one beat back (1 ring, pause, 4 rings), and I want you to listen to his response. He gave four consecutive beats. This is a code meaning that he wants permission for an express passenger train to approach. Had there been a pause before the last of the four beats, like this (3—1), it would have meant not an express, but a stopping passenger train.

There is a multitude of variations in bell signals, covering everything from a platelayer's bogie to a millionaire's "special," all of which the signalman has to know pit-pat, to say nothing of "cancelling" signals, emergency signals, and many others.

Nothing comes forward to this box without my permission. It is my duty to see that permission is not given until the previous train, whatever it may be, has got well past, and the section is quite clear. The instruments help me, but the human factor is still the thing that counts. I repeat the four consecutive beats to the man behind (4) which means that all is well and the train may approach. Then, as an additional precaution, I peg over the needle of this little indicator to the point marked "Line clear," which, by the agency of electricity, will make a pointer on one of the instruments in the South box move in a similar way.

I will now call the attention of my colleague at the box in advance by the same process of one beat on the bell (1 ring). I must await his answer (1 ring). Then I follow it by four consecutive beats (4 rings), which he repeats in the same way as I did a moment ago (4 rings). I wait until he moves the pointer on this other indicator to "line clear," and then I pull off the signals which will allow the express train to pass

my box and go on to the next. And so it goes on all down the line.

You would notice I pulled down four signals in all. The first signal is called the "advanced starting," the second, the "starting," the third, the "home," and the fourth, the "distant." The last signal took some pulling, because it is nearly a mile away. It is not only brain work that is required in a signal-box!

(Pause, then 2 rings). Those two beats on the bell were from the South box. That means that the express train is actually passing that box. I acknowledge this by repeating the two beats (2 rings) and move the needle of the indicator from "line clear" to "train on line."

And now here is the train approaching. I must notify the box ahead by giving two beats (2 rings), which he will acknowledge by repeating (2 rings). I would know it to be an express passenger train by the sound, even if this had not been indicated to me on the bell. If you will excuse me I must now look out of the window.

Signalmen do not look out of their windows merely to get the air, or out of curiosity. They have to see that nothing is amiss with the trains. There might be a smoking hot axle, or a carriage door might be open, or, in the case of a goods train, a load might have shifted. It might even happen that a train has been broken in two so I must make sure that this train now passing carries a tail lamp. Lamps on trains are not for the same purpose as lamps on motor cars. The front lamps on an engine, by their colour and arrangement, tell the signalman what kind of a train is behind them, the rear lamp shows that the train is complete. Now that this train has passed in good order I notify this to the signalman in the rear by calling his attention (1 ring, pause, 1 ring). Now that he has answered I give him three beats with a pause between the second and third, like this (2—1), which he will repeat (2—1), and the section is now clear again.

Perhaps you have been wondering what my boy assistant has been writing in that book. That is called the "train register book." He is writing down the exact time at which all the signals we have heard were received. The boy also attends to the telephones and telegraph instruments, but he is not allowed to manipulate the levers or block instruments. That kind of work is too important for boys.

You will notice that things are now getting fairly busy, but the clash of levers and clanging of different toned bells need not alarm you. It is merely a slight congestion of traffic of a kind that keeps cropping up at intervals during the day. Those two freight trains you see there in the sidings both want to get away. I give the preference to the one whose head lamps show that it is a through train. This engine here has vehicles to attach to the passenger train at the platform, and the shouting is to let me know which siding they want the engine to go into for the horse box, or whatever it is.

(Pause, 1 ring). I wonder what this fellow wants. I'll answer him. (1 ring, pause, then 1—5—5). The signalman behind has sent a special signal telling me to turn an approaching freight train on to a side line so that a more important train may get past it. I must acknowledge it (ring 1—5—5).

Here are two trains arriving simultaneously on different lines for the same sidings. I must get to know from the yard inspector which train he wants in first. And now, to crown all, here is a train without its tail lamp. By means of my bell code, nine consecutive beats to the box in advance (9 rings), and four, then five to the box in the rear (4—5), I have let the boxes on both sides know so that all trains may be stopped and warned in case it means that a derailed vehicle is fouling the lines.

* * *

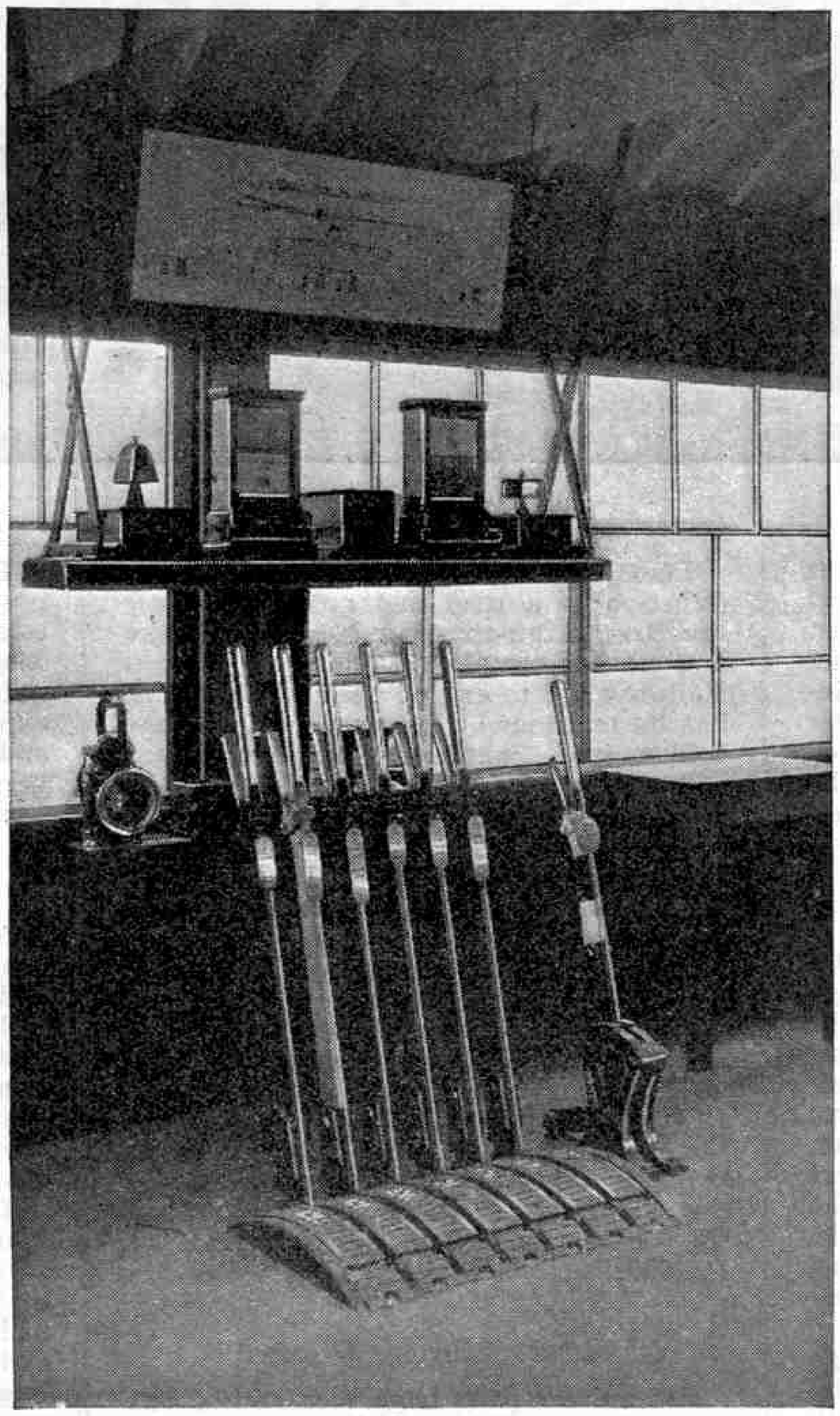
I have tried to give you typical occurrences in my daily routine. All routine is liable to be a bit dull, but the signalman is never sure when the unusual is going to happen. When it does he must deal with it as promptly, as reasonably, and as coolly as his temperament and training will permit. At all times the signalman's work depends primarily upon a clear head.

You now, I think, know a little of what occurs inside a signal-box. I am sure that having seen how much depends upon our work you will be less critical of the man in the box when he keeps your train waiting for a few moments. You will now realise that it is for your own especial safety that he does so.

My work is now finished and I am going to close the box and go home. Before doing so I must indicate to my colleagues by a special bell signal, 7—5—5 that my day's work is ended. That is the signalman's "Good night, everybody," as it were (ring 7—5—5).

* * * *

It is difficult for those who have never visited a signal box to realise the large amount of detail and painstaking care that the signalman puts into his work. This is the case even in a small box, and when one considers that a box may contain as many as 200 levers one cannot fail to appreciate that an enormous strain is borne by the signals' staff. The strain is physical as well as mental, for no mean strength is required to pull over a lever controlling a set of points placed perhaps a thousand yards away from the box.



Hand-operated Signal Levers, showing "releasing numbers." On the shelf above are the tapper bell and disc instruments



The New Destroyers

It is now officially announced that H.M. Destroyer *"Ambuscade,"* launched at Scotstoun by Yarrow & Co. Ltd., last year, has completed her full power trial of six hours' duration and easily maintained a speed of over 37 knots. Her sister ship, H.M.S. *"Amazon,"* was launched at Southampton about the same date by Thornycroft & Co. Ltd., and is now undergoing her speed trials on the Clyde.

* * * *

Deep Water Quays for the Congo

Two reinforced concrete deep water quays are to be constructed on the Congo River. An entirely new quay is to be built at Ango-Ango, a few miles below the existing port of Matadi, on the left bank of the river. This quay is to have a length of 196 yds. and a further section of pier, 44 yds. in length, is to connect the quay and river bank. At Matadi the port is to be enlarged, the quay is to be extended by 371 yds., and a connecting link of 88 yds. between the quay and the river bank will be built.

The construction at both Ango-Ango and Matadi is to be of reinforced concrete, with hollow steel piles, filled in with reinforced concrete below. Filled ground behind the quays will provide an area for the erection of warehouses on pile foundations.

* * * *

Madras Irrigation

The Government of Madras have decided to attempt to complete the construction of the Mettur irrigation project in seven years instead of ten. The floods during 1924 showed the necessity for providing more effective surplus escapes and the site of the dam has been shifted a mile upstream. Steady progress has been made in the work, 37 miles of road from Erode to Mettur having been laid. A standing camp for 5,000 coolies at Mettur, quarters for officers and staff, and a pure water supply are nearing completion.

* * * *

Under a scheme to operate under the Government Electricity Act, the power stations of Glasgow, Dundee, Edinburgh, Greenock and many other Scottish towns are to be linked up. Transmission is to be at 132,000 volts on overhead lines, which are to be carried on towers 100 ft. in height. The conductors are to be of aluminium.

Important South African Bridge Scheme

Plans have been prepared for the construction of a road and rail bridge over the River Limpopo near Messina, to take two years to complete. The South African Railways are to extend their track, which has its terminus at Messina, over the new bridge into Southern Rhodesia. There will still remain about 100 miles between the termini of the South African Railways and the West Nicholson branch of the Rhodesian lines. Owing to the cost that would be incurred in overcoming the engineering difficulties there is no intention of closing this gap at present.

In addition to its use for railway transportation, this bridge will be used for motor traffic and the transport of cattle, forming part of the great African trunk road from the Cape to the Nile. A step in the construction of this important road is being taken by the strengthening of the Victoria Falls Bridge. The cost of the Limpopo bridge is estimated at £55,000.

* * * *

Melbourne Bridge Repaired

Extensive repairs have been carried out on the Princes Bridge, Melbourne, in order to make it available for heavy traffic. This bridge crosses the River Yarra and is 120 ft. in width, consisting of three river spans each of 10 arched girders carried on masonry piers, and a land span of 24 ft. over a roadway on the river bank.

Strengthening and repairing became necessary on account of the decision to run a service of electric trams over the bridge, cable trams only having crossed previously. On examination it was discovered that, owing to the open slot under which the cable ran, the main girders of the bridge were kept constantly covered by a layer of wet street refuse, which had resulted in very extensive corrosion taking place.

* * * *

A new type of motor boat, built for service on the Danube, is flat-bottomed in order to allow it to move anywhere along the river independent of the depth to which the water may fall. An aeroplane engine is installed and drives an air propeller at the stern of the vessel, no underwater propeller being used. This boat will operate between Vienna and Budapest and it is anticipated that a speed of 40 to 50 miles an hour will be obtained.

Fifty Ships for Czecho-Slovakia

The Czecho-Slovakian Government propose to purchase 50 ships as a basis for the establishment of a mercantile marine. The first three of these ships, which range in tonnage from 3,000 to 8,000, will operate experimentally between Britain, Hamburg and the Baltic. A loan of £2,000,000 has been offered by English financiers to the Government concerned.

* * * *

Coal Transporters for Sudan

A number of very important engineering projects are to be undertaken in the Sudan and will be commenced shortly. These include a bridge over the Nile, tramway and waterworks schemes and the construction of an important coal-handling plant at Port Sudan, the modern seaport that has come into existence near Suakin on the Red Sea.

This complete coal-plant will comprise four of the largest electrically-driven travelling and slewing bridge transporters in the world. Each of the transporters will be 425 ft. in length and 215 ft. in span, and will be capable of raising its load to a height of 45 ft. above the ground. High speed grabs of 2 tons' capacity will be fitted. This plant is to be used in the loading and unloading of steamers and barges.

* * * *

Power from the Tides

The Government of Korea are making plans to utilise the power provided by tidal movement and intend to erect eight hydro-electric plants at different places along the coast between the ports of Jinsen and Zuisan. The average tide on this coast is 19 ft. with a maximum of 28 ft. and it is considered that the power developed will be about 1,658,000 kilowatts. The total cost of the eight plants is estimated at £24,600,000.

* * * *

New Elevators for Canada

An interesting sidelight is cast on the growth of the Canadian wheat trade by the statement that private grain companies and wheat trusts intend to construct no fewer than 1,000 new grain elevators. Some of these will be erected at various places in the prairie country and others at the seven big terminals at the head of the Great Lakes to which the wheat is first carried by rail on its way to the great grain markets of the East Coast of America and Europe.

A Roof over New York

A project for the construction of an overhead highway over New York has been put forward by a noted American engineer, Mr. J. K. Henchen. According to plan this will extend from Battery Park over Manhattan Island to the City of Yonkers, a distance of 16½ miles, providing space for two immense roads and a tree-bordered promenade for pedestrians.

This overhead highway is, however, only a part of the plans for a roof for New York, and the engineers responsible for the scheme are attempting to obtain a capital of £132,000,000 for the purchase of land and buildings along the route of the projected highway. It is proposed to purchase a strip of land 425 ft. in width and to erect or transform buildings to cover a central portion of 120 ft., avenues on each side making up the total width. Under these buildings there will be laid four railway tracks for use by the New York Central Railway instead of the existing tracks that pass through the open streets.

The first floor of the buildings will contain shops, a pavement 10 ft. in width and a roadway 50 ft. in width. The second floor is designed for shops, restaurants, etc., a series of seven moving platforms of different speeds ranging from three to 21 m.p.h. providing free transport for passengers. The upper floors are to be devoted to offices, schools, theatres, etc. Bridges at three levels, the first and second floors and the roof, are to cross the roads and avenues intersecting the buildings. Motor traffic will be carried on the roof, to which huge ramps will lead from street level. The heights of the buildings may vary from 10 to 12 floors above ground level and it is estimated that approximately £60,000,000 will be obtained from their rental.

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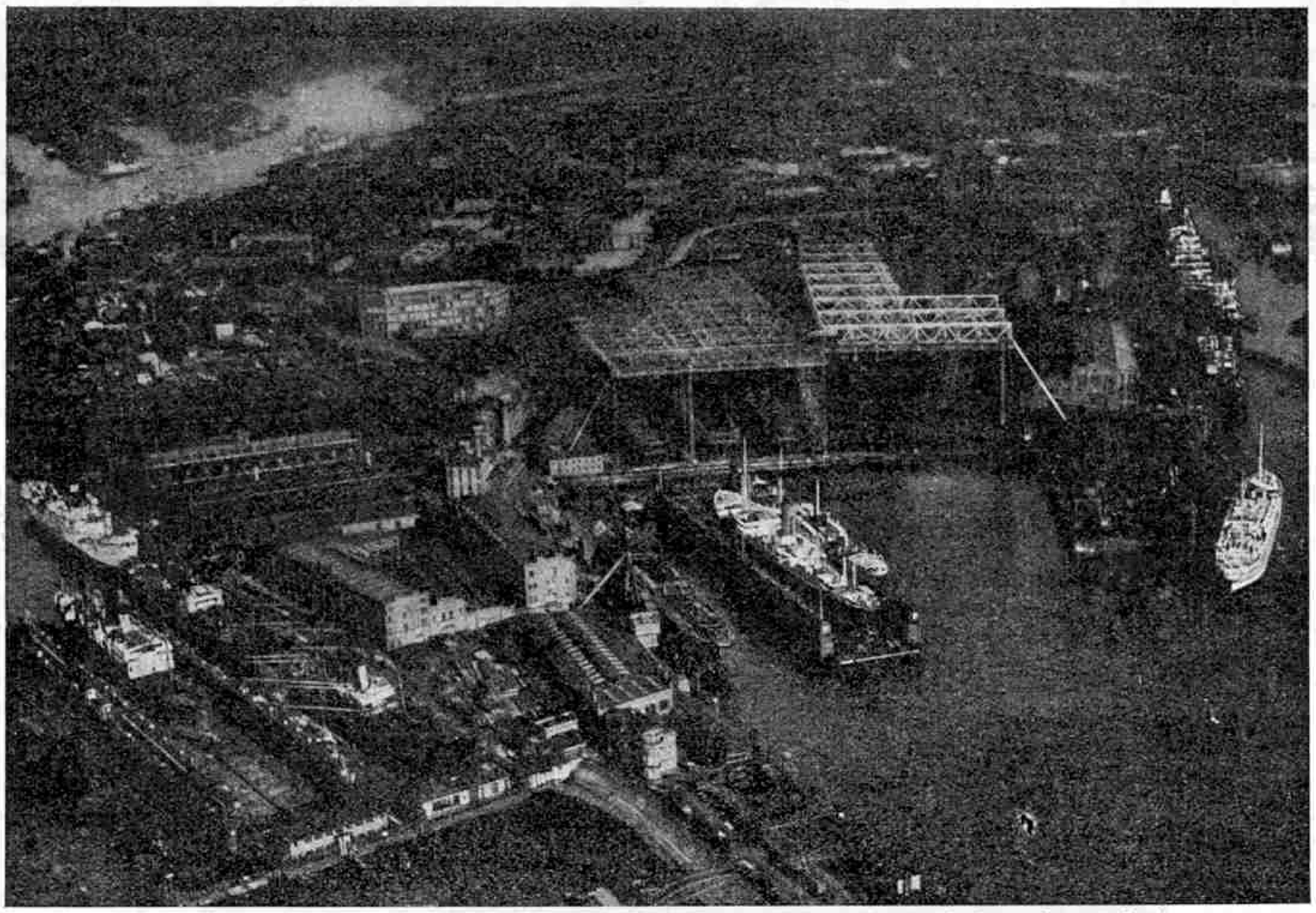
A proposal for the construction of a bridge across the San Pablo Bay, California, has been put forward. This bridge is to be 14,000 ft. in length with a carriage way of 30 ft. and a clearance for shipping of 135 ft. The estimated cost is £2,400,000.

* * * *

An electric conveyor has been installed at Victoria Station to handle luggage at the baggage room of the Customs Office. It is 200 ft. in length and can handle about 360 trunks per hour.

Twenty-Mile Aqueduct for New York

A second tunnel aqueduct for the purpose of carrying water from the Catskills to New York is to be constructed. It will be over 20 miles in length and will be cut in rock at a depth of about 500 ft. The carrying capacity is estimated at 700 million gallons a day. The existing tunnel has a capacity of 500 million gallons a day.



General view of a shipyard showing building slips with closed gantries, floating docks and repair basin
(From "Slip to Sea" reviewed on page 507)

Hull Dock Improvements

Two new outer gates for the 85 ft. entrance lock of the Alexandra Dock, Hull, have been erected recently. As the old gates had to remain in position until replaced by the new ones, the latter could not be built on the spot but had to be constructed at a shipyard and towed into place. The gates, each weighing about 150 tons, exclusive of anchorage, were launched after construction, towed to the entrance locks and hoisted into position. This work was carried out by Armstrong, Whitworth & Co. Ltd.

Three pairs of 80 ft. gates for the Alfred Lock, Birkenhead, and one pair of 80 ft. gates for the Avonmouth Dock are being constructed by the same firm and are to be launched in a similar manner to those of the Hull Dock.

* * * *

White Star Motor Liner

A motor liner has been ordered for the Liverpool–New York service of the White Star Line and construction has been started. This vessel will have a gross tonnage of 26,000, somewhat bigger than any British motor liner now afloat. At present the sister ships *"Alcantara"* and *"Asturias,"* with gross tonnages just over 22,000, hold the record as the largest British motor ships.

The new vessel is being built by Harland and Wolff Ltd., and will be fitted with Harland-Burmeister and Wain Diesel engines.

Irrigation in Peru

In Northern Peru the irrigation by the River Amazon of some 350,000 acres, 168,000 of which are uncultivated, is being undertaken, and a pure water supply also is being provided for three towns and a number of villages. The waters of Huancabamba, a tributary of the Amazon, are to be led through a tunnel to be bored under the main range of the Andes, and these waters, after uniting with four other rivers, are to be used for irrigation purposes. It is estimated that the total cost of this work will be £5,000,000. In addition, more roads are to be laid down and electric lighting and telephones installed.

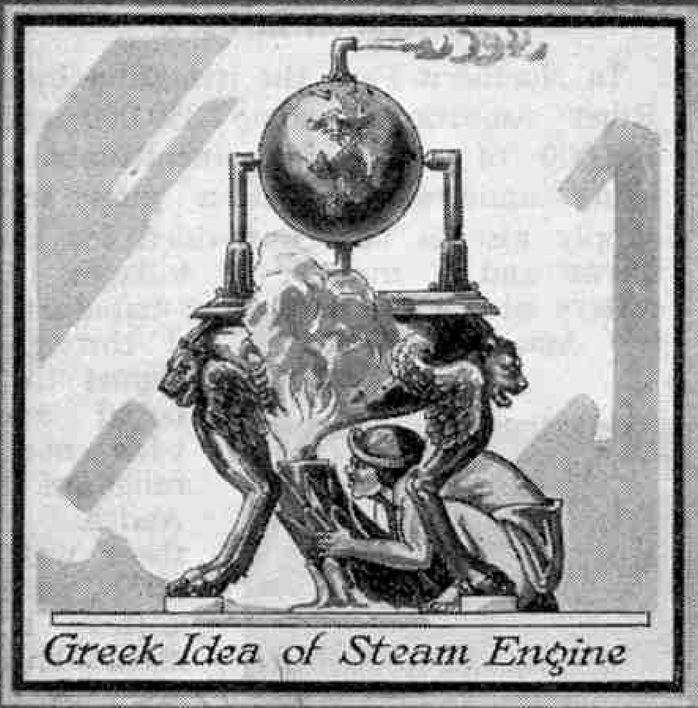
The success of this scheme seems assured for the roads between the towns of Chiclayo, Lambayeque, and the Port of Pimentel, already constructed by the Irrigation Commission, are being used by an increasing amount of motor traffic. The value of the land has also increased.

Irrigation in a neighbouring district was undertaken some time ago and has paid for itself in two years. This work was undertaken under the Pampas Imperial scheme and 20,000 acres of soil were watered.

* * * *

A new bridge across the River Clyde is nearing completion and will be formally opened on 2nd July. The bridge is built of reinforced concrete and faced with grey granite. It stretches from the Broomielaw to Clydeplace, just west of the L.M.S. railway bridge, and has an overall length of 535 ft. A centre span of 166 ft. and two shore spans of 129 ft. are included in this length.

The bridge carries a roadway 50 ft. in width and two pavements each 15 ft. in width and two lines of tramways pass along the roadway. The foundations consist of 14 caissons sunk, in the case of the river piers, to a depth of 34 ft. below the river bed. Massive cross-beams are carried on these caissons and support the superstructure, which itself rests on roller bearings, allowing free expansion and contraction. The bridge is being built in two sections and the closing of the central gap of 15 ft. will form the final step in the construction. The estimated cost, including approaches, new quay and other works, is £200,000.



LIVES OF FAMOUS INVENTORS

III. WATT AND THE STEAM ENGINE

IN the two previous articles in this series (published in the March and May "*M.M.*") we dealt with the early experiments of James Watt and the patenting in 1769 of the first true steam engine. The early trials of Watt's first engine and its subsequent dismantling and removal from Scotland to the Birmingham works of Matthew Boulton were also described.

When Watt arrived at Soho from Scotland in 1774 all was ready there for the re-assembling of "*Beelzebub*," the trial engine. This was accomplished without mishap, and to Watt's great relief the engine worked much better than during either of the two previous tests.

The patent of 1769 assured legal protection to Watt's invention for 14 years from that date, but as a considerable portion of the time had now elapsed and the building of engines for sale had not yet begun, it was decided to apply to Parliament for an extension of the patent. Watt accordingly went to London to push the matter forward.

The application was opposed by a number of impatient mine-owners who chafed at the prospect of being further prevented from freely copying Watt's invention. Rivals also cropped up, one of whom was seeking to establish a pumping engine built to plans stolen from Kinneil House, Scotland, by a faithless Carron servant who had disposed of them for a handsome sum. Boulton and Watt won their case, however, and a revised patent extending the period of legal protection to 25 years from 1775 was granted in that year.

While Watt was in London he received word from Boulton of the death of Dr. Small, and he was deeply grieved at the passing of one who had been largely the means of bringing Boulton and himself together. Before returning to Birmingham, Watt received a letter from his old friend Robison, then a professor at Cronstadt Naval School, offering him an appointment under the Russian Government at a salary of £1,000 per annum. Fortunately for the steam engine he did not accept the tempting offer, but journeyed back to Soho immediately the revised patent was granted.

Success of the Trial Engine

In the meantime further improvements had been made in the trial engine at Soho, the sheet tin cylinder being replaced by a new cast iron one, more than 18-in. in diameter and 1 in. in thickness. This had been specially cast by an ironfounder named John Wilkinson of Willey, near Broseley, Shropshire, and weighed half a ton. Watt's invention greatly interested the ironfounder, and on being commissioned to make the new cylinder he devised a machine in his workshop to ensure accurate boring. In order to reduce friction the piston was fitted with a brass hoop 2 in. in width.

At first the engine worked very reluctantly, achieving no more than eight strokes per minute and many 'restoratives' were applied to facilitate the working, including blacklead powder, grease and papier mache. An old hat was adopted as a special lubricator, the contents of a bottle of oil being poured into it and allowed to drain through and lubricate the sides of the piston. Nevertheless the engine finally stopped and could not be coaxed to restart.

Sundry defects in the valves were subsequently remedied, however, and finally "*Beelzebub*" rewarded the perseverance and ingenuity of its owner by achieving "2,000 strokes with one cwt. of coals." This performance was considered satisfactory enough to justify the manufacture of engines for sale, and it was not long before the Soho works became a scene of unprecedented activity. New workshops were erected to accommodate the new trade and "*Beelzebub*" was put to good use by being set to feed the water wheel of the rolling mill.



Soho Workmen's Cottages: Murdock lived in the left-hand one

The single-acting steam pumping engines that Boulton and Watt then commenced manufacturing were fashioned after "*Beelzebub*" and worked as follows. The downstroke of the piston was effected by steam admitted to the cylinder from above by way of a valve that also admitted steam into the steam jacket cloaking the cylinder. During this stroke any steam remaining beneath the piston from a previous stroke was allowed to escape through a valve to a separate condenser. As the cylinder end of the engine beam was drawn down by the descending piston, the opposite end of the beam canted up proportionately, thereby lifting the pump rods and allowing the pumps to fill with water.

Cycle of Valve Operations

The top valve through which steam had been admitted and the bottom valve leading to the separate condenser then closed, and a second valve at the foot of the cylinder opened and admitted beneath the piston steam available from the earliest admission at the top. The excess steam entered and lifted the piston until there was an equal pressure above and below, when, the weight of the pump rods exceeding that of the neutralised piston, the engine beam recanted and the piston was quickly drawn up to the top of the cylinder, while at the other end of the beam the pump rods descended again and discharged the water pumped up. The valves then reversed and the cycle of operations was repeated.

The air and water forced into the condenser chamber at each downstroke of the piston were drawn thence by an air pump working from the same engine beam, and were ejected into a "hot well." Water was drawn from the hot well by a feed pump also actuated by the beam, and passed along a pipe back to the boiler.

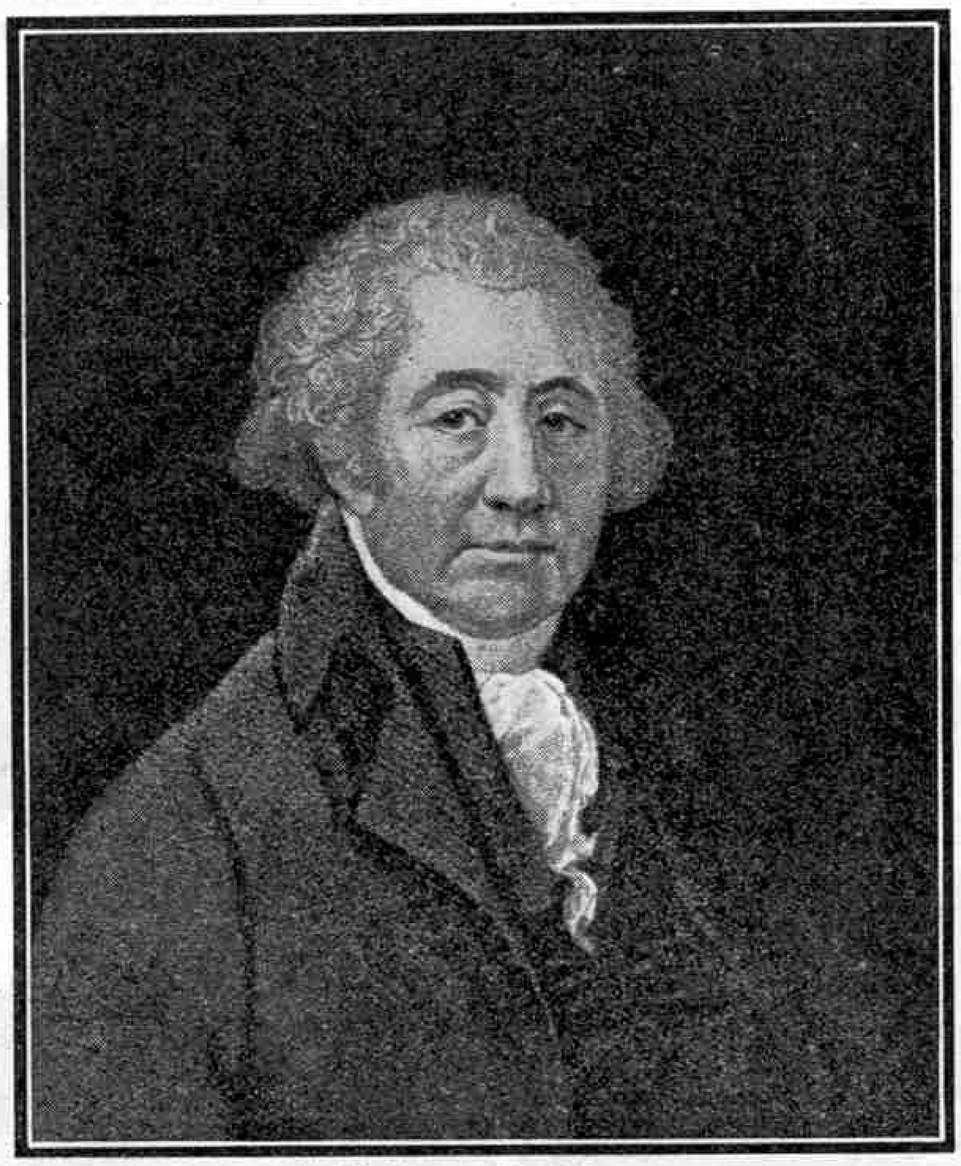
First Soho Steam Engines Supplied

One of the first two steam pumping engines supplied from the Soho works was erected at Smethwick for the Birmingham Canal Navigation and was put into commission in 1776. This early example of Boulton and Watt's workmanship was in use at Smethwick for over 120 years, being removed to the Ocker Hill (Tipton, Staffs.) Canal Works of the company in 1898. It was there that the historic engine was once more set working when on exhibition last year, during the James Watt centenary commemoration held at Birmingham. Many people visited Ocker Hill to acquaint themselves with this interesting old engine.

The other pumping engine was supplied to Wilkinson, the ironfounder, who required it to blow the bellows at his Broseley Works. Great importance was attached to the supplying of this engine, as some of Wilkinson's neighbouring ironfounders, who were about to instal Newcomen engines in their works, had decided to wait and see what the new engine from Soho could accomplish. Watt in due course journeyed to Broseley and personally superintended the erection of the engine which, when put into operation early in 1776, worked excellently and was a splendid advertisement for the invention.

While work in connection with these first orders was being carried out, further orders for steam pumping engines came in steadily, and called for engines of all sizes. One engine required by a Bristol distiller had to be capable of raising 15,000 gallons of ale per hour to a height of 60 ft.

Wilkinson had undertaken to make all cylinders and condensers required and speedily found himself a very busy man. During the time Watt was at Broseley he received many "hustling" letters from his partner at Soho.



Matthew Boulton

" Pray tell Wilkinson," urged Boulton on one occasion, " to get a dozen cylinders cast and bored, from 12 to 50 in. diameter, and as many condensers of suitable size. The latter must be sent here as we will keep them ready fitted up, and then an engine can be turned out of hand in two or three weeks....."

In a later communication to Watt, Boulton remarked that " if we had a hundred small engines like Bow engine, and twenty large ones executed, we could readily dispose of them." The " Bow " engine was a nickname for an engine supplied from Soho to Cooke and Company's distillery at Stratford-le-Bow, near London, and incidentally it was the first Watt steam pumping engine to be erected in the London district.

Watt superintended the design, construction and erection of the engines while Boulton managed the general and financial side of their affairs.

First Watt Engine in Cornwall

The first two Watt pumping engines ordered for flooded Cornish mines were for the Wheal Busy Mine, near Chacewater, and the Tingtang Mine, near Redruth. By the summer of 1777 the engine parts for the Wheal Busy plant were ready and sent to Cornwall, and Watt went along to supervise the erecting of the engine. He found that the affairs of the Cornish tin mines were truly critical, and on every hand mines were being shut down owing to the existing pumping machinery being unable to cope with the water pouring into the mine workings. Nevertheless Watt speedily discovered that it was only the mine-owners who welcomed the reputed powers of the new pumping engines, for among the miners generally he was treated with considerable hostility and ridicule. That they should be jealous of an engine that promised to enable them to continue earning a living in the mines seems incredible, yet such was the case, and during the construction of the engine at the Wheal Busy Mine, Watt's workmen were subjected to a great deal of abuse.

On the day the completed engine was to be tried out a crowd of curious engineers and mining men from all parts of Cornwall gathered at the mine in the full expectation of seeing the engine disgrace itself. Many unkind and ignorant comments were made. " Pshaw ! she's but a bauble. I wouldn't give twopence-halfpenny for her " scoffed an engineer named Jonathan Hornblower, with whom Watt was destined to have further trouble at a later date. Hornblower had established a reputation in the Chacewater district by his skill in erecting Newcomen engines, and thus looked upon Watt's invention as an enemy.

The new engine was duly started up, commenced pumping at the rate of eleven 8 ft. strokes to the minute, and later speeded up to eighteen strokes. To the amazement of the watching critics, appreciably more water was lifted at each stroke than the discarded Newcomen engine had accomplished and, moreover, only about one-third as much coal was consumed by Watt's engine. Watt was elated by this triumph. " We have had many spectators," he wrote to Boulton, " and several have already become converts. I understand all the West country captains are to be here to-morrow to see the prodigy."

No one was more impressed and fascinated by the engine than Mr. Wilson, the superintendent of the mine. " The velocity, violence, magnitude and horrible noise of the engine give universal satisfaction to all beholders, believers or not," wrote Watt. " I have once or twice trimmed the engine to end its stroke gently, and to make less noise ; but Mr. Wilson cannot sleep unless it seems quite furious, so I have left it to the engine men....."

"*Old Bess*" Succeeds "*Beelzebub*"

While Watt was in Cornwall "*Beelzebub*" was seriously damaged by a fire that occurred in the engine house at Soho and destroyed the roof. The outbreak was welcomed by Boulton, who had long desired to rebuild and enlarge the place. On learning how destructive the fire had been he exclaimed, " *Now* I shall be able at last to have the engine house built as it should be."

When a new engine house had been built a new and larger engine was erected therein, and in time became known as " *Old Bess.*" This engine was the first one made at Soho that embodied the principle of expansive steam, and was in use there for several years before Watt included the new characteristic in a patent. We shall refer to it again when we deal with the later patents taken out by Watt.

As soon as the Wheal Busy engine was successfully established Watt returned to Soho to draw up plans for the engines ordered during his absence. One of the seven engines completed while he was at Soho was that for the Tingtang Mine, and some time after the material had been sent off Watt again left Soho for Cornwall to superintend the erection of this and other engines. On arriving in Cornwall in July 1778 he rented a house at Plengwarry, on the outskirts of Redruth and conveniently near the Tingtang Mine. The engine for this mine was in due course erected and proved very efficient.

As more engines were erected at Cornish tin mines agreements were made for Boulton and Watt to be paid annually one-third of the money saved during the year by the use of their engines, and in October 1778 Boulton visited Cornwall to negotiate for this royalty with the Wheal Busy and Tingtang owners, whose engines had been erected unconditionally. Before he returned to Birmingham two months later he had succeeded in obtaining an agreement from the former company to pay the Soho firm £700 per annum for the use of the engine, and an agreement had also been made with the Tingtang Mine. Watt returned to the Soho Works once more in January 1779.

Murdock's Timber Hat

The many callers at the Soho works varied from eminent personages wishing to inspect Boulton's famous artistic wares to ambitious mechanics looking for jobs. One of the latter, who called one day in 1777 when Watt was away on his first visit to Cornwall, was a young millwright from Ayrshire in Scotland, named William Murdock. After expressing regret that the firm had no immediate vacancy, Boulton was about to dismiss Murdock when his attention was attracted by the uncommon looking hat the young fellow was nervously fingering. " That seems to be a curious sort of hat," he remarked, " Why, what is it made of ? "

" Timmer, sir," replied Murdock.

" Timmer ! Do you mean to say that it is made of wood ? "

" Yes, sir."

Boulton was now full of interest. " Pray, how was it made ? "

"I turned it mysel', sir, in a bit lathey of my own making," explained Murdock.

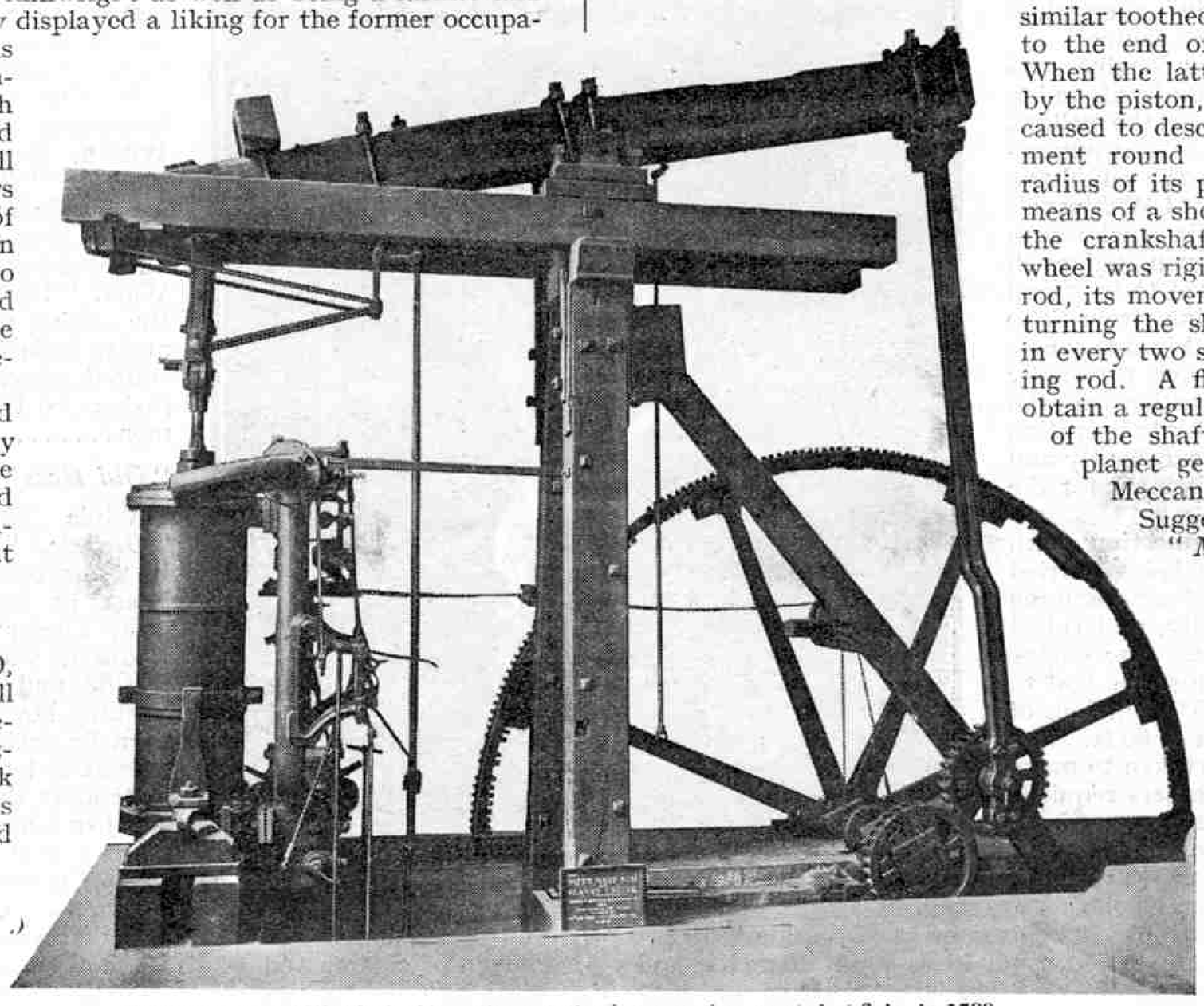
Boulton looked at Murdock more keenly. Here was someone capable of constructing a lathe and making a neat hat upon it. Murdock was bidden to return the following morning, and upon doing so he was engaged for two years at a salary of 15/- per week when employed at Soho, 17/- per week when working in Cornwall or anywhere else other than Soho, and 18/- per week for any period of work in London.

William Murdock was born at Lugar, near Old Cumnock, Scotland, on 21st August, 1845. His father, John Murdock, carried on business as a millwright as well as being a farmer and miller, and William early displayed a liking for the former occupation. An instance of his native talent was his invention of a chuck with which oval articles could be turned in a lathe as well as round ones. At 23 years of age, having heard of the famous firm of Boulton and Watt, he decided to tramp to Birmingham and seek a situation at the Soho Works, with the result we have described.

Murdock soon proved his ability and was rapidly promoted until he became the partners' most trusted workman, and their adviser on all important mechanical matters.

An Exciting Night

In September, 1779, Murdock went to Cornwall with Watt and there became the latter's "right-hand man." Murdock proved devoted to his work, which so occupied his thoughts that he often lay awake at night seeking to solve some problem or other that had presented itself during the day. This absorption in his work was illustrated by an amusing incident that occurred at the time the new pumping engine installed at the Wheal Union Mine was about to be started up. The people of the house wherein Murdock lodged were suddenly roused one night by the sound of heavy blows overhead. Considerably alarmed they rushed up to his room, there to behold him clad only in his shirt, heaving away in his sleep at one of the bedposts and shouting: "Now she goes, lads! Now she goes!"



Early example of Watt's double-acting rotative beam engine, erected at Soho in 1788

In an endeavour to help some of the Cornish tin mines through a period of bad trade, Boulton and Watt became large share-holders, and to safeguard their interests, as well as to negotiate agreements for engines with several new customers, Boulton again went to Cornwall in the autumn of 1780. He found as before that some of the mines were suffering more from mismanagement than from poor trade or flooded workings, and in order to emphasise his desire to improve conditions he purchased a country house at Cosgarne, in the Gwennap Valley, and this was occupied by himself or Watt and their families whenever they were in Cornwall. Having established himself among the mining community Boulton attended company meetings and gradually introduced order and method, his business ability and the successful results of his improvements in the management of distressed mines becoming in time readily acknowledged.

In spite of his business activities Boulton never lost an opportunity of endeavouring to increase the efficiency of the steam engine and to make it adaptable for work other than pumping. While in Cornwall he brought about a marked improvement of the 26 ft. boiler of the Wheal Busy engine by inserting four copper tubes, each 20 in. in diameter, the furnace air entering the boiler by two of the tubes and returning through the second pair. By this innovation Boulton was literally the inventor of the tubular boiler, a contrivance that was revived when the locomotive came into being.

By the close of 1780 over 40 single-acting steam pumping engines had been made and supplied, half of this number being erected at Cornish mines.

"Sun and Planet" Rotative Motion

During the ensuing two years Watt took out two further patents covering a variety of important improvements on his original invention. The first of these patents was obtained on 25th October, 1781, and dealt with five different methods of converting the reciprocative motion of the cylinder to continuous rotative motion, without the use of a crank. Of these five methods the "Sun and Planet" motion became the best known.

In this motion a toothed wheel was firmly fixed to the end of the shaft corresponding to the crankshaft of the later engines, and its teeth were engaged by a similar toothed wheel rigidly secured to the end of the connecting rod. When the latter was set in motion by the piston, the second wheel was caused to describe a circular movement round the first wheel, the radius of its path being decided by means of a short link mounted upon the crankshaft. Since the second wheel was rigid with the connecting rod, its movement had the effect of turning the shaft gear wheel twice in every two strokes of the connecting rod. A flywheel was added to obtain a regular and smooth motion of the shaft. Watt's sun-and-planet gear was reproduced in Meccano and described under Suggestion No. 38 (see "*M.M.*" for May 1926), and readers should have no difficulty in understanding the principle on which it is based if they refer to the Meccano model.

The familiar cottage spinning-wheels and knife-grinders' foot lathes were simple examples of rotative motion being obtained from a crank, and Watt's avoidance of this principle in his patent was due solely to his being forestalled. He had long regarded the crank as the easiest way of achieving circular motion with the engine, and by the summer of 1780 a model, embodying the idea had been built up at Soho. A dramatic incident put an end to the matter, however.

The workmen were wont to gather at night in the local alehouse where conversation would often turn to the subject of Watt's inventions. One evening a man named Cartwright, a pattern maker who had been helping in the crank scheme, in a boastful moment sketched the new arrangement in chalk on a table top. A rival who was present disguised as a workman quickly studied the rough drawing, then lost no time in getting to London and patenting the idea for himself!

When Watt learnt of the patent and the mean theft of knowledge he was greatly angered, and set about devising other means of securing his object. The sun and planet method was embodied by Boulton and Watt in many of their subsequent engines until their rival's patent expired, when they promptly adopted the crank.

The third patent in respect to the steam engine was obtained on 4th July, 1872. It was one of the most important taken out by Watt and the improvements it dealt with definitely opened the way for the steam engine to be adopted to many new uses. Of these new arrangements some were of a temporary character and enlarged upon later, while others were adopted immediately at Soho. One of the latter was the use of steam on the expansive principle.

Utilising the Expansive Force of Steam

Watt's investigation of this idea had begun in Scotland and trials were made on "*Beel ebub*," both there and later at Soho. Boulton likewise realized that to be able to cut off the steam when the piston stroke was only partially effected and complete the stroke solely by the expansive or elastic force of the admitted steam would be a great economy. In the early engines made at Soho an effort was made to effect this by constructing the cylinders twice the size ordinarily required and cutting steam off at half stroke, the heat conserving effect of the steam jacket being relied upon to ensure that the steam in the cylinder would expand and

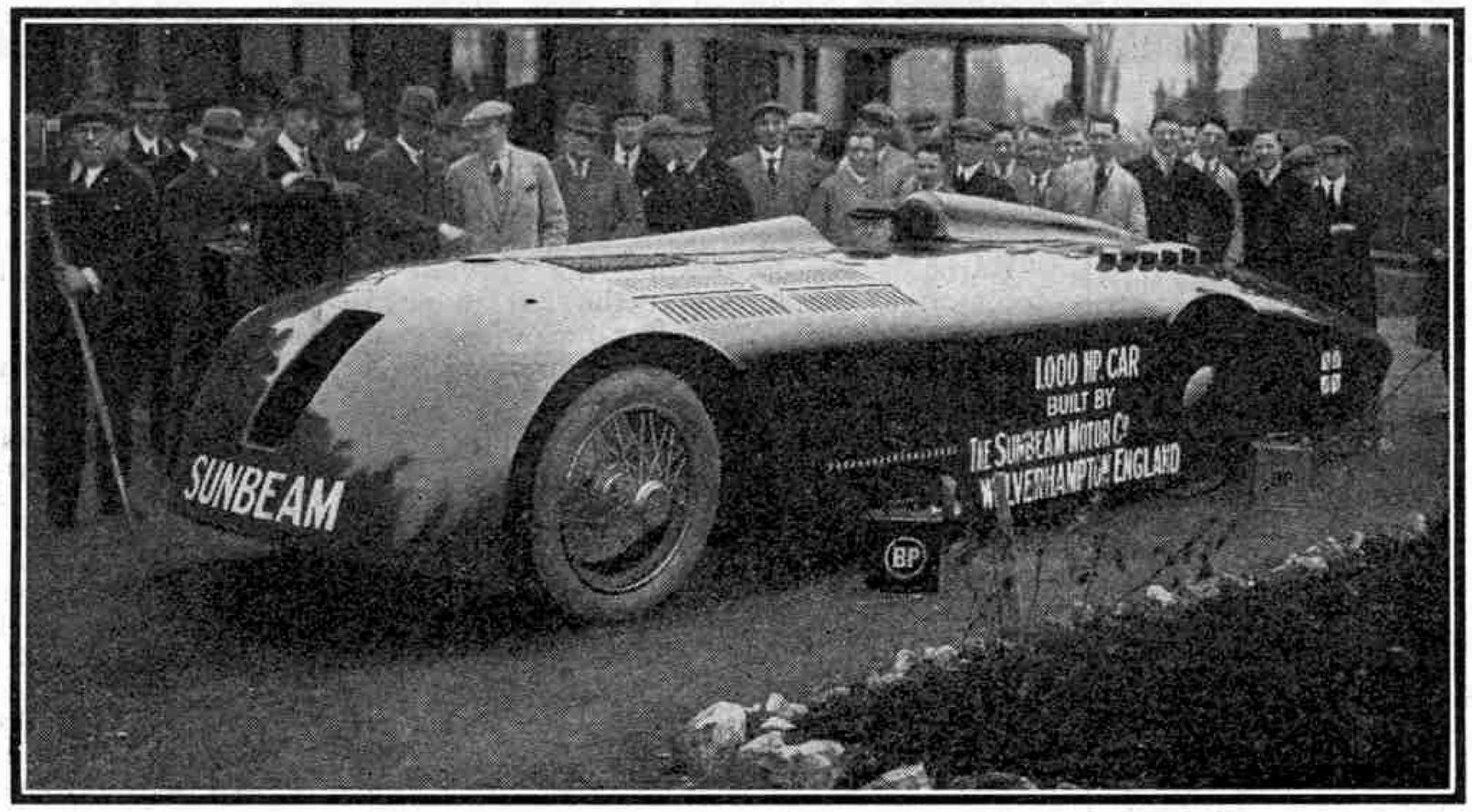
not condense before the completion of the stroke.

At the Cornish mines, however, the practice led to trouble. Some of the enginemen to whom the new engines were entrusted could not be relied upon to regulate them correctly, and in endeavouring to improve the stroke of the piston they frequently admitted too much steam. As a result a boiler was unable to meet the heavy demand for long, and a stoppage ensued sooner or later while steam was got up again. These annoying delays led to complaints of the engines failing, and Soho received frequent requests for a man to be sent at once to rectify matters. Such troubles were alike expensive to the Soho firm and to the mineowners, and Boulton and Watt ultimately decided to cease using the expansive system until the unlearned enginemen had become thoroughly familiar with the ordinary Watt steam engine.

In the specification of his 1782 patent Watt recommended that the "cut-off" be made when steam equal to one quarter of the capacity of the cylinder had been admitted, declaring that the resultant effect would almost equal that hitherto gained by admitting steam into the cylinder during the entire length of the piston stroke. This proportion was in no sense a fixed rule, however, and in practice was often varied slightly by Watt himself.

Watt also outlined in this patent a number of devices for equalising the steam's expansive power, which he found ordinarily varied at different periods of the stroke. These devices took the form of variously designed equalising beams to be used instead of the customary fixed beam, one being a beam curved in the centre of the underside and with the hollowed out section resting freely upon a roller bearing.

Major Segrave in the 1,000 h.p. Sunbeam Car



Readers of the article in last month's "M.M.," describing Major Segrave's wonderful record-breaking feat with the 1,000 h.p. Sunbeam car, will be interested in the above photograph, which we are able to reproduce through the courtesy of the Sunbeam Motor Company. This photograph gives a particularly striking view of the monster car and additional interest is lent to it by the fact that Major Segrave himself is seen at the wheel

The Double-Acting Engine

Among the most striking of the innovations patented in 1782 was that of the "double-acting" engine. In the early trial engine "*Beelzebub*" Watt had effected a partial return stroke of the piston upward by admitting at the foot of the cylinder surplus steam from the top admission. By continued research and experiment, however, the true double acting engine had finally been evolved. In this the steam admitted at the bottom of the cylinder was entirely independent of steam admitted through the top valve, and was sufficient to effect a complete upward stroke of the piston as powerful and rapid as the downstroke.

The movement of the piston was greatly accelerated also by the vacuum simultaneously created on the side of the piston opposite to that receiving steam. This great improvement, coupled with that of steam expansion, indicated clearly the progress made in rendering the steam engine economical as well as practical.

Another important innovation included in the patent was described by Watt as "a new compound engine, or method of connecting together the cylinders and condensers of two or more distinct engines, so as to make the steam which has been employed to press on the piston of the first act expansively upon the piston of the second, etc., and thus derive an additional power to act either alternately or conjointly with that of the first cylinder."

With these varied important improvements protected Watt was relieved of the risk of his ideas being stolen and patented by others and was able to turn his attention to constructing his first rotative steam engine.

Camping in Comfort—(*continued from page* 493)

the tasks relating to cleansing of cooking and feeding utensils are probably the least liked. See to it that each boy has his fair share and arrange for hot water to be available immediately after each meal. That is merely a matter of placing hot water pans on the fire as soon as the preparations for the meal are finished.

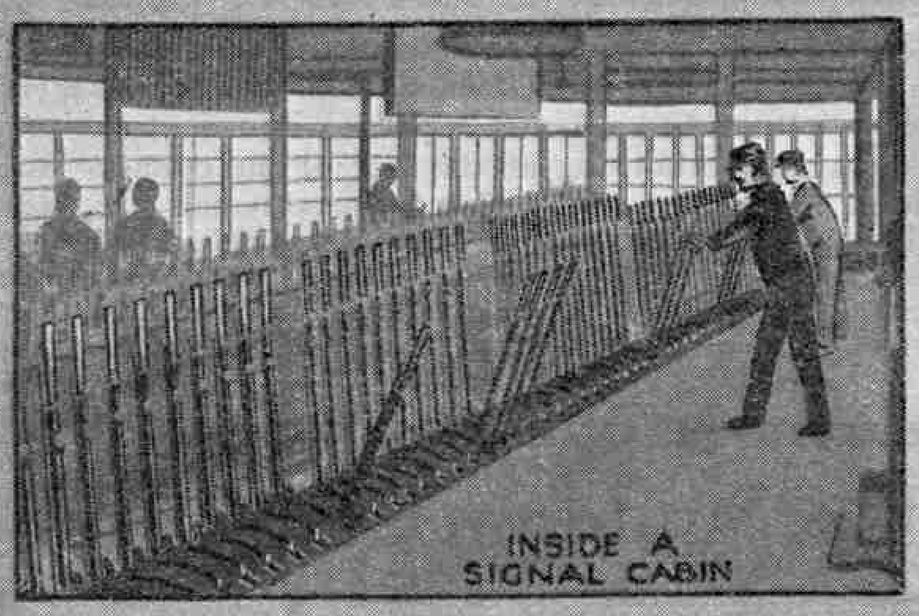
The cook's is the hardest job of all in camp; make things as easy as possible for him by providing all the assistants he wants and giving him ample working accommodation. A table is essential. Here is one little tip that may ease the burden. When potatoes have to be cleaned take them to the nearest stream and let the water wash away the dirt clinging to the skins. New potatoes will require no other attention; boil them in their jackets.

Tidiness in the tent is of supreme importance if a thoroughly comfortable camp is to be maintained, and the first duty to which attention must be given is the removal into the open air of all bedding at the earliest possible moment each morning. Every boy must look to his own and no shirking should be allowed. If drill is not a part of the daily routine it should be a strict condition that shoes should not be worn within the tents, and everybody must slip them off at the door. The tents should be inspected daily and the award of a prize to the tent obtaining the most marks for general tidiness throughout the camp is usually a big incentive to the maintenance of a spick and span appearance.

In rough weather the guy ropes should be examined more than once each day for ropes and fabrics shrink during rain and when the dew is rising, and stretch as they dry out. Consequently, if the guys are not slackened slightly each night or during rain the pegs holding them down will be pulled out or the fabric of the tent itself torn.

With the adoption of the few simple precautions and suggestions that I have made, there should be very little chance of your holiday under canvas being spoilt by any ordinary occurrences, and I am confident that your Club will wish to run another camp next year. In that case, let me suggest that during the coming autumn a tent-making class be formed and a set of light weight tents made to provide accommodation for everyone in the Club.

It is one of the delights of camp craftsmanship to construct as much of the camp equipment as possible at home and I have heard of excellent tents made by quite young boys. One provided accommodation for over 20 boys and weighed barely 20 lbs. It survived seven seasons of constant weekending trips from Easter to the end of October. But, having made their tent, the boys did not leave it out exposed to the rain and wind through the week, as so many bell tents are left. The cost of a home-made tent for two, by the way, with ground sheet and ground blanket complete, need not exceed a couple of guineas for material, and will not prove hard to make.



Railway News of the Month

Electric Storage Battery Locomotive

An electric locomotive that is stated to possess remarkable powers of acceleration and to be capable of hauling a train weighing 3,000 tons, has recently been constructed in America. This engine is of the storage battery type and is the largest of its kind ever built, its weight being 110 tons, its wheelbase 39 ft., and its length 52 ft. A gas engine accommodated on the locomotive is directly connected to a generator and may be used for charging the battery, which contains 120 cells and weighs over 39 tons. This method renders it possible for the engine to be kept continually running for 24 hours.

* * * *

United States Efficiency

During recent years striking progress in the handling of goods traffic has been achieved in the United States. In 1920 the average goods train speed was 10.3 m.p.h., showing a performance equivalent to the hauling of 7,302 tons of goods one mile in one hour. By 1925 this figure had crept up to 8,773 ton miles, this rise being due to an increase both in the average tonnage per train and in the speed. These figures include all stops made for the purpose of shunting and picking up trucks.

In 1925 also a remarkable record in fuel consumption was achieved on passenger trains, the average quantity of coal consumed per passenger car mile having fallen from 18.8 lb. in 1920 to 16.1 lb. The average train loads in the same period rose from 687 tons to 752 tons and the total number of car loadings rose from 42,000,000 to over 52,000,000, while the number of employees fell from 1,999,000 to 1,783,000.

It may be mere coincidence, but it certainly is significant that the U.S. Government's control of the railways ceased in 1920, since when the companies alone have been responsible for all operations.

* * * *

New Engines for "*Union Express Limited*"

With the introduction of the new Baldwin-built 4–6–2 and 4–8–2 engines, the timing of the "*Union Express Limited*," which runs twice weekly between Johannesburg and Cape Town, a distance of 956 miles, has been accelerated to 28 hours 23 minutes, showing an average speed of approximately 34 m.p.h. In these days of high speeds that figure may not appear impressive at first sight, but in point of fact it is a world's record for a run of this mileage on a 3 ft. 6 in. gauge track.

The 4–8–2 engines work the trains up through the heavy grades of the Hex River Mountains on to the central African plateau, and the 4–6–2's handle them from there across the plain, known as the "Karoo." The former are the heaviest locomotives employed on the 3 ft. 6 in. gauge, and have the following dimensions :– Cylinders, 23 in. by 28 in. ; driving wheels, 4 ft. 9 in. ; boiler diameter, 6 ft. 4 in. ; total heating surface, 3,482 sq. ft. ; fire-grate area, 48¼ sq. ft. ; working pressure, 200 lb. per sq. in. ; tractive effort (at 85 per cent.), 44,175 lbs. ; weight of engine, 101½ tons ; weight of engine and tender (with 7,200 gals. water and 12 tons coal), 167 tons.

A photograph of the 4–8–2 type locomotive appears on the opposite page.

* * * *

Direction Guides on Underground

The continual search for improved methods of regulating the passenger traffic and easing the congestion at the principal stations on the Underground Railways goes on apace. Among recent innovations at the Charing Cross Station is a novel type of traffic direction sign consisting of aluminium lettering let into the floors of the connecting passages to guide passengers in their right direction. A similar sign was tried as an experiment at the interchange area of the Hampstead and Bakerloo lines and proved a great success.

Other types of floor signs being experimented with consist of glass letters illuminated from below, and aluminium letters inlaid in rubber.

* * * *

News from Glasgow

L.N.E.R. No. 9415 "*Claverhouse*" was responsible for a very fine piece of running on the 6-29 ex Edinburgh on a recent Saturday. The turn is normally worked by a "Director," and these engines have to be worked very hard to maintain time on this 65-minute booking. No. 9415 handled 340 tons and cut off two minutes from Falkirk to Glasgow.

Recent scrappings at Cowlairs include 'P' class 0–4–4T 9091 and 9591, G.N.S.R. 4–4–0 6803 (built 1878).

Pacific 2564 has come to Cowlairs for overhaul after completing 98,000 miles.

Atlantic 4419 (booster fitted) has recently been working test trains on the Edinburgh-Carlisle road. One of the Gresley "Pacific" engines stationed at Edinburgh has also been successfully tried over the Waverley route.

L.M.S.R. The 10 o'clock Buchanan St. to Perth and the North was recently observed leaving with McIntosh 4–4–0 14440 on 335 tons.

On a cheap excursion day-ticket scheme, the L.M.S. ran two big specials to Liverpool recently and both trains were well filled. On the first train Pickersgill 4–6–0 14637 and 4–4–0 14363 (pilot to Beattock) left on 450 tons. The second train had Pickersgill 4–4–0 14475 on 290 tons. All the engines were exceptionally clean.

A fine run was performed by a Pickersgill 4–4–0 14461 on a Carlisle–Glasgow fast train. The engine left Carlisle 15 minutes late, but arrived two minutes early on 340 tons. The notable point is that it is a compound-worked turn, but this timing will take some beating.

The train conveying excursionists on a recent 24/– day trip to London left Central Station on the Friday night with two McIntosh non-superheated 4–4–0's, 14351 and 14363 (pilot to Beattock). The load was nine bogie-coaches and dining-car, and the train was well filled.

* * * *

New L.N.E.R. Express

A new night express train service from King's Cross at 1.15 a.m. for York, Darlington, Newcastle and Edinburgh has been introduced by the L.N.E.R. The new service will enable travellers to spend an additional two hours in London and yet reach north-country towns before breakfast next day.

* * * *

G.I.P. Main Line to be Electrified

The Great Indian Peninsula Railway has placed a contract with British Insulated Cables Ltd., of Prescot, Lancashire, for the electrification of its main line from Poona to Izatpuri, together with sidings, storage yards, etc. Altogether 334 miles of track are involved, including approximately four miles of tunnels. The trains will be operated on direct current at 1,500 volts supplied from sub-stations that will step down the main supply from 120,000 volts.

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The L.N.E.R. locomotive No. 9903, "*Cock o' the North,*" has been equipped with a Worthington feed water heater and pump. This engine is attached to the North British Section.

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An excellent example of the admirable qualities of British steel was given in a recent number of the "*Great Western Railway Magazine.*" A locomotive crank axle supplied to the company by a well-known Sheffield firm was in continuous use on engine No. 807 for 34 years, the total distance covered during this period by the engine being over 1,250,000 miles !

Difficulties Explained
THE 24-HOUR DAY

Many of our readers appear to be puzzled by references to the 24-hour clock in use on most of the Continental railways.

This system has been adopted in order to simplify timetables and railway working in general. The terms ante meridian and post meridian commonly contracted to a.m. and p.m. respectively are no longer used. The day is considered to consist of one period of 24 hours instead of two periods of 12 hours each. The day starts at one midnight and finishes at the following midnight, and midnight is therefore expressed as 24.00. We then go back to zero and build up again minute by minute. Thus a train starting at one minute after midnight would be timed 00.01; if it started at 15 minutes past midnight its time would appear as 00.15. One a.m. is shown as 01.00; 2 a.m. as 02.00, and so on up to and including 9 a.m., after which the preliminary 0 disappears and 10 a.m. is shown as 10.00. From this point hours and minutes are added until, arriving once more at midnight, we reach 24.00. It will be seen that in order to convert any p.m. time to the corresponding Continental railway time it is only necessary to add 12 to the hour number.

It is important to notice that all four figures are used in each case, even when the first figure is 0 as in the case of the hours up to 10.00. No doubt it will occur to many readers that this course has a parallel in the Whyte system of locomotive classification according to the number and arrangement of the wheels. In this system, although an engine may be without either leading wheels or trailing wheels, the three-fold nature of the notation is retained, a 0 being used in place of a figure, giving such results as 0–4–0, 4–4–0, etc.

The 24-hour clock system has many features to commend it and so widely is its value recognised on the Continent that the Dutch railways are the only lines of importance that have not yet adopted it. Coming nearer home, the Southern Railway times its Continental boat services on this system in order to facilitate the checking of times and connections by Continental passengers.

It is also interesting to note that Imperial Airways make use of the 24-hour system in their recently issued timetable of Continental air routes and connections.

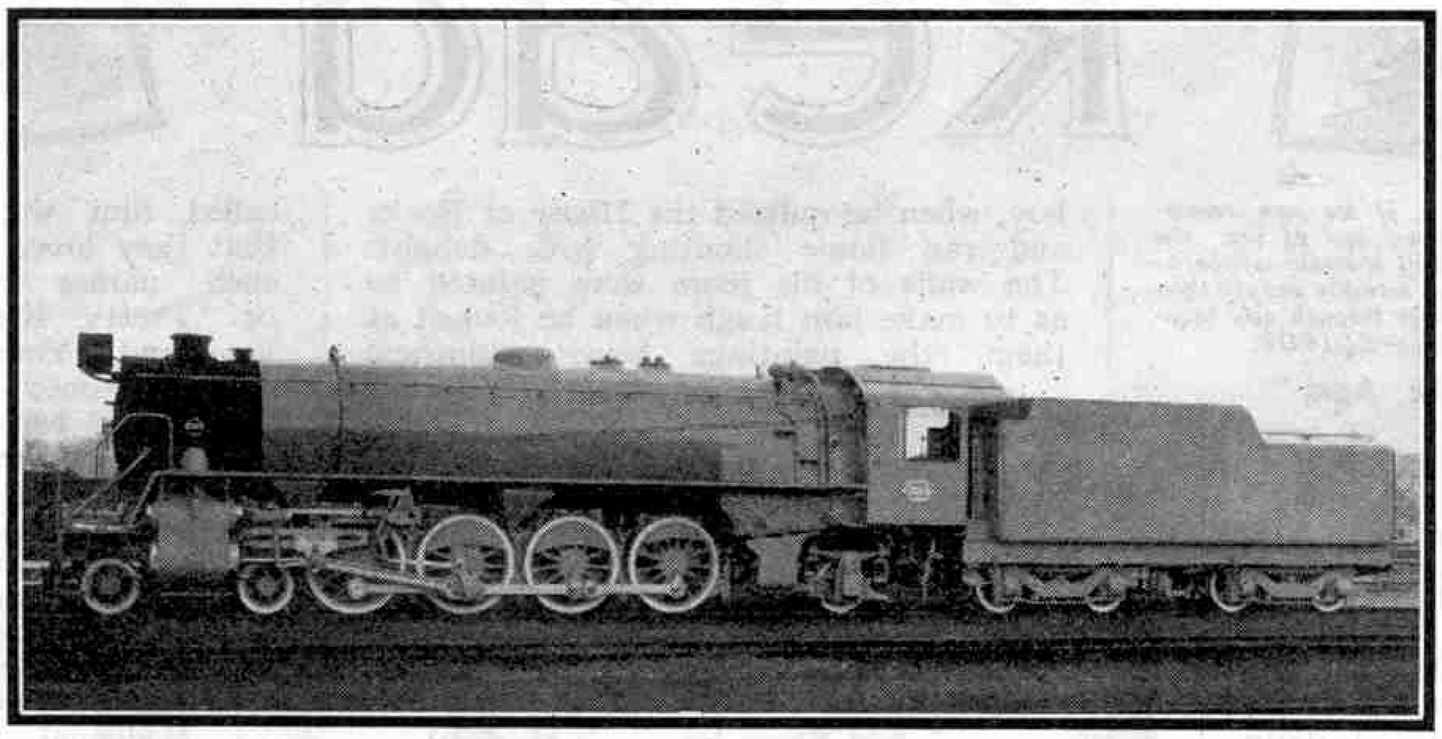
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More Water Troughs

To avoid stops for watering purposes on the Scottish sections and to render practicable longer non-stop journeys, new water troughs are being laid at Floriston, seven miles north of Carlisle, and at Carstairs, and Cumnock, the latter two points being on the Caledonian and G. and S.W. sections of the L.M.S. railway respectively. The new facilities will render stops at such places as Dumfries, Kilmarnock, and Carstairs unnecessary save for traffic requirements.

Proposed Railway for Iceland

A proposal is before the Alting, the Danish Parliament, to construct a railway 50 miles in length to connect Reykjavik, the capital of Iceland, with the richly fertile districts in the southern portion of the island. The scheme is expected to take four years to complete, owing to the difficult nature of the country, and the estimated cost is 8,000,000 Kroner, approximately £435,000.



The Baldwin-built "Mountain" type engine that hauls the "Union Express Limited" on its 936-mile run between Johannesburg and Capetown

Foreign Electrification

The rapid development in the application of electric traction to railway operation abroad is providing some exceptionally good contracts for British electrical equipment manufacturers and several firms have booked important orders.

The Metropolitan Vickers Co., for example, are undertaking the electrification of a portion of the Oeste de Minas Railway in Brazil, the work including a hydro-electric power station, high tension distribution mains, trolley lines and five electric locomotives. For the Paulista Railway, Brazil, the same firm have built an electric locomotive weighing 100 tons which, with motors developing 2,340 h.p., is the most powerful ever constructed in Britain. This will be beaten in point of size and power, however, by 41 freight locomotives now under construction by the same firm for the Great Indian Peninsula Railway, the electrification scheme for which was mentioned recently on this page. These engines will weigh 115 tons each and will develop 2,600 h.p. Another electric engine of 2,160 h.p. for the G.I.P. will be for passenger service and is designed for a safe working speed of 85 m.p.h.

* * * *

Aluminium Railway Stock

An experiment is to be made in Berlin on the Stadtbahn (Underground Railway) with two half-trains in which the principal parts will be built of aluminium. The use of this metal for rail-coach construction is an entirely new departure for Germany and it is intended to investigate the possibilities to the fullest degree.

* * * *

Caprotti Steam Valve for L.M.S.

After several months of experiments the L.M.S. have decided to adopt the Italian Caprotti steam valve for their express locomotives. Several of the latest type engines are to be fitted with this invention by which, it is claimed, a considerable saving in operating costs can be effected.

News from Glasgow

L.N.E.R. Recent football specials have been handled by 9242 "*Glen Mamie*," 9281 "*Glen Marran*" and 9408 "*Glen Sloy*" (Eastfield shed).

Class 'M' 4–4–0 9730 (Haymarket) recently did a good run on an extra train from Edinburgh to Glasgow, taking 68 mins. on a 240-ton train.

After completing seven successive runs on the 6.29 ex Edinburgh on Saturdays, 9415 "*Claverhouse*" was replaced by Director 6384 "*Edie Ochiltree*," this latter engine losing three minutes on a 320-ton train. The initial effort of 9415 was a gain of two clear minutes on 360 tons.

Atlantic 9902 "*Highland Chief*" (Dundee) has returned to Cowlairs, after being overhauled and repainted as recently as January.

* * *

A Unique Railway Town

An Oxford reader claims for his city that it is almost unique as far as railway matters are concerned, for locomotives of all the four railway groups are to be seen regularly although there are only two stations serving the city, these being owned by the G.W. and L.M.S. lines respectively. The Southern and L.N.E.R. engines are worked into the G.W. station on certain through services.

We should be interested to hear from other readers who possibly can claim for their towns a similar distinction.

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New Railway Bridge at Nottingham

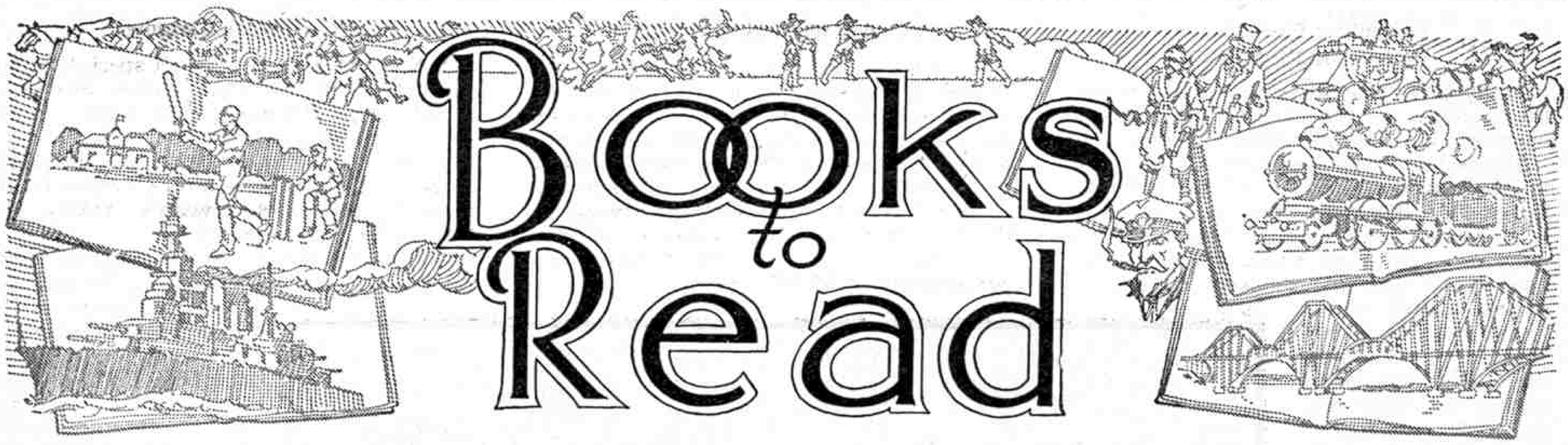
The existing bridge on the L.N.E.R. at Trent Lane, Nottingham, is to be replaced by a new structure that has been designed to afford safe passage to the heaviest locomotives likely to be introduced in the future, and a commencement has been made on the task of effecting the substitution. The final change-over is timed to occupy only 24 hours.

A staging of iron and wood that will serve as a temporary resting place for the new bridge is being built alongside the old bridge, which is to be removed in sections. The new bridge meanwhile will be assembled complete and simply rolled into position on the present stonework. The nature of the task will be realised from the statement that the bridge will weigh 580 tons and will be 200 ft. in length. It will be built in three sections and the principal girders will be 114 ft. in length, about 9 ft. 6 in. in depth and will weigh 45 tons each. The bridge is to carry a double track.

* * * *

Manchester Engines for the Argentine

The first of 20 superheater compound goods engines of the 2–8–2 type will shortly be placed in service on the Central Argentine Railway. These engines, which have been built by Beyer Peacock and Co. Ltd. of Manchester, have a weight in working order, complete with tender, of 149 tons each. The wheelbase is 57 ft. 3¾ in.



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

"The Boy Through the Ages"

By D. M. STUART

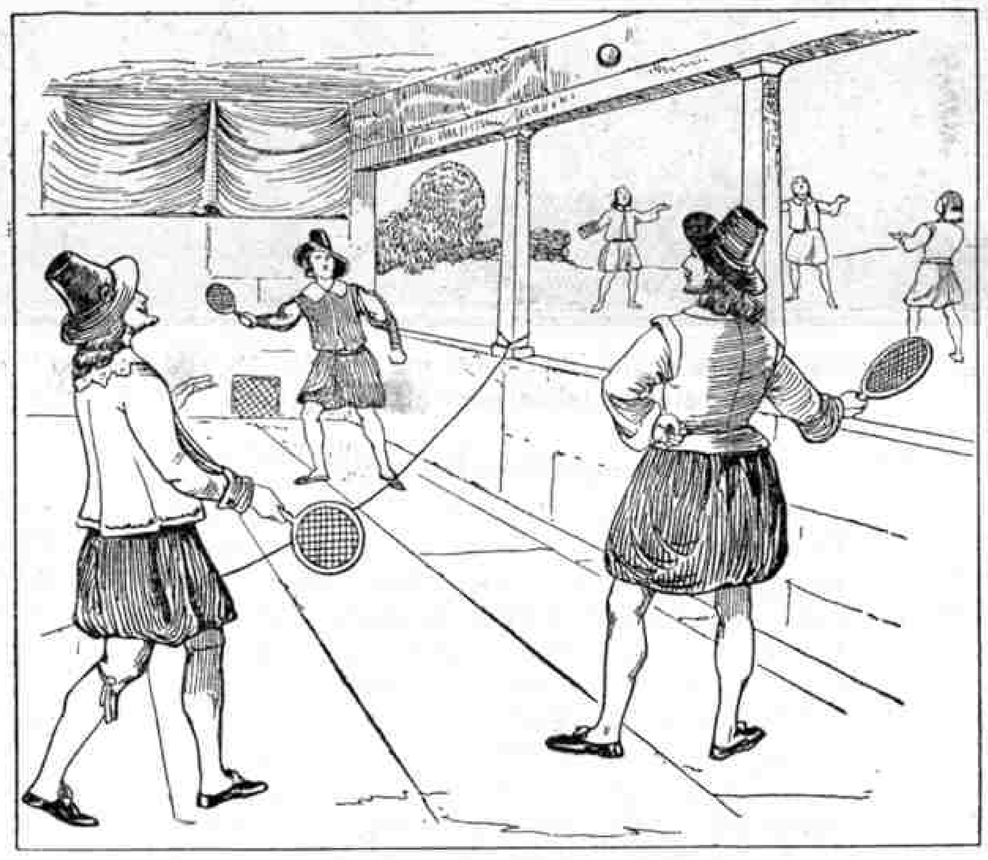
(G. G. Harrap & Co. Ltd. 7/6)

This book, which is of special interest not only to boys and girls but also to their fathers and mothers, presents a faithful picture of the life of the average boy from the time of the cave dwellers to the middle of Queen Victoria's reign. It deals with all aspects of daily life during this long period, telling us all about boys through the ages, their studies and sports, and about the kind of lives they must have lived, as determined by their surroundings.

It will surprise no one to learn that in many respects boys have not changed a great deal during the past ages—they played whenever they could and worked when they had to! Boys in ancient Egypt played with a host of fascinating toys—they had balls made of plaited rushes or of leather stuffed with husks; wooden models of lions and crocodiles, with movable jaws like the Meccano model of St. George and the Dragon; and models of bakers that kneaded dough with tremendous energy when a string was pulled. As for work—why every day the boys went to school at "the House of Books," where the masters were very stern, as may be judged from their idea that "a boy's ears are in his back." Thoroughly believing this axiom, the masters strove to make their pupils listen and remember, by belabouring their backs with their canes!

In regard to lessons in those days, the young Egyptian was taught Arithmetic—addition, subtraction and a kind of multiplication table. The problem sums he was set were not very different to some of those set to-day—he might be asked to calculate the area of a field or to find how much grain could be stored in a granary of a given size. Writing was much more difficult, however, and paper was unknown; in its place was used the fragile inner fibres of the papyrus reed, squeezed together with gum to make them smooth. The pen was also made from a reed, thin and fine, which was crushed at the top so that it more closely resembled a brush than a pen. There were two kinds of ink, held in hollows scooped in a wooden tray, the tray being held on the thumb of the writer as a painter holds his palette.

It is pleasing to find that "the world was full of laughter for the little Theban boy, when he quitted the House of Books and ran home shouting with delight. The walls of his room were painted so as to make him laugh when he looked at them, the paintings being whimsical pictures of cats driving flocks of geese, or hippopotami sitting up at table! The names by which his father and mother called him were a constant reminder that they loved their little brown son—such names as 'Beautiful Morning' or 'Pretty Kitten' for the younger boys and 'Young Wild Lion' for the older ones!"



A Game of Tennis, as played in the seventeenth century (From "The Boy Through the Ages")



A seventeenth century Boy with Hawk. Hawking was a popular sport in which boys of those times took as keen an interest as did their fathers

And here we must close our brief mention of this most interesting book, much as we are tempted to continue and to deal at even greater length with the fascinating story of the boys of ancient Greece; the boys of historic Rome; the sons of the Norsemen; the Anglo-Saxon boys, the Norman, the Mediæval boys and all the other boys of the ages.

There are over 200 helpful illustrations taken from many sources—museums, ancient manuscripts, portraits in public galleries and in private collections, etc.—and each illustrates some point or episode in the accompanying text.

* * * *

"The British Navy in Adversity"

By Capt. W. M. JAMES, C.B., etc.

(Longmans, Green & Co. 25/-)

This book deals with a period of the American War of Independence and deals successfully with a subject that has long baffled experienced historians. The War of American Independence began as a colonial expedition and ended in a great naval struggle between France, England and Spain. Troops had to be convoyed across the Atlantic, and the Navy had to support military operations on the coasts and inlets of the American colonists. When the war finished the British fleet was fighting desperately for the command of two oceans, and simultaneously the British flag was threatened at home, in the Mediterranean, in the West Indies and in the Indian Ocean.

We have recently given some account of the land operations in the American War in our stamp pages, and we need not therefore go over the ground again here. The British Government made a mistake in the first instance by deciding to reduce the American colonists to submission, in the belief that the colonies as a whole were loyal and that the trouble arose simply from a small number of rebels having taken up arms against the Government. They soon found, however, that they were confronted by the resistance of an entire nation, and to crush the resistance it would have been necessary for British troops to occupy all the important coastal towns and harbours so that the colonists would have been deprived of their important bases. So vast an operation was not possible and so the war dragged on for two years.

Meantime the French were watching

events and it was not long before it was evident that we were in serious difficulties, with the French fleet operating against us in three different places and with Spain joining them in 1779. It was with these adverse circumstances that the British Navy had to contend between the years of 1778 and 1783, and it is with this period that the book deals.

Many famous names were associated with these operations, such as Rodney and Hood, who were responsible for the success in the conduct of the naval campaign. We have not space to follow Captain James in his analysis of the naval actions of the war, but the book will be an important addition to the library of the student of English History in general and of the British Navy in particular.

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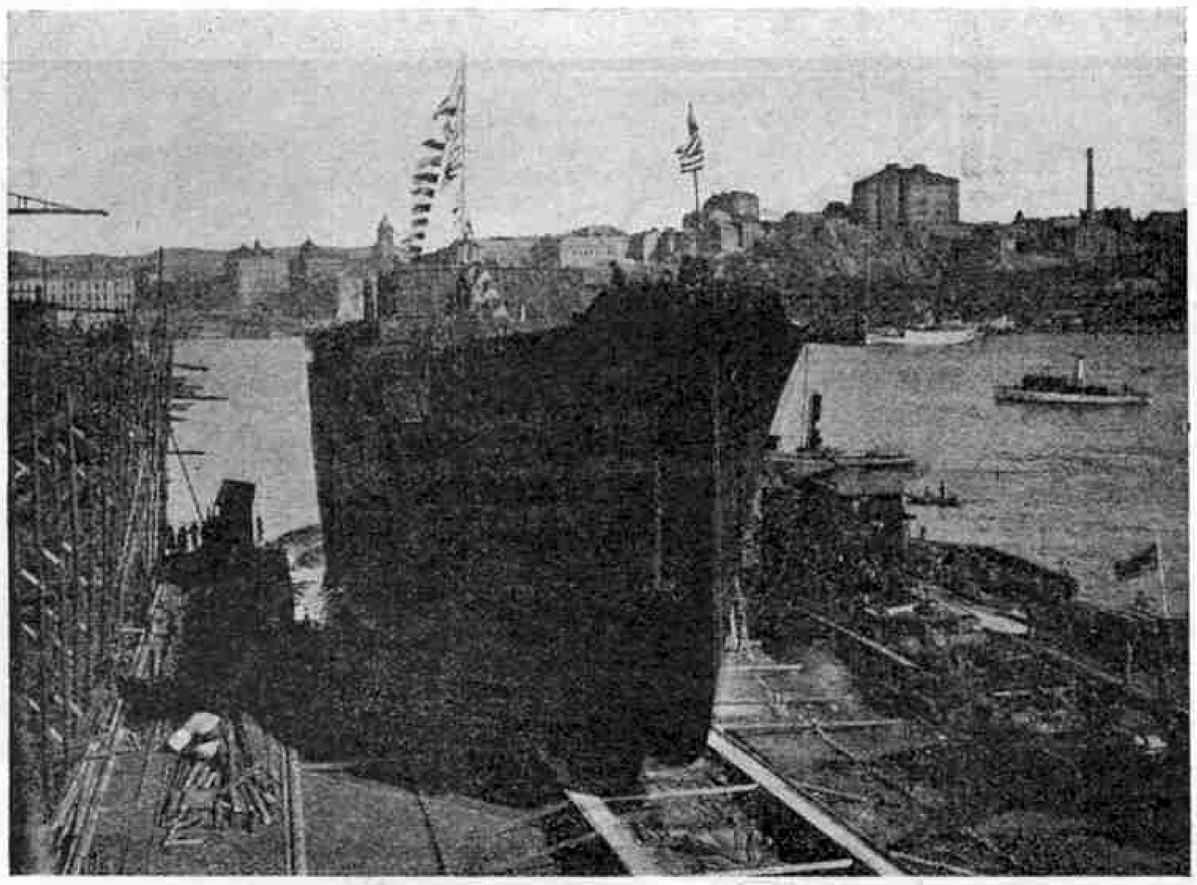
"From Slip to Sea"

By A. C. HARDY, B.Sc., etc.
(J. Brown & Sons, Glasgow. 10/6)

Mr. Hardy tells the story of the construction of a mechanically-propelled ship from the time of the raw iron-ore entering the iron works to the time when the finished article, having completed her trials, steams out to sea. He describes the preparation and erection of hull members; special types of construction; the laying down of the keel; erecting the frames; plating and rivetting the hull; launching and fitting out, etc. The book is profusely illustrated and line drawings and sketches make everything clear.

The book is written in a non-technical manner but it loses nothing because of this, and the author is well qualified to write on his subject and has already contributed two important books to modern shipping literature. There are two useful appendices, one of which gives a collection of structural midship sections, and the other a selection of outline profiles indicating the internal arrangements, erections, etc., of various types of merchant vessels.

We do not remember having seen any other book written on exactly similar lines to this one and it should prove of considerable value, not only to general readers interested in ships and shipbuilding, but also to students of practical shipbuilding, those who are "reading for their tickets," and to those concerned with, or interested in, maritime matters. Students of naval architecture also should know of this book, for not unusually at the outset of their college career, they have but a slight acquaintance of the practical side of shipbuilding. Similarly it should also be useful to those who intend to become naval architects and who proceed directly to the university or technical college, or a public or secondary school. They cannot be expected to have any knowledge of the complex structure that is to be the subject of their studies, but this book will soon put them on terms of familiarity with the subject.



The Launch of a vessel at the Götaverke shipyard, Gothenburg ("From Slip to Sea")

* * * *

"Largest Ships of the World"

By V. S. F. WILSON (Crosby Lockwood & Son. 10/6)

This book, it is explained in the preface, deals with the wonders of the largest ships of to-day as seen in the passenger vessels plying on the Atlantic. It has been written to illustrate the use that man has made in almost every branch of science of those inventions that are specially adapted to "a life on the ocean wave." The book is not intended as a manual of seamanship and little attention has been given to the history of shipbuilding or navigation. Instead, the author has endeavoured to tell something of the eternal struggle between man and nature, and how disaster has been met by science. The ground covered includes the coming of giant ships and docks; the construction and launching of a mammoth ship; engines and auxiliaries; how the ship works from within and without; safety and comfort at sea, and similar subjects.

The subject is, of course, of the greatest interest, and our only regret is that the book has not been put together in a more readable form. It is arranged in a large number of paragraphs of varying lengths, each one with its subheading, and although this arrangement may he helpful at times, it makes the book appear rather scrappy and disconnected if read for any length of time. As an instance of the somewhat puzzling arrangement of material as grouped in the book, the four concluding paragraphs of the chapter entitled "Engines and Auxiliaries" deal with the trim of a ship, the duties of a staff captain, the office of "Chief Constructor" (which, incidentally, is peculiar to one transatlantic line only) and the Doldrums—quite a heterogeneous collection, even if classed under so wide a term as "auxiliaries!"

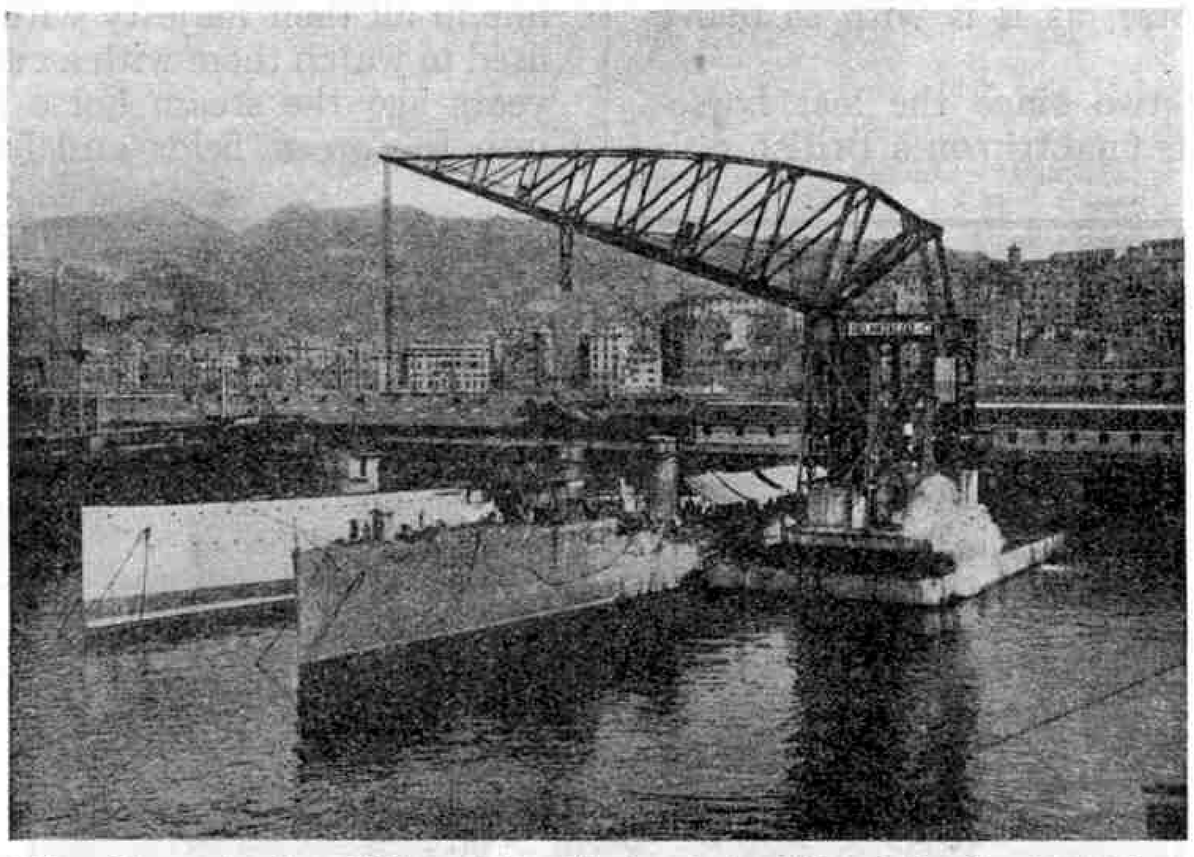
Two rather interesting instances are given of the punctuality of the White Star Liners in their journeyings across the Atlantic. "In March 1924, when the White Star Liner '*Majestic*' was 48 hours from New York, her commander sent a wireless message to England that he expected to reach Ambrose Channel lightship at 1 p.m. on the Tuesday. The ship got there at 12.58 p.m. On the return journey, a wireless message was sent when the '*Majestic*' was 48 hours from the French coast that she was due at Cherbourg at 7 a.m. The ship dropped anchor at 6.59 a.m. In view of the distances covered, and the many forces to be reckoned with in the calculation, this precision is wonderful."

* * * *

"Practical Electrician's Pocket Book"

(S. Rentell & Co. Ltd., London. 2/6)

This valuable reference book is now issued in its twenty-ninth edition and, so far from showing any signs of decay, it is improved in many respects. All the sections have been brought up to date and additional matter has been incorporated, while several new sections have been added. It is an extremely useful little book to have at hand for quick reference, as it covers an enormous amount of ground briefly but accurately, and it is thoroughly well indexed.



Italian ship construction—Fitting out two ships in a basin at Genoa, the ships having been launched directly into the sea at the Ansaldo yard, Sestri Ponenti (see above)

* * *

Interesting New Books

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

"RADIO, BEAM AND BROADCAST" *by* W. F. Morse (E. Benn Ltd.), 12/6 net

"SOME REMINISCENCES. 75 YEARS' WORK IN CIVIL ENGINEERING" *by* Prof. H. Adams (Institution of Structural Engineers), 2/6 net

"ROMANCE OF GREAT BUSINESSES" *by* W. H. Beable (Heath Cranton Ltd.), 15/-

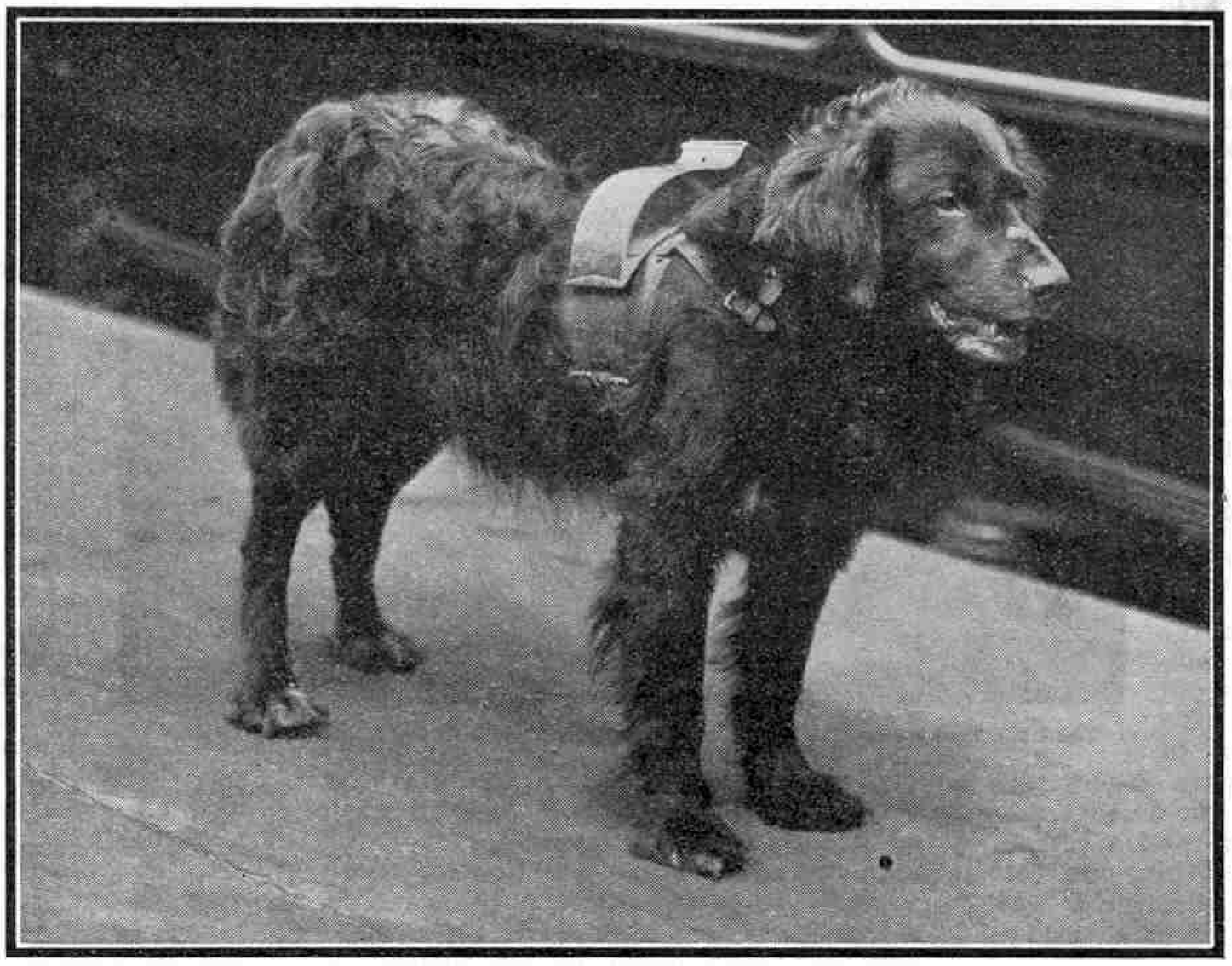
"ENGLISH BRASS AND COPPER INDUSTRIES TO 1800" *by* H. Hamilton, M.A. (Longmans, Green & Co.), 18/-net

Animal Railway Workers and Travellers

Dogs, Horses, Cows and Birds

By R. S. McNaught

THE staff of any of the great railway companies by no means ends with the newest boy helping to clean its locos or taking the number of carriages, but goes on to include a wide assortment of animals. The splendid draught horses that haul heavy goods drays are familiar to every reader, and great pride is taken by the carting and delivery staffs in these noble and well-groomed beasts. Even in this age of the all-conquering motor there is little danger of the replacement of most of the railway horses. The splendid stables provided for them make one think that to be a railway servant should be the ambition of every normal horse, as it is with so many boys !



Courtesy] "Brum the Second" [*L.M.S. Rly.*

Although it is a year or two since the last horse-drawn passenger train made its final trip on a British railway—it was a little jaunting-car affair called a "Dandy," worked on the Port Carlisle branch of the former North British Railway—shunting-horses are still to be seen at work in many places. Wearing a heavy type of harness, they are hitched on to the goods trucks by means of two chains ending in steel hooks and, after a strong starting effort, one horse is capable of hauling several heavy trucks with surprising ease.

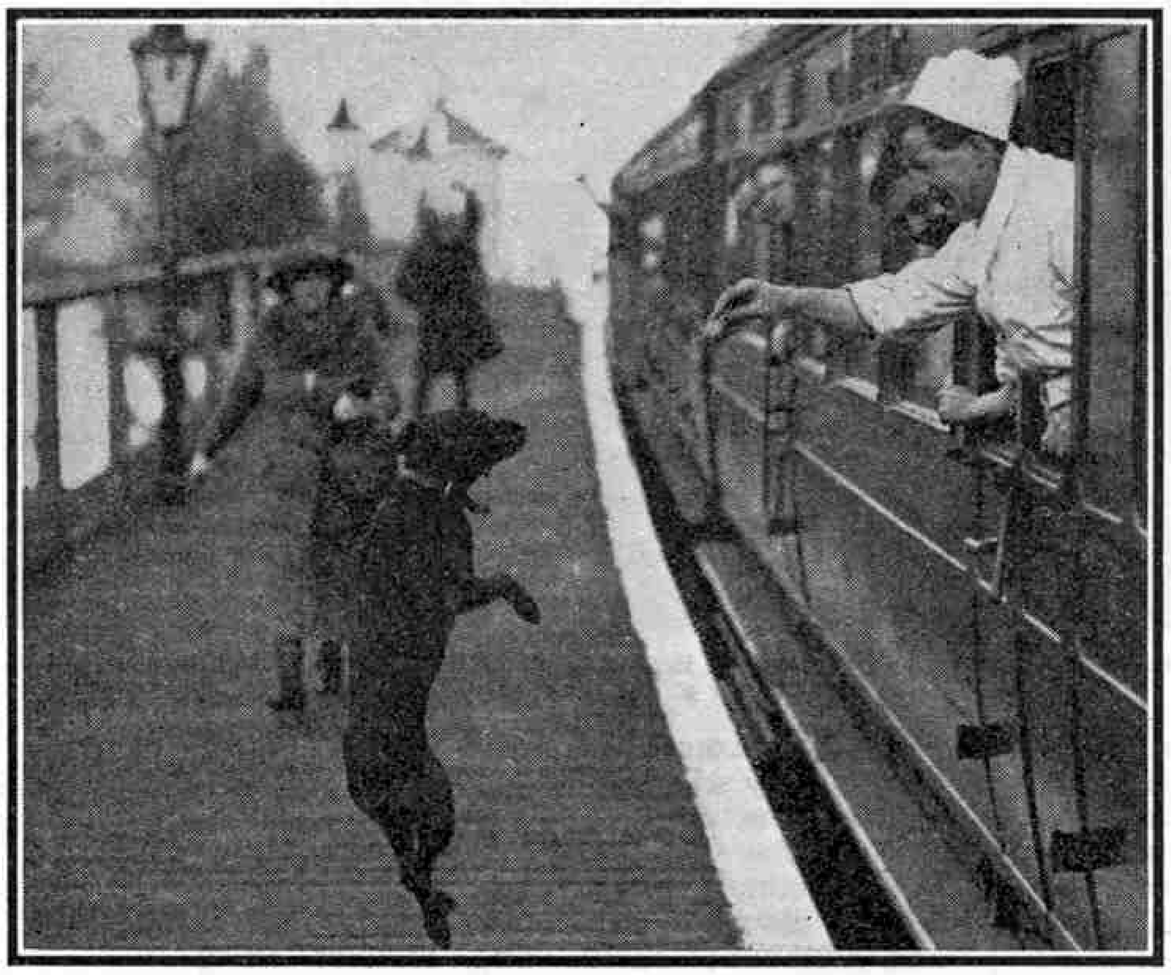
The Passing of Charlie

Charlie was one of these shunting horses who worked in the goods yard of a small station not more than 20 miles from London. Day after day his work was to walk alongside the trucks and just at the right moment to throw his weight into his collar, stiffen up, and get the wheels moving towards the unloading dock where the whirring motors whisked away the produce to the waiting shops. Charlie knew just when the chain had been hitched and when and how much to pull. An ancient carriage body, which would no longer take tired suburbanites back home, was his noon-day shelter from the sun or rain and he knew how to get in and back out gracefully without ruffling as much as a hair of his dappled grey coat.

When the proud iron horses flashed by on the main line in all their majesty with a rattle and a roar, Charlie used to watch them with a cunning look as if he knew that years ago the steam horse had put his ancestors back into the green fields and lanes and seen the "Gentlemen of the Road" out of business.

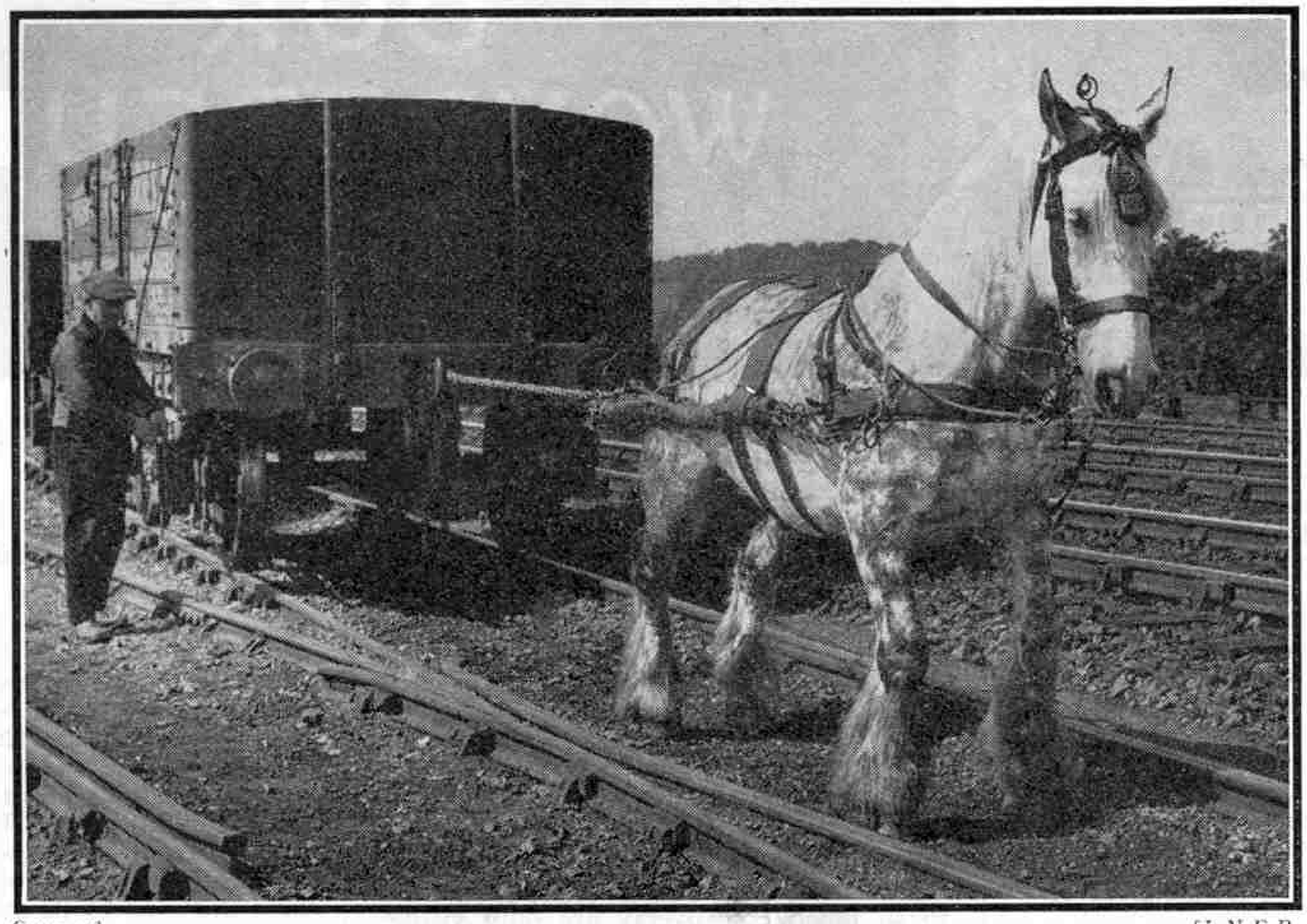
The shunters all loved Charlie for there is a kinship between men and horses that is intensified by a world of coal, iron and steel. The directors decided, however, to rebuild the goods yard and to substitute for Charlie a tank loco to clatter and snort the strings of wagons into their correct place, with many puffs of steam that will go upward to join the white clouds of the otherwise blue sky.

On one of our main lines a specially proud shunting-horse earns his fodder by taking part in first-class express train working. After spinning along for an hour or two at very high



"Prince," a dog owned by the Reading Stationmaster's daughter, having discovered that a Dining Car on the 2.30 to Newcastle means Scraps, is always on the platform in time to meet it, and accompanies it along the platform barking his gratitude

speed, the rear carriage of a non-stop train from London is "slipped" on approaching its terminal station. While the main portion of the train rushes on, the detached vehicle, with its brakes applied, slows down and comes to a stand just outside the station points. The shunting-horse now takes charge and the carriage, whose passengers are collecting their light luggage ready for detraining, is shunted by its new steed to its appointed platform. For some years a regular passenger in the slip carriage was an old gentleman who was a special friend to "Dick," the shunting-horse. Every day a lump of sugar was passed down from the end compartment, and the efforts of "Dick" to set the heavy load in motion were accompanied by a satisfied crunching sound.



Courtesy [*L.N.E.R.*

"Charlie," the Shunting Horse at Welwyn

Collecting Dogs

Visitors to many of the largest stations in the country are invariably interested by the sight of the collecting-dogs which, however, for some reason or other are not to be seen so frequently as in former days. Generally a large retriever or collie is chosen for this work, and in trying to fill the boxes strapped to their backs these four-footed "railwaymen" show great intelligence. Making their way among the thronging crowds, the collecting-dogs are expert in the art of jingling the contents of their boxes and thus attracting attention to the good work they have in hand. In practically every case, the funds so collected are devoted to railway servants' benevolent societies and institutions.

One favourite retriever, who had been a familiar figure for many years at a great London terminus, began to lose her sight and to show in other ways that she had reached the time for being pensioned off. But nothing could induce "Jess" to live peaceably in retirement. At every opportunity she slunk out of the house and made her way to the station, and was observed to pick her way among the passengers just as she had done with the little box on her back. It was thought that her intelligence might still serve a good cause, so she was allowed once more to resume her duties. Her old box was removed from the younger dog that had succeeded her, and once again "Jess" was happy. But alas for her failing eyesight! One dreadful day she was too slow in dodging a hurrying taxi, and had to be mercifully put out of her pain.

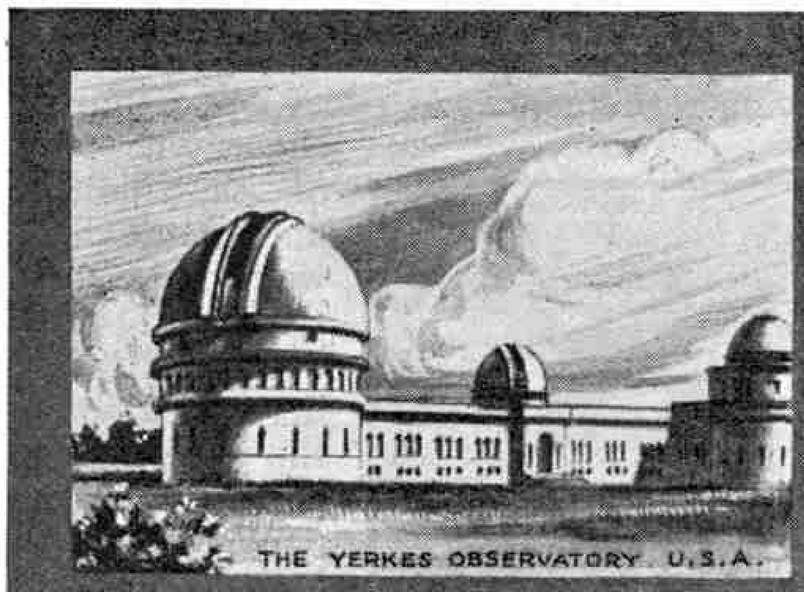


"Cupboard Love"—The dining-car attendant looks after the station dog

Cats "Officially Employed"

Cats serve a more utilitarian purpose in the railway service. It is their part to deal with the rats and mice that are to be found in the goods stations, warehouses, etc. So essential are our friends of the fireside in some depôts that one or two are officially "employed," their remuneration being board and lodging, the former consisting of an allowance of milk—and as much fresh meat as they can catch!

A tabby whose centre of operations was the refreshment room of a big station recently developed the "wander-fever" and contrived on more than one occasion to slip into the luggage van of a local train during the bustle of departure. One day the guard of a long-distance express was sorting out the packages in his charge when he heard a faint but unmistakeable "mew." He searched among the parcels and boxes in the expectation of finding a consignment of live-stock, but there was no article that could possibly hold a live cat. He moved all the contents of the van in the hope of (*Continued on page* 555)



OUR WONDERFUL WORLD

Atomic Heat for Welding

The free particles or molecules of the gas hydrogen are composed ordinarily of two atoms, and recently Dr. Irving Langmuir, the research chemist of the General Electric Company, discovered that these molecules could be split up into their constituents by intense heating. Conversely, when the atoms recombine to form the molecule, this heat is liberated. This discovery has been utilised as a means of producing the high temperature required in the welding of metals.

The stream of hydrogen in its normal molecular state is blown through a powerful electric arc between two tungsten electrodes to reduce it to the atomic state, and thence is directed on to the work requiring welding. As the atoms of hydrogen pass out of the flame they recombine, so that the heat of recombination is given out on the surface of the metal itself, this heat reinforcing the heat of the flame.

Welds can be made very rapidly by this method, and a very great advantage is that the metal is protected from the oxygen of the air by the hydrogen blown through the arc. No film of oxide is formed, and consequently welds made by this method are less liable to crack or break.

* * * *

Timing the Ice-Break in Alaska

The annual break-up of the ice in Alaskan waters means the unlocking of the frozen ports. The date is of great importance to traders, whalers and many others and has become the subject of an annual sweepstake at Nenana. Scientific means are adopted to calculate the break up to the second. A tripod is fixed into the ice in mid-channel, and lower down a heavy wire is stretched across the river. A battery is connected with the wire, together with a locked alarm clock. When the ice breaks up and moves it bears the tripod along, tightens the wire by pressing against it, and this sets the clock.

* * * *

Atmosphere 100 Miles Deep

Surprising results have been obtained as a result of a new method of taking photographs of the planet Mars introduced by Dr. Wright, of the Lick Observatory, in California. By placing colour screens in front of the plate Dr. Wright obtained pictures of Mars in several different colours. Thus one screen cut off all the light reaching the plate from Mars except blue, another allowed only the ultra-violet rays to act on the plate, and so on. The astonishing fact was then brought to light that a photograph taken in blue light made the planet appear larger than one taken in infra-red light, the difference in diameter being over 200 miles.

The interpretation of these photographs is a matter of great interest. The most likely suggestion at present is that Mars is of the size indicated by the infra-red photograph and is surrounded by an atmosphere about 120 miles in depth. The infra-red rays penetrate the Martian atmosphere more easily than do the blue rays, as in the case of air and fog on Earth, so that of the two only the infra-red rays reach us from Mars itself. Photographs taken in blue light, on the other hand, also include the light reflected from the atmosphere or clouds.

A further interesting feature is that the markings, or so-called "canals" on the surface of Mars that have given rise to so much controversy are only visible when light of long wave-length, such as yellow, red and the infra-red, is used. Cutting off the rays of light of these colours always gives photographs in which the markings do not appear. This again suggests that the actual body of Mars is seen clearly only in the photographs obtained when blue and ultra-violet rays are cut off.

Further experiments are of course necessary to settle the questions that have arisen and it will be advisable to take photographs on similar lines of landscapes on Earth through various thicknesses of air and clouds before any final opinion can be expressed on the questions of the size of Mars and the depth of its atmosphere.

* * * *

Strange Discoveries by Aerial Photographers

Photographers who survey land from the air have occasionally obtained strange results, and one of the most remarkable of these was the discovery of "lost property" in the United States. Close examination of the aerial photographs of towns in one district revealed the existence of hundreds of houses, sheds and other buildings on which no tax was paid by the owners. The cost of this particular survey was very quickly repaid by the collection of arrears of taxes!

Equally strange was the discovery made during an aerial survey some time ago of two submarines, although these were not exactly lost property. The country being surveyed was on both sides of the River Hudson, north of New York, and development of the films disclosed two forms, lying side by side under the water of the river, that were declared by naval authorities to be submarines.

Enquiries showed that none of the United States boats could possibly be there at the time and the only possible solution seemed to be that the boats belonged to rum-runners. By the time that a search could be made, however, the boats had disappeared, and nothing has since transpired to give any indication what craft they were.

* * * *

Fish Choose their Own River

The belief has long been held in the Lake District that the trout and the char in Windermere travel together at spawning time up the river flowing into the lake until they reach the point of junction of the two tributaries, the Rothay and the Brathay rivers. Then the trout proceed up the Rothay while the char choose the other turning up the Brathay.

This remarkable performance is exceedingly difficult to explain. No doubt now exists as to its truth and it is even said that any fish that takes the wrong turning turns back to the junction again. Other instances are known of two similar streams of which one is full of trout while the other contains no fish life at all, and it is remarkable how sensitive fish are to slight variations in their surroundings.

* * * *

Examining Steel Alloys by X-Rays

A future development of X-rays that can be confidently looked for, and which will give valuable results, is in the examination of the composition and structure of iron and steel alloys. It is possible now to get an approximate idea of the proportions of the constituents of an alloy by these methods. Thus, in a series of carbon steels, the steels with the greater proportion of carbon will be the more transparent to radiation.

This method is more advantageous in dealing with alloys containing tungsten and other metals of high atomic weight. Tungsten has a much higher atomic weight than iron, and gives a much denser shadow if equal thicknesses of the two are examined under exactly similar conditions. Alloys of the two give shadows of various depths in between, so that by comparison of the X-ray shadow of an unknown sample of tungsten steel with those of standard pieces of equal thickness and of known composition, the proportion of tungsten can be found immediately with a fair degree of accuracy. We could not, of course, distinguish by this method between a bar of tungsten steel and one of chromium steel, as both tungsten and chromium are of high atomic weight and give shadows of similar densities in this test. Either of them, however, could easily be detected among a number of carbon steel bars. This method has been suggested and used by Sir R. Hadfield, the famous Sheffield steel expert, and further refinements in the methods of measuring the intensities of X-rays will make it of great value.

Dinosaurs Alive in Africa?

A staff of experts is steadily and methodically unpacking and examining the contents of over 300 cases of bones at the natural history section of the British Museum, South Kensington. These cases have come from the vicinity of Lake Tanganyika, where an expedition sent out by the British Museum has been at work for some time on the task of unearthing the fossil remains that were discovered by the Germans just before the war.

The bones of many kinds of animals are contained in these cases, but the most interesting are those of the dinosaurs, gigantic reptiles, some of them far larger than elephants, that were the lords of creation some millions of years ago. In view of the large number of bones found and the huge area of comparatively unexplored land in East Africa, it is not surprising that some people express a belief that the discovery of a living dinosaur is possible, and accounts by natives of giant monsters of the African jungles have been quoted in support of this view. Such a discovery would indeed be sensational!

Fossilised bones are very fragile and in digging them up a single blow of a pick may badly damage a specimen, so that when most of the earth surrounding the remains has been removed the rest is usually scraped away by hand. The bones are then swathed in silk paper and covered with plaster to protect them from injury during their long journey over land and sea, and the task of removing the protective wrappings is necessarily a slow one, even with the aid of machines specially designed for the purpose. The ensuing task of cleaning the bones, hardening them with chemical solutions, and identifying and mounting them is also slow and delicate work, taking so long that the dinosaur that came from Canada in 1915 has only recently been placed on view.

So far only 50 cases have been opened, and what the remaining cases have in store is a matter for conjecture. Already some of the bones have been found of a monster that must have measured over 150 ft. in length, twice the length of the great blue whale, the largest of all known animals of the present day. Hopes are entertained that its remaining bones will be found also, so that the complete skeleton may be reconstructed.

Mr. F. W. H. Migeod, the present leader of the expedition in South Africa, is now turning his attention to Nyasaland where other interesting discoveries are expected. So far the most sensational "finds" made in this connection are the mummified remains found by Mr. Sternberg in Kansas, and now in the American Museum of Natural History, and the 25 dinosaur eggs found by Mr. Roy Chapman in Mongolia. The latter explorer found 12 complete dinosaur skeletons, and 70 skulls, as well as the five-million-year-old eggshells.

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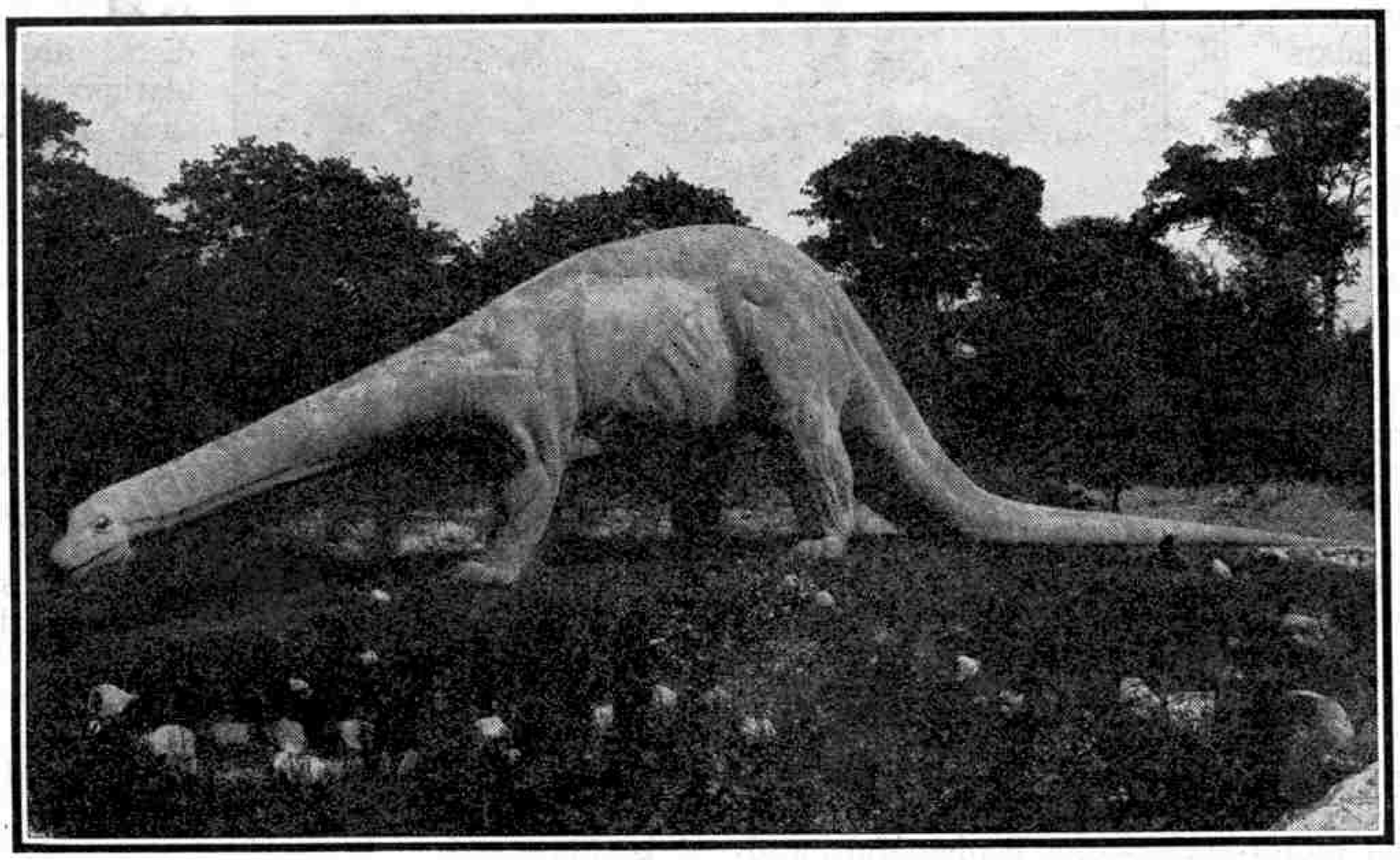
Work of the Mint in 1925

The report of the work done in 1925 at the Royal Mint holds out no hope of the return of gold coinage at the present time, as the gold reserves in this country are still insufficient for this purpose. In spite of this, however, over three-and-a-half million sovereigns were minted during that year, but not for circulation in England.

Another curiosity of the work of the Mint for 1925 was that again no bronze pennies were made, and it has been suggested that the reason for the lack of demand for these coins is that there is always a huge reserve of comparatively unworn coins in the penny-in-the-slot gas meters so common nowadays. Whether this be so or not, no pennies have been minted since 1922, with the exception of little silver Maundy pennies, such as are distributed by the King on Thursday in Holy Week to old people chosen from London parishes.

The original penny, by the way, was a silver coin made by the Anglo-Saxons, and pennies of silver and gold have been made under many of our kings, the gold penny of Henry VII. being regarded by collectors as one of the finest coins ever produced. Copper was first used for halfpence and farthings in the reign of Charles II., but our present penny is comparatively new, first appearing in 1797, with a companion twopenny piece, as a pure copper coin, "strictly and unequivocally honest," in the words of the maker, the famous Matthew Boulton of Birmingham. The first appearance of the penny in the form of a bronze coin, as we know it to-day, dates back to 1860 only.

Although no pennies were made in 1925, the workmen at the mint were kept busy, for the number of other coins made was enormous, including over five million shillings and nearly thirteen millions each of sixpences, halfpennies and farthings! Nearly four million threepenny bits were also made, which seems a surprisingly large number for so unpopular a coin.



Our photograph shows a life-size model of one of the pre-historic Dinosaurs, some of which are believed by some people to be living even to-day in unexplored Africa. The huge creature shown is the Diplodocus, an animal that is familiar to all Meccano boys as being the subject of model No. 403. The Diplodocus ranged in size from 40 ft. to 50 ft. in length and was a kind of huge lizard (see article on this page)

Elephant Mistaken for the Missing Link

Those who take part in the excavation work necessary for the study of the nature and habits of primitive man are very liable to be deceived, from the nature of their task. An amusing story based on this is to be found in Dickens' "*Pickwick Papers*," readers of which will remember the excitement of the members of the famous club over Mr. Pickwick's discovery of a stone with a Roman inscription, which eventually was read as "Bill Stumps his mark!"

In actual life it has happened more than once that a deluge of sham pre-historic relics has been showered on an excavator as soon as his workers have found out the sort of thing he is expecting to discover, particularly if rewards are offered. In fact, one old man developed the art of chipping flint in the Stone Age style to such an extent that it was exceedingly difficult to distinguish between the genuine pre-historic implements and the modern imitation. He finished up by giving demonstrations to learned societies of the art of manufacturing pre-historic implements!

A serious, but somewhat humorous, illustration of the care necessary to avoid pit-falls has just been given in connection with the recent alleged discovery of a skull of a very early type of man near the village of Trinil in central Java. In 1892 Prof. Eugene Dubois, of Amsterdam, discovered there a skull cap, two teeth, and a thigh bone, which turned out to be of very great importance, for they were those of a man-like and ape-like creature of thousands of years ago, called "*pithecanthropus erectus*" by scientists, and popularly hailed as the "missing link," a cousin to the human race. The possibilities of a further discovery in the same neighbourhood were kept in mind, and at last it was announced that Prof. Heberlein, of the Dutch medical service, had discovered a complete skull of the same type. Wide publicity was given to the discovery in the press, but when further details were published some doubts began to arise as to the genuineness of the bones.

Now Prof. Dubois, the discoverer of the first and genuine skull, has exploded the whole story, by detecting from the photographs sent him that the bones are parts of the skull of a pre-historic elephant!

At various times fragments of skulls of great antiquity have been discovered in various parts of the world—at Piltdown in Sussex, in Rhodesia, and at Gibraltar, for instance, all of them showing characters that are partly human and partly simian. Each discovery has given rise to the hope that the bones of a genuine ancestor of man have been found, from which his development into the highly specialised being of to-day could be traced.

A Revolution in Gear Changing

A Remarkable Invention, Giving an Infinitely Varying Drive

SOME time ago we gave some particulars of the interesting Constantinesco Torque Converter, and in this article we are able to describe another form of an infinitely variable gear, for which mechanical engineering has been waiting a long time. The new invention, which promises to revolutionise gear-changing, is a device with which, by simple operation of a lever, any speed variation may be given to a driven shaft from a driving shaft, itself altered in speed if necessary.

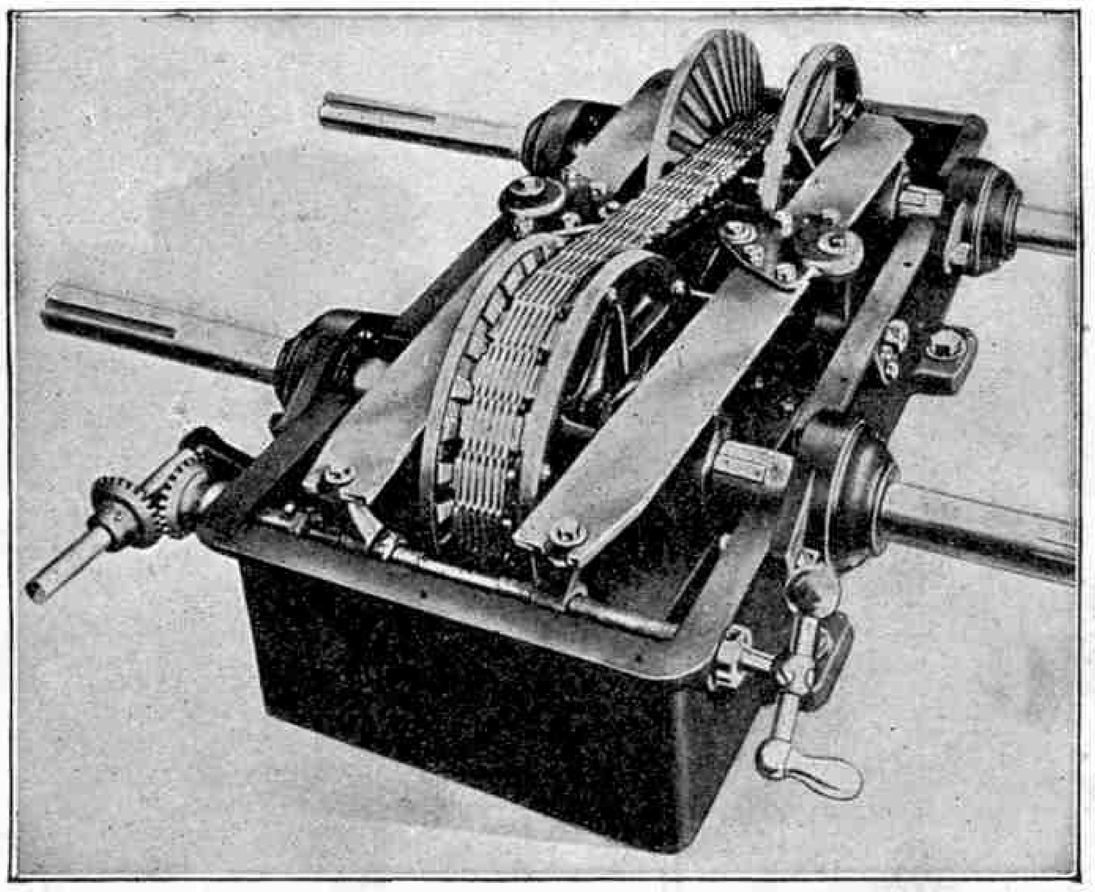


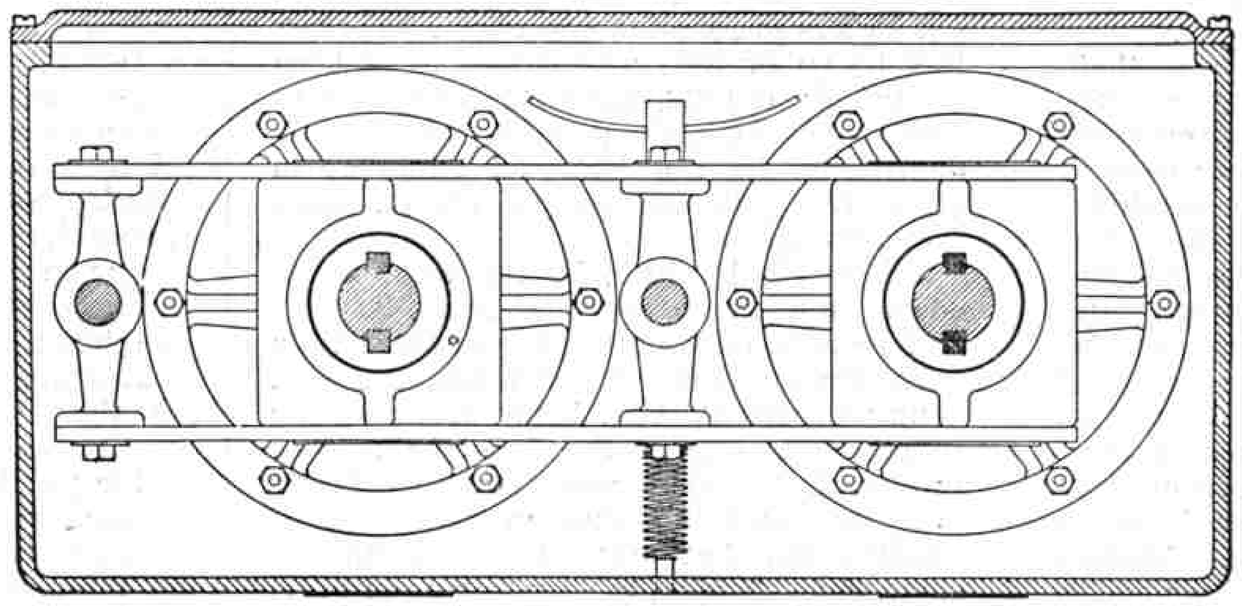
Fig. 1. General View of P.I.V. Change-Speed Gear

Some of our readers may have heard of a similar form of variable gear that was applied some years ago to at least two kinds of motor-cycles—the Rudge-Multi and the Zenith-Gradua. In these cases a rubber driving belt was used, but it was liable to slip in wet weather or, sooner or later, to break when subjected to any abnormal strain. In the end these and other disadvantages outweighed the advantages, and we believe that both these variable geared motor-cycles have now been superseded by models fitted with standard gear-boxes.

The new P.I.V. (" positive-infinitely-variable ") gear, which it is interesting to note is British throughout, is claimed to be the only form of change speed gear at present in existence that, whilst being positive and mechanical in all its parts and action, gives a continuously variable speed over the range for which it is designed. It does this without depending on a frictional drive and without the " steps " usually associated with gear-box change of speeds.

General Description of the P.I.V. System

The P.I.V. Gear is constructed on the following basic principles. Two pairs of expanding pulleys, of the opposed conical-disc type, are mounted one on the constant speed shaft of the gear and one on the variable speed shaft. These opposed discs are provided with feathers and are arranged to slide axially on their respective shafts so that they may be moved from, or towards, each other. Two arms on each side of the pulleys (as shown in Fig. 1) are mounted on pivots in such a manner that when the gear-operating handle is turned, the discs on one shaft approach each other, whilst the discs on the other shaft move apart. This is shown on the half plan of the gear in the lower illustration Fig. 2. Here the arm is shown engaging at the extreme left on a threaded rod, to which the handle outside the box is connected.



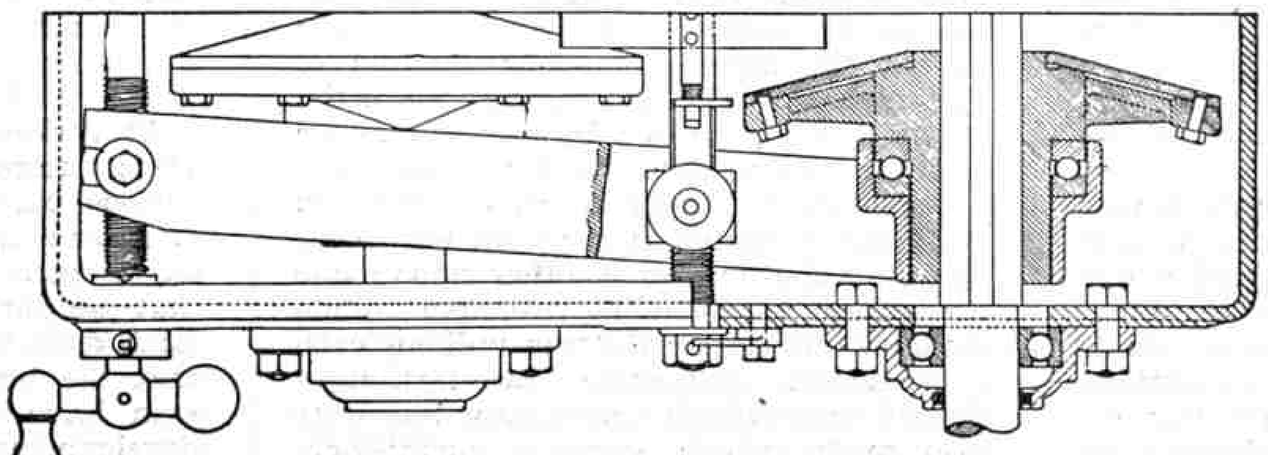


Fig. 2. Sectional elevation and half plan of Standard P.I.V. Gear-box

Radial Teeth Cut on Pulley-faces

A number of radial grooves are cut on the surface of the face of each pulley. These teeth are shallow and taper to the centre of the wheel. They are of constant depth and are so arranged that the teeth on one disc are opposite the spaces between the teeth on the opposed disc. The space is identical in shape to the tooth.

Although they maintain the same depth throughout their length, the grooves decrease in width towards the pulley shaft, and the edges are inclined at an angle of 30° to the surface of the pulley. Although a leather belt could then be used for the drive between the pulleys, its use would set up considerable friction. Also it would be untrustworthy, both from the point of view of non-slip and wearing qualities. Instead of leather, therefore, power is transmitted from one shaft to the other by a chain of special construction to which we shall refer later.

This chain rides in the Vee formed between the opposed discs and runs in a position on the pulleys tnat depends on the axial distance separating the

pulley discs. A simple mechanism controls the axial movement and causes one pair of discs to approach each other as the other pair separate, so that the chain rises in one wheel by the amount that it descends in the other.

So far the invention is not any more complicated than many other engineering devices. The greatest ingenuity lies in the construction of the chain, which may be best described as "self-pitching."

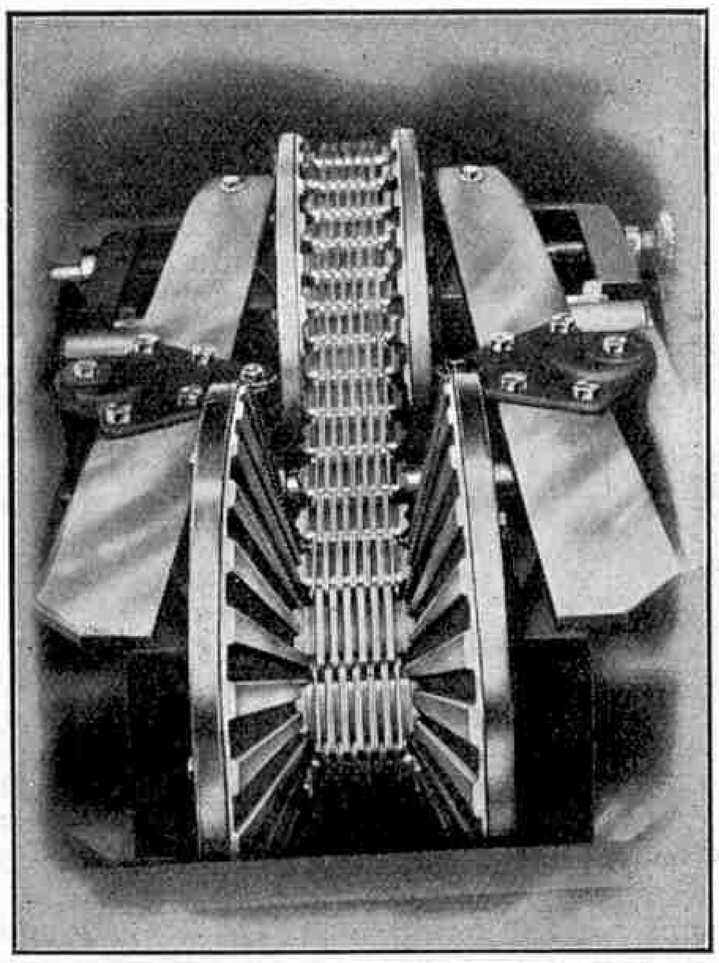


Fig. 3. Chain on Smallest Diameter of Pulley

A Chain that Adjusts Itself

The reason for employing a special chain is, of course, that the pitch of the teeth on the pulley faces decreases from the outside edge towards the shaft centre. Thus, in order for a chain-drive to be practicable, it must be automatically able to accommodate its pitch to the pitch of the teeth on that point of the pulleys at which it is riding. The chain used must also automatically be capable of changing its pitch between the time in which it passes from the driving to the driven pulley—and vice versa—where it always encounters a different pitch (except when it is driving in the 1 to 1 setting—that is, on mid gear).

The inventors of the P.I.V. gear have overcome all these difficulties by employing what is not only an ingenious device constructionally, but one that lends itself to economical production on a commercial basis—always an important point to bear in mind. Thousands of useful and valuable patents, brought out at one time or another, have never been developed simply because, although interesting enough in theory, there are no commercial possibilities in them, or because the cost of the manufacture of the article is prohibitive.

The Ingenuity is in the Slats

The illustration on the next page (Fig. 7) shows the upper and reverse sides of the chain. An assembled element of the chain consists of a casing, over which a series of links is passed. Within these links are inserted thin slats, of which there may be two dozen or more, according to the size of the chain. These slats are free to slide on one another across the width of the chain, their movement in either direction being limited by small projections at their ends, which abut against the edges of the casing.

At each end of the bundle of slats is an extra stout slat formed of half-round material, and with its ends milled off to an angle of 30°.

The total crosswise distance through which the slats may move is approximately equal to the depth of the teeth on the faces of the driving and driven pulleys. The end-wise movement of the slats is automatically produced by the engagement of the chain with the pulley, the teeth on one conical face pushing the slats over into the gaps on the other conical face.

The stout end slats, with their bevelled ends, assist the movement by relieving the thin slats of shock at the instant of first contact.

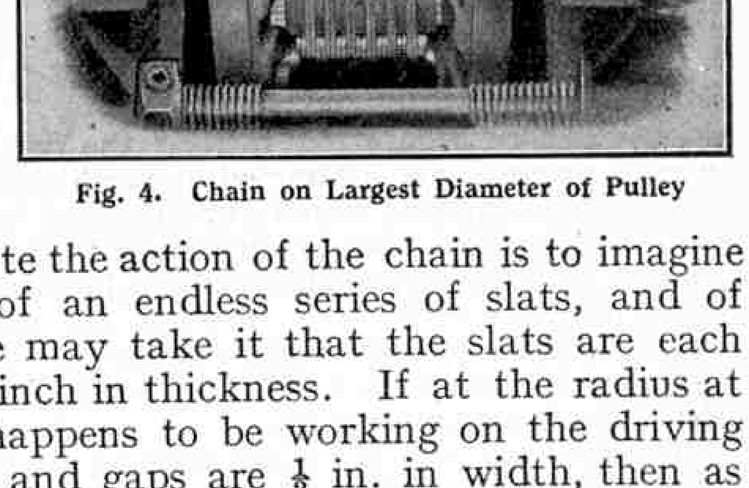


Fig. 4. Chain on Largest Diameter of Pulley

Perhaps the best manner in which to appreciate the action of the chain is to imagine it as composed of an endless series of slats, and of nothing else. We may take it that the slats are each one-fiftieth of an inch in thickness. If at the radius at which the chain happens to be working on the driving pulley, the teeth and gaps are $\frac{1}{2}$ in. in width, then as the chain passes on to the driving pulley a group of twenty-five slats will be moved to the left, the immediately succeeding twenty-five slats will be moved to the right, and so in equal-sized groups in alternate directions.

How the Slats Adjust themselves to Different Conditions

The left-ward moving groups fill the gaps on the left-hand face of the pulley and the right-ward moving groups, the gaps on the right-hand face. The last slat of each group makes driving contact with the flank of the tooth following the gap in which the group lies and is backed up by the preceding 24 slats in the group.

The slats remain in this group-setting as they pass round the driving pulley, and they reach the driven pulley with the grouping substantially unaltered. At this pulley the chain, we will suppose, is working at a radius at which the teeth and gaps on the pulley faces are a quarter of an inch in width. On reaching the driven wheel the slats therefore re-group themselves to fill the reduced size of the gaps.

Our example illustrates a minor but important point. Twelve and one-half slats would be required to fill the gaps on the driven pulley. The movement of the thirteenth slat is therefore ambiguous. It cannot be

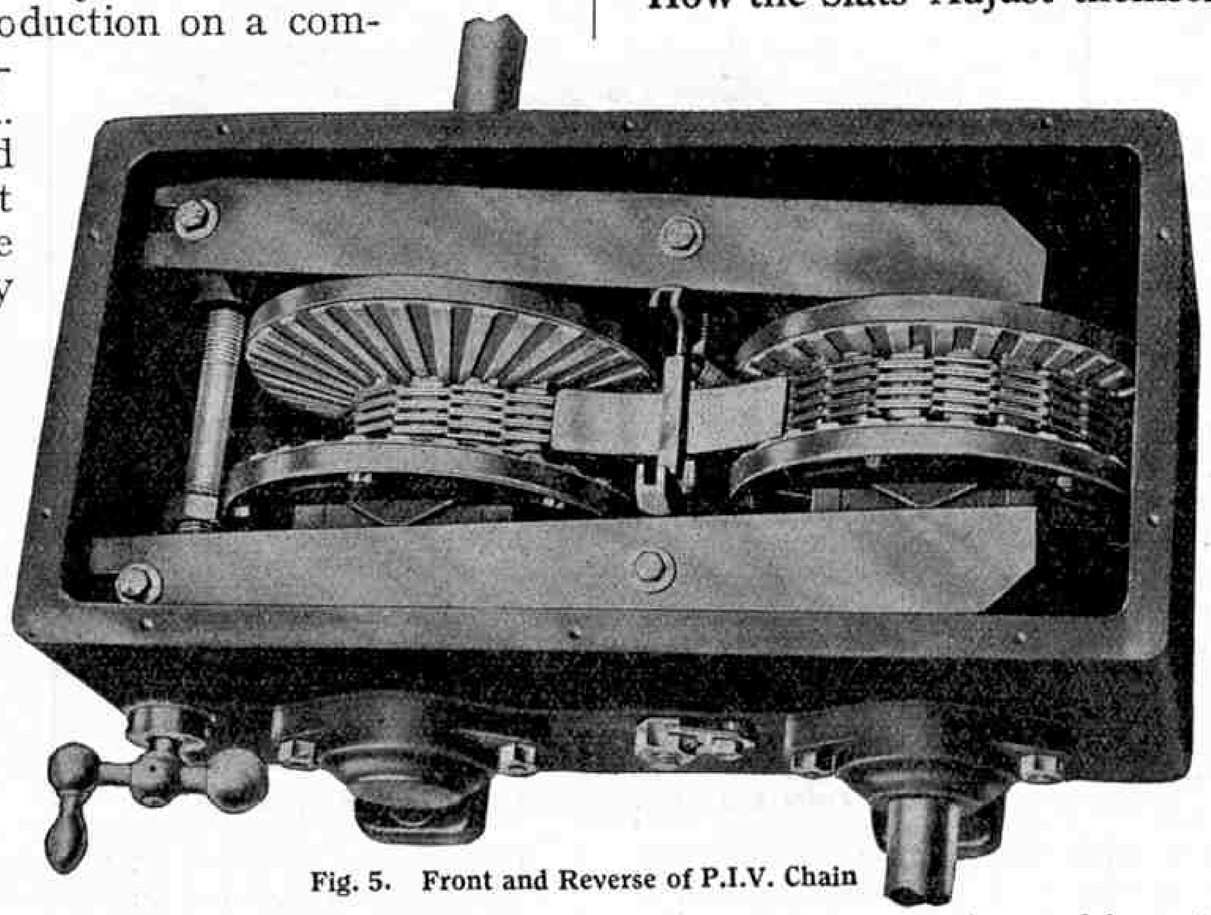


Fig. 5. Front and Reverse of P.I.V. Chain

allowed to jam itself into the half space available in the gap. If moving over to the opposite side it inserts itself as the first slat in the succeeding gap, it will separate itself from its neighbour in front by one-hundredth of an inch.

If there are, say, twenty groups in engagement with the pulley simultaneously the effect will be equivalent to a stretch of the chain by one-fifth of an inch—a stretch that in our example would occur only in that part of the chain in engagement with the driven pulley. The consequence would be that this slip-like effect would result in the speed curve being not continuous, but minutely stepped.

Overcoming a Difficulty

The difficulty here indicated is overcome by inclining the flanks of the teeth at 30° to the conical faces, a procedure that enables the thirteenth slat in our example to occupy a mid-way position and gives a speed curve that is completely continuous. In other settings some fraction of a slat other than a half is required to fill the gap. In such cases more than one slat is accommodated by the 30° flanks in a partially displaced position.

In general, therefore, the slats are not displaced in sharply defined groups but, instead, the first and last two or three in each group suffer a stepped or fan-like displacement.

An interesting and important practical fact may here be mentioned. The slats that at any given instant are making driving contact with the teeth flanks will not in general make such contact again until the chain has run round the pulleys several or many times. All the slats in a regular order—not necessarily arithmetical—make driving contact with the teeth flanks and consequently the chain wears uniformly.

The chain as actually made consists in effect of groups of slats separated by intervals of about the same length as that occupied by the groups. This interruption of the slats is necessary in order to accommodate the links and rivets required to render the chain capable of transmitting tension. The action of the chain is, however, similar to that which we have pictured in connection with the theoretical chain consisting only of slats.

Immense Strength of the Slats

As shown in Figs. 3 and 4, the non-continuous arrangement of the slats may result in some of the teeth-gaps being incompletely filled. As a consequence some of the driving contacts may be omitted, while in other circumstances the contacting slat is backed up by less than the full number of slats theoretically possible. The number of actual driving contacts is, however, in all settings sufficient to transmit the power without overloading the slats. In any case the strength of the half-round end slat is sufficient to prevent damage, even although it and but one other slat are called upon to transmit the driving pressure.

As the slats gradually become shorter from wear, the chain accommodates itself in the Vee without affecting the efficient running of the gear. Slackness in the chain due to shortening of the slats and to wear at the rivets can be taken up by a partial turn on the "chain tightening screw." This adjustment, which does not alter the correct alignment of the pulleys, is made whilst the machine is running.

Alternative Designs of P.I.V. Gears

There are, of course, many alternative applications for the P.I.V. gear and different designs are evolved to meet different requirements. In one design the constant speed and the variable speed shafts are kept at close centres, and the whole of the moving parts of the mechanism enclosed in a cast iron box. This box serves as a protection against grit, metal particles, fumes or other deleterious influences, and at the same time provides an oil bath into which the lower rims of the pulleys dip, thus ensuring efficient lubrication. The shafts are reversible in their bearings so that the extensions may be arranged to project on either side of the box as desired.

In another design the chain runs in the open, being used to transmit power from one point to another as well as to provide an accurate speed control. The mechanism expanding the wheels is so constructed as to enable the shaft centres to be varied to suit requirements.

In still another design, notably in application to drives direct from electric motors, a small expanding pulley is mounted on the motor shaft and the chain used to transmit the power from the motor to a larger non-expanding pulley on the driven shaft (see Fig. 6). This provides the initial step-down from the motor speed to that of the driven machine, and at the same time provides a control of speed which would be otherwise impossible on account of the constant speed characteristics of the motor. For example, if the motor runs at 1,000 r.p.m., the chain would drive the variable speed shaft at any speed say between 500 and 250 r.p.m. The initial step-down would be arranged according to requirements.

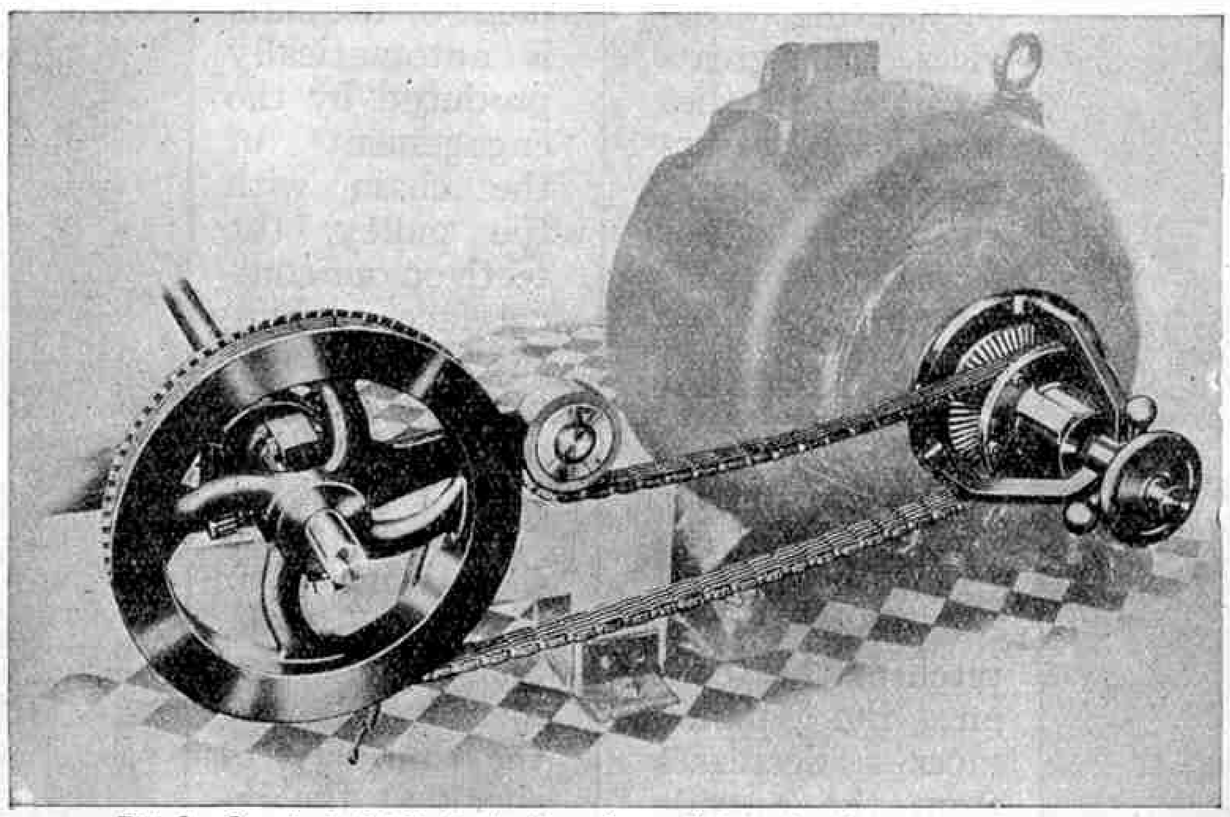


Fig. 6. Standard P.I.V. Reduction Gear giving step-down, together with infinite variation from full to half speed

The P.I.V. Gear in Italy

We have not space to describe all the possible developments before this gear, but will conclude by briefly referring to the case of an Italian artificial silk factory. In this case a gear was required that would reduce the driving speed of the bobbins progressively with the winding on of the thread, and so preserve the tension in the thread constant as the size of the reel increased.

The P.I.V. gear supplied in fulfilment of this object is capable of varying the speed, automatically and uniformly, from 330 to 270 revolutions per minute over a period of three-quarters of an hour. On the operation of a press button it restores the original speed of 330 revolutions in a matter of four seconds.

In this application both sides of the driving pulley and one side of the driven pulley are made fast to their shafts. The second side of the driven pulley is mounted to slide on its shaft and is advanced towards its mate by means of a screw which, through a train of gear wheels deriving power from the driving shaft, is caused to make about $2\frac{1}{4}$ turns in three-quarters of an hour. The gear wheel train includes two wheels differing by unity in the number of their teeth. These wheels are driven by a common pinion and by their relative rotation turn the controlling screw at the required slow rate.

During the interval a flat spring between the two gear wheels is slowly wound up. At the end of the interval a touch on a press button operates a dog clutch in the common pinion and separates that pinion into two parts. Under the action of the flat spring the wheel with the extra tooth is free to recover its lost relative motion and to wind the screw back through the $2\frac{1}{4}$ turns communicated to it.

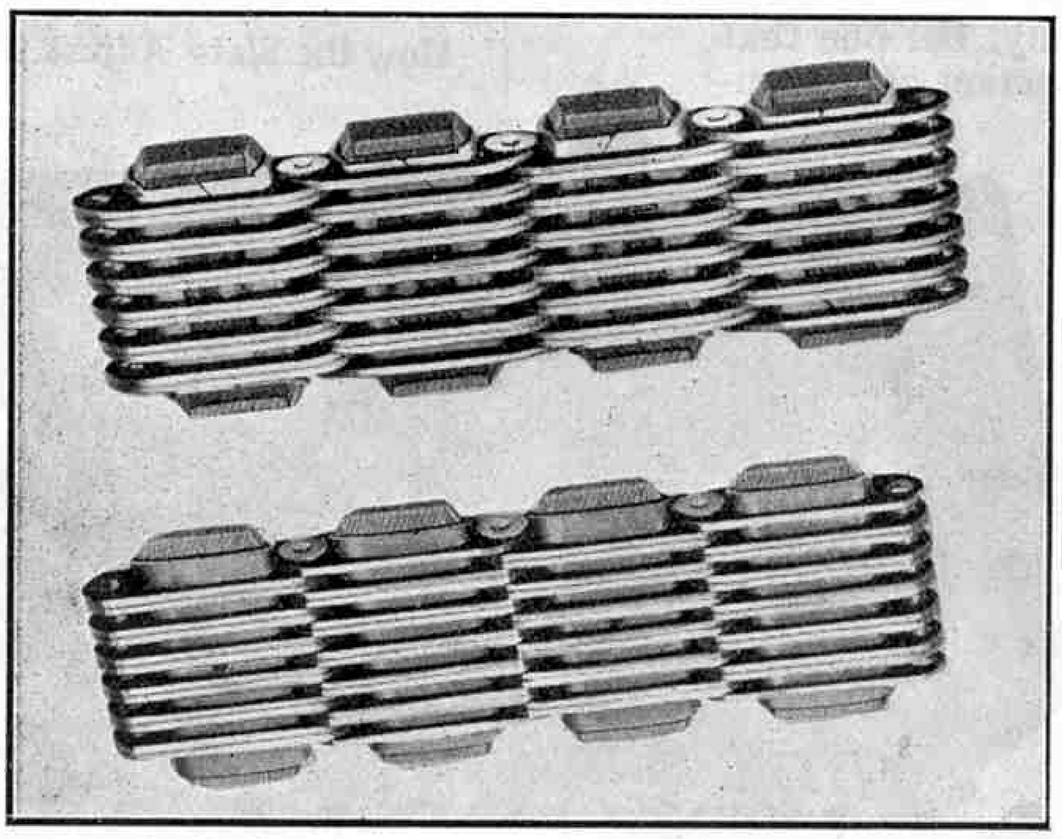


Fig. 7. Front and Reverse Views of Special P.I.V. Chain

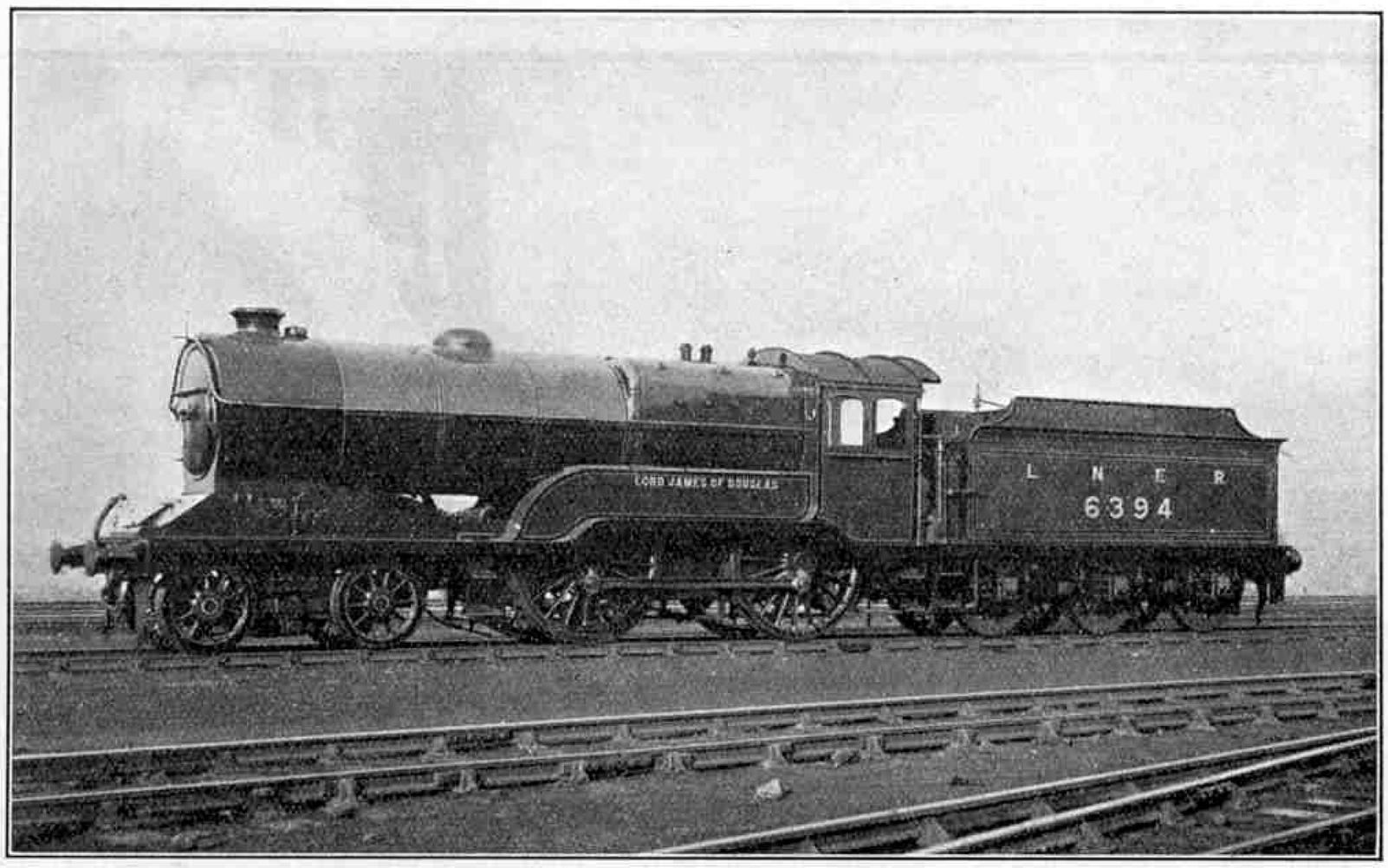
Its Universal Application

The introduction of this gear applies to practically every industry in which power is used, and it enables alternating current motors to be used for variable speed work without difficulty. The gear has already been applied in the bakery, confectionery, and biscuit-making industries and in (*Continued on page* 526)

L.N.E.R. "Director" Locomotives

For Express Passenger Service in Scotland

BY the courtesy of The London & North Eastern Railway we are able to reproduce a photograph of one of the latest "Director" class express passenger engines as used in Scotland, 24 of which were placed in service in the Scottish area in 1925. The design originated with Mr. John G. Robinson when Chief Mechanical Engineer of the Great Central Railway, and the first engines of this kind were constructed at the Gorton Works in 1913. A subsequent and improved class, having the same general characteristics, was built in 1919, and the latest engines agree in the main with the 1919 series.



"Director" Class Express Passenger Engine

The photograph shows that the chimney now fitted is of the standard pattern adopted by the L.N.E.R., both this and the steam dome being lower than the original fittings, in order that the engines may be available for use on the North British section of the system. The "Director" design has always been characterised by its symmetry of outline, and its general proportions are such as to ensure ample tractive effort and general efficiency. Steam is distributed to the cylinders by 10 in. diameter piston valves working above the cylinders and actuated by Stephenson link motion and rocking shafts.

An engine and tender of this class, in working order, weighs 109 tons 9 cwt., and of this, 39 tons 16 cwt. rank for adhesion. The tractive effort, at 85 per cent. of the boiler pressure, is 19,644 lb., and the adhesive factor is 4.537.

The tender is of the six-wheeled pattern, with wheels of 4 ft. 4 in. diameter and a wheelbase of 13 ft. The water capacity is 4,000 gallons and the coal capacity six tons. Water pick-up apparatus is fitted.

"Directors" were not at all popular when first introduced into Scotland. Their design was radically different from the "Glen" and "Scott" classes that the Scottish drivers were accustomed to handling, and it was not surprising that it took the men some little time to settle down to them. In the interim many little slips and oversights occurred. These possessed their humorous side, and in this connection "*The Locomotive*" has an amusing tale to tell.

The "Directors" have a right-hand drive, to which the Scottish drivers were unaccustomed, and this proved a source of annoyance when a "Director" was required to make frequent stops. The drivers, so long accustomed to pulling the train up by acting when opposite a marked spot, missed their usual marks. One driver, on learning that he was to get a "Director" the following week, hit on the method of observing the advertisement plates on the platform opposite to the place where he usually stopped. Duly on the Monday morning, "Jock," as we will call him, got his "Director" and, after a few stops that might be called good, allowing for the adverse circumstance of the right-hand drive, forgot, or rather got mixed, in regard to which particular advertisement plate was his mark at the next station. It must have been amusing to hear Jock calling to his fireman, as they approached a stopping place: "What's this yin, Bill, 'Lux' or 'Bovril'?"

The alteration in the location of injectors and keys caused some trouble at first and the designer was very unpopular with Scottish enginemen until the variations were thoroughly understood.

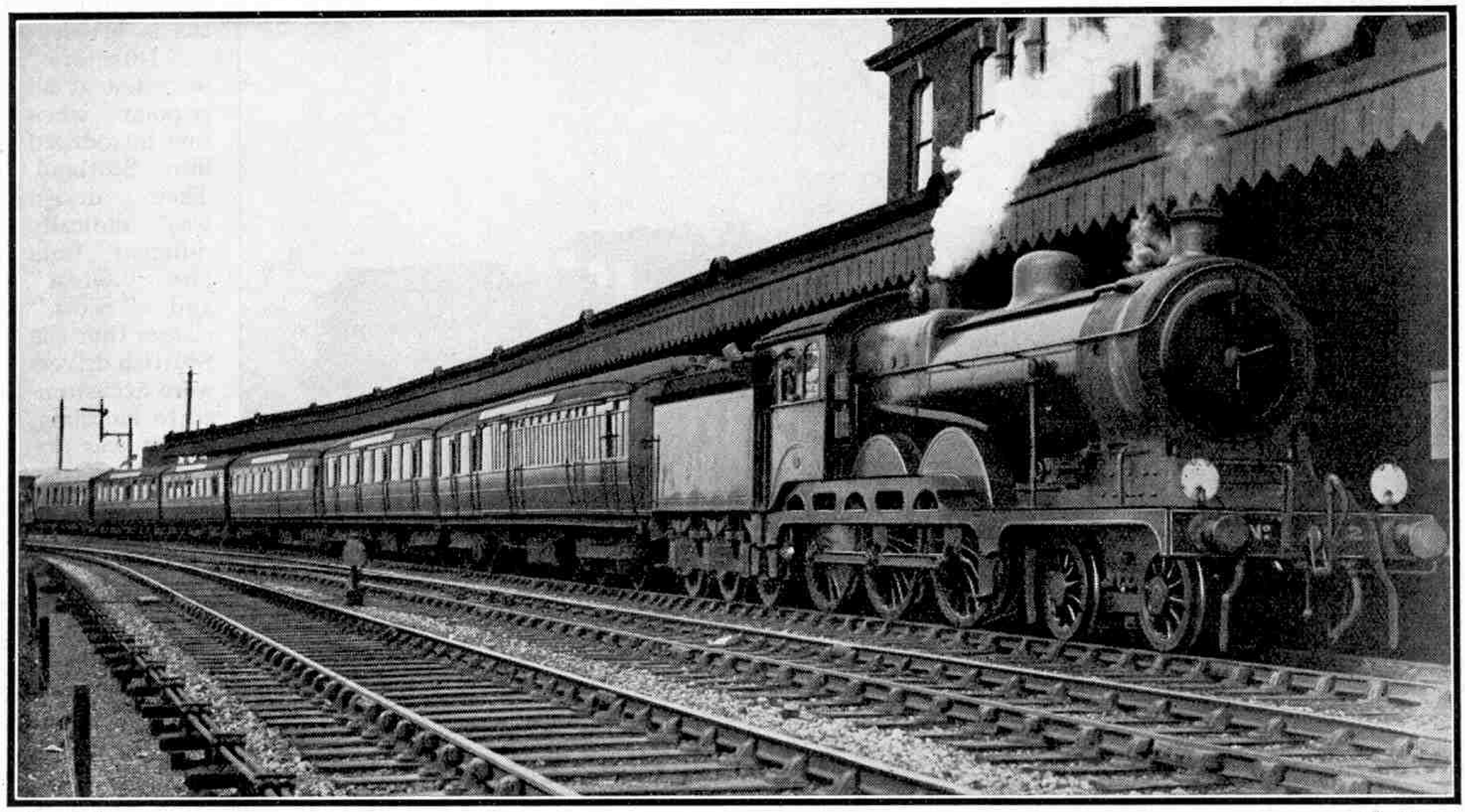
Leading particulars of "Director" class

Cylinders—	
Diameter	20 in.
Piston stroke	26 in.
Cylinder horse-power	1,295
Wheels, coupled, diameter ...	6 ft. 9 in.
Wheelbase—	
Rigid	10 ft.
Engine, total	25 ft. 3 in.
Boiler—	
Diameter of barrel, maximum...	5 ft. 3 in.
Length of barrel	12 ft. 3 in.
Firebox—	
Length outside	8 ft. 6 in.
Width	4 ft. ½ in.
Heating surface—	
Firebox	155 sq. ft.
Tubes	972 sq. ft.
Flues	416 sq. ft.
Total evaporative	1,543 sq. ft.
Superheater (24 elements) ...	209 sq. ft.
Total	1,752 sq. ft.
Working pressure	180 lb. per sq. in.
Grate area	26.5 sq. ft.
Boiler horse-power	1,146.

FAMOUS TRAINS: VI.

The Hook of Holland Boat Express

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



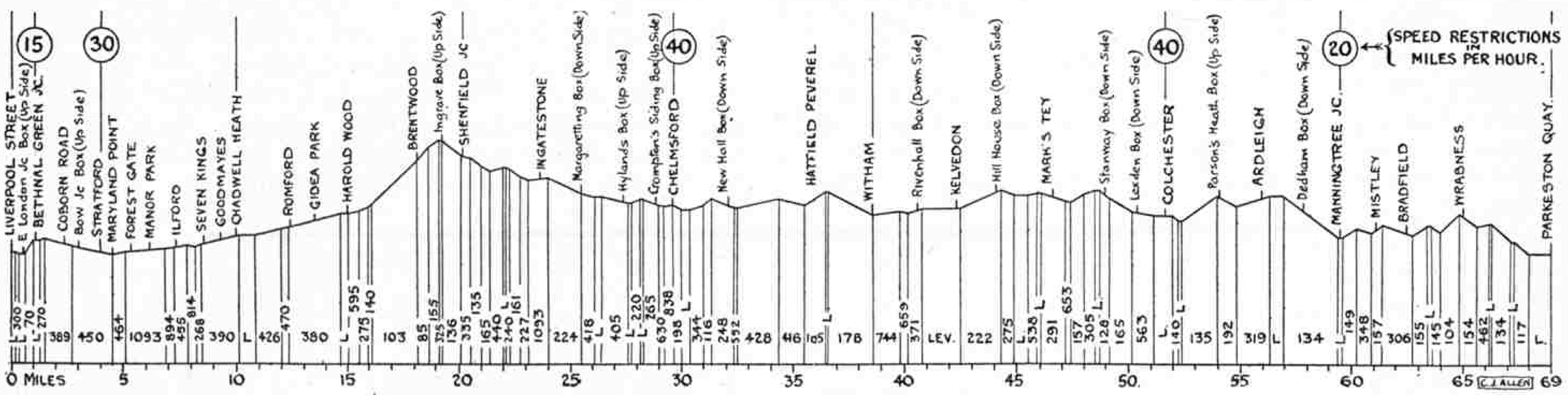
Courtesy] [*L.N.E.R.*

IT would be interesting to know the exact derivation of the injunction to "hook it," which in the course of time has doubtless been hurled at most of us—and probably not without good reason! If you want to "hook it" in the very best style, the London and North Eastern Railway, so their posters tell you, can provide you with a train for the purpose. You may, in fact, "hook it" by the "Hook train," as the subject of our consideration this month is generally known, *tout court*, to the railway staff who are concerned with its working. It conveys passengers from Liverpool Street Station in London to Parkeston Quay at Harwich, on the Essex coast, where they join a swift turbine steamer to take them to Hook of Holland, the Dutch seaport on the northern side of the delta of the great Rhine. From Hook of Holland Continental trains hurry away to Rotterdam, Holland, Germany and beyond.

Our train this month furnishes a decided contrast to those with which we have already dealt in this series. Instead of a journey of 400, 300, 200, or even 100 miles, the "*Hook of Holland Boat Express*" is content with one of 69 miles only, although, to be sure, it makes the trip twice daily, up in the early morning and down at night. No tremendously high speeds are possible during the run, because of the serious obstacles to speed, which we shall note in a moment. We are unlikely to "clock" any higher maximum rate than 70 miles an hour, or slightly over, save on the up journey, where we may reach 75 or so at the foot of Brentwood Bank.

Neither can the London and North Eastern Railway authorities use any of their biggest and most powerful locomotives on this service, as the clearance of certain overline bridges makes it necessary to keep the maximum height of the engines down to a shade under 13 ft., and the comparative weakness of certain bridges under the line has made it necessary to restrict the maximum weight of engines over this route to a figure considerably below that obtaining on other parts of the system. So our Great Eastern 4–6–0 engine, at the head of the train, has a weight, without tender, of only 64 tons, as against, say, the 92½ tons of a Gresley "Pacific."

And why all these difficulties? The old Great Eastern Railway was an amalgamation of a number of lines constructed through country that could never offer much in the way of remunerative traffic, save for a couple of months or so in the summer, when holiday-makers are hurrying to the East Coast. Consequently not so much was done as on our other great trunk lines in the way of heavy earthworks or engineering works, with the result that, in the nominal flatness of the Eastern Counties, the Great Eastern has some very

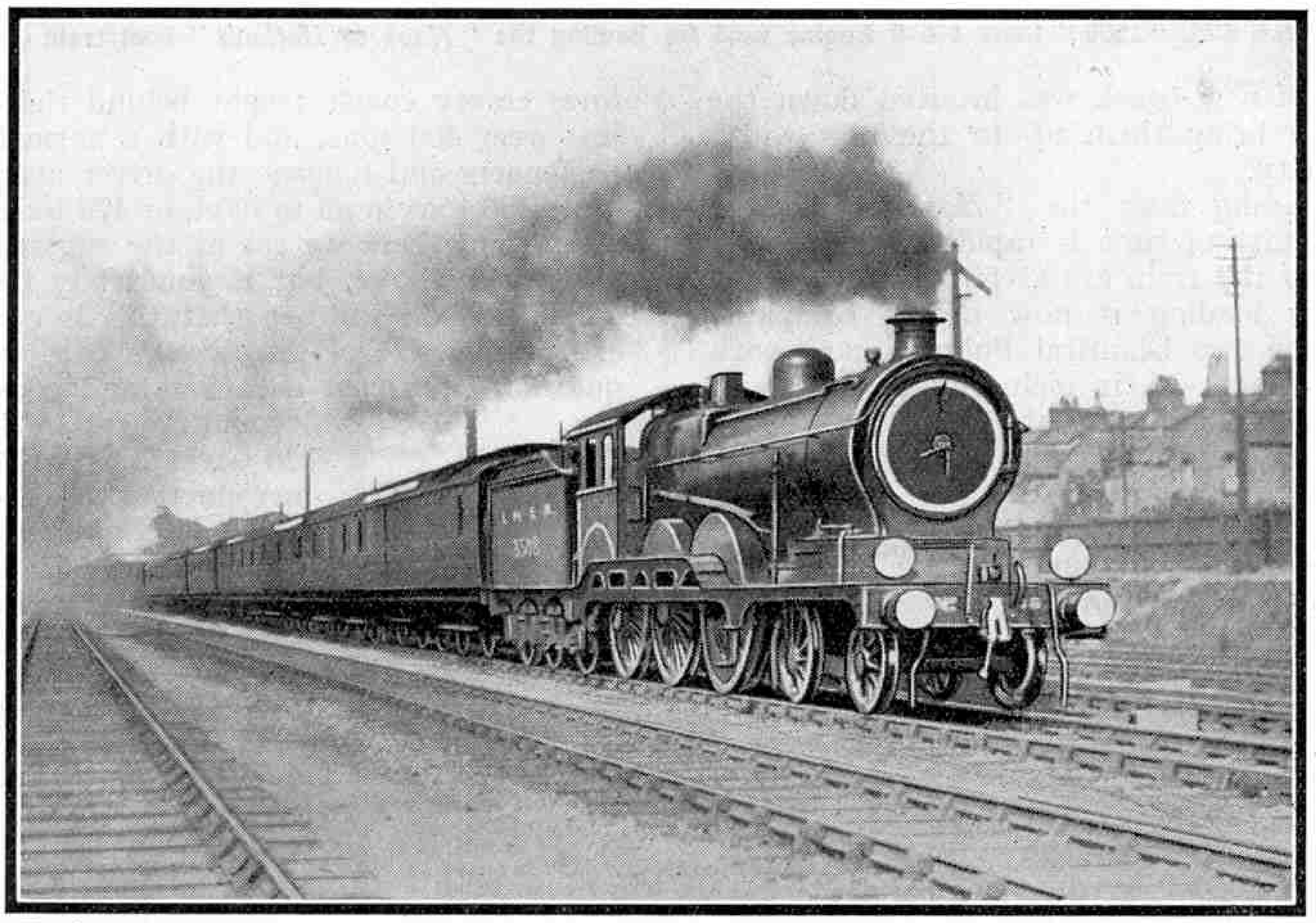


heavy gradients. In order that you may understand how this fact affects the working of the "*Hook of Holland Boat Express*," I have prepared a profile of the "banks" between Liverpool Street and Parkeston Quay, which is here reproduced. You will see that there is not a level stretch anywhere on the journey.

Not only that, but on account of sharp curves through various big towns and junctions severe reductions of speed are necessary at the five different points that I have indicated; at three of them the speed would normally rule at a high figure, as they are at the bottom of inclines from both directions of running. In this manner, too, insult is added to injury, as the unfortunate locomotive has to try and recover her lost momentum on an ascending gradient. To maintain an average speed of 50.3 miles per hour over the 69 miles between Liverpool Street and Harwich is therefore a really marvellous feat for a 64-ton locomotive hauling a train which, inclusive of her own tender, may weigh anything up to 470 tons, or occasionally even 500 tons.

It is, indeed, a job for expert drivers and firemen only. The small "link" of engine crews engaged in working the night boat expresses—the Hook of Holland and Antwerp trains down and the two corresponding trains up each day—numbers only four all told, each of which gets one Continental working a day. The drivers and firemen are all attached to the locomotive shed at Parkeston Quay. It should be added that the up morning Continental trains have rather easier timings than those in the down direction, while even the down Antwerp train, which runs ten minutes behind the "*Hook of Holland Express*," although it maintains the same start-to-stop time of 82 minutes to Parkeston, is not quite such a hard duty, as it carries a lighter formation than its predecessor. At normal times the "*Hook of Holland Express*" is, by a wide margin, the stiffest locomotive duty over any part of the old Great Eastern system.

Arriving at Liverpool Street Terminus shortly after eight o'clock in the evening we shall find a scene of considerable activity at No. 9 platform, where is drawn up the luxurious set of coaches in which we are to be whirled to Parkeston Quay. No. 9 is the longest platform at Liverpool Street, measuring 900 ft. from end to end, which is just as well, as no other of the Liverpool Street departure platforms could accommodate the full length of our train.



Photo] **"Hooking it" by L.N.E.R.** [*F. E. Mackay*

The "Hook of Holland Express" at Full Speed, passing Chadwell Heath

There are at Liverpool Street in all some 18 platforms, 10 of which belong to the original terminus, opened in 1874, and the remaining eight to the "East Side," which was added in 1894. For the enormous traffic that it handles daily, Liverpool Street is a remarkably compact terminus; despite its 18 platforms, it covers no more than 16 acres. No less than 1,200 trains are worked in and out of Liverpool Street in every 24 hours, the station having to deal with roughly one-quarter-of-a-million passengers daily. Not even the bigger Waterloo can equal such figures as these, which are a record for a British terminus.

To see the stream of business passengers pouring into Liverpool Street in the mornings is one of the sights of London. By the time of our arrival in the evening the outward-bound stream has dwindled, by comparison, to a mere trickle. An evidence of its extent, when in full flood, is afforded by the fact that 24 steam trains per hour, with a total seating capacity of 20,000, pass out on the down Suburban line *alone* (apart from the trains over the down "Local" and down "Through"

lines) during the "rush" hours.

This is what has been called the "Intensive" train service to Walthamstow, Chingford, Enfield and Palace Gates, and represents by far the densest service of steam trains ever put upon metals in any country. The old Great Eastern always specialised in rapid passenger handling, and was the first railway to introduce suburban coaches seating six passengers a-side. Later on, by a surgical operation of considerable interest, the older five-a-side suburban coaches were cut in halves lengthways, and a strip of new coach was inserted down the centre of each, to bring them up to the new width and seating capacity.

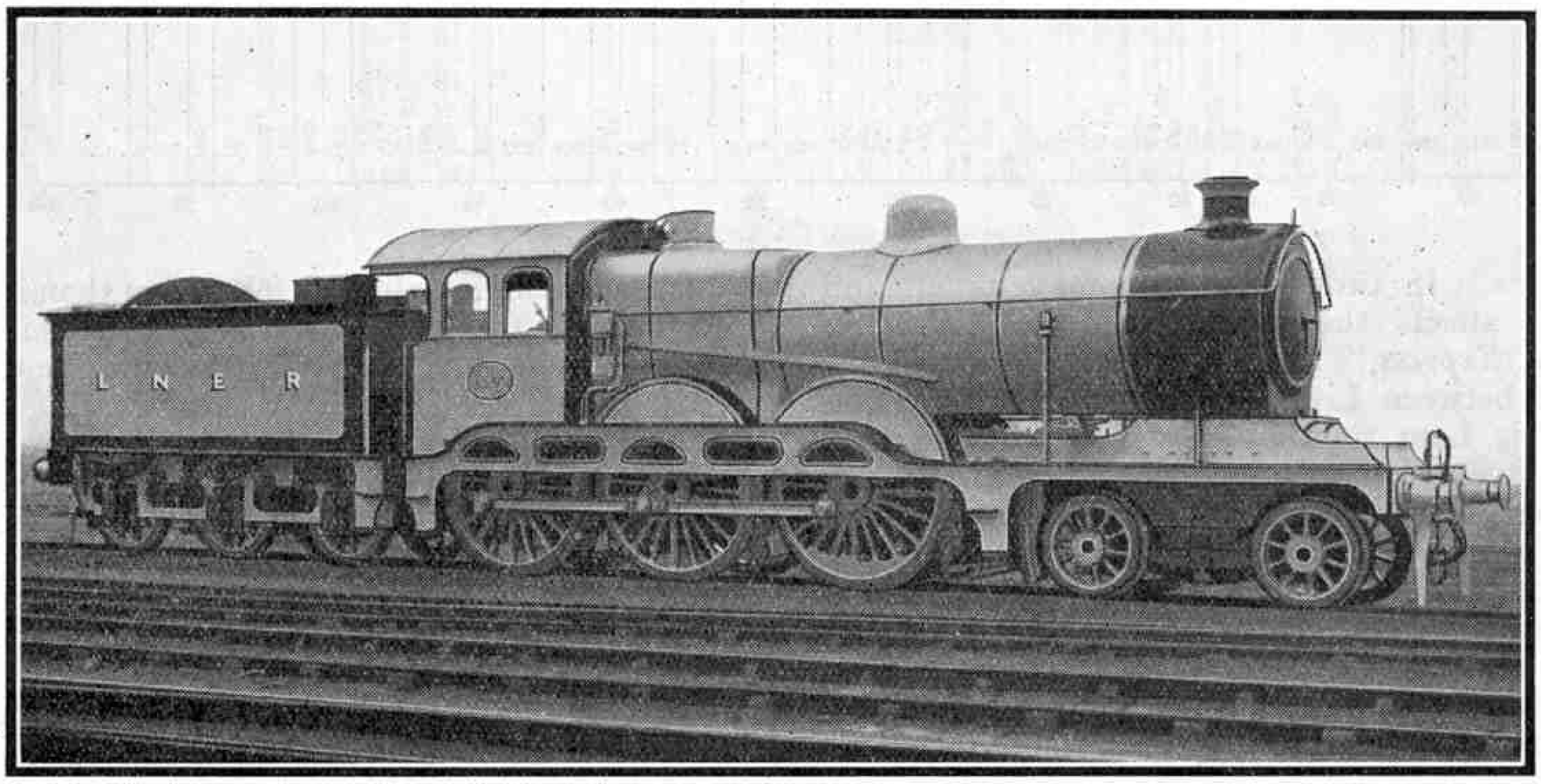


Photo courtesy] [*L.N.E.R.*

L.N.E.R. "1500" Class 4–6–0 Engine used for hauling the "*Hook of Holland*" boat train

But we are straying from the "*Hook of Holland Express*," whose starting time is rapidly approaching. At the back end of the train are a couple of capacious brake-vans; their loading is now nearly complete. Next in order come two beautiful Pullman cars, with their inviting interiors; their inclusion in the train, however, means another 88 tons of "tare" for the locomotive, and all for the seating of, at most, 40 fortunate first-class passengers. Pullman car accommodation therefore means rather over two tons of coach weight to every passenger conveyed.

The main passenger part of the train now begins, and its similarity in appearance to the "*Flying Scotsman*" may make us rub our eyes at first, and wonder whether we have not come to King's Cross by mistake! But this is the new standard for L.N.E.R. main line stock, with the rounded coach-ends and curved roof-ends that give such a handsome and distinctive appearance to a London and North Eastern express. You will notice, too, the automatic central couplers, instead of side buffers and screw couplings. These couplers, which are used universally in America and have been standard on the East Coast Route since 1897, add greatly to the steadiness of the train when running, and are a valuable safeguard against telescoping in the unlikely event of a derailment.

A considerable addition was made to the weight of the "*Hook of Holland Express*" when these luxurious coaches were introduced. Previously the ordinary Great Eastern corridor coaches weighed about 27 tons apiece; these cars weigh 32 and 33 tons, and the dining cars even more. The probable formation of the train will be two first-class corridor coaches, then an open first-class dining car, a combined first-class "diner" and kitchen, an open second-class dining car, two second-class corridor coaches, and a second-class brake coach in front. With the two Pullmans and the two rear brakes, we therefore have 12 vehicles, all 8-wheelers except the Pullmans, which are 12-wheelers. This makes a total empty coach weight behind the engine tender of just over 400 tons, and with a normal complement of passengers and luggage the driver may expect to have some 430 tons in all to haul, or 470 tons with his tender.

And now here we are at the engine. It looks quite deceptively large, but if you study the side elevation carefully, you will see that this is chiefly due to the exceptional size of the driver's cab, which is, without question, the most capacious and comfortable express locomotive cab in the country. The old Great Eastern Railway, from the introduction of the 4–4–0 engine "*Claud Hamilton*" in 1900, has always taken a lead in looking after the comfort of its locomotive crews. This fine cab, with its big side-windows and roof extending well back over the front of the tender, is an object-lesson in what can be done; its only possible objection is the distance that the fireman has to traverse his coal from the tender across to the fire-hole door.

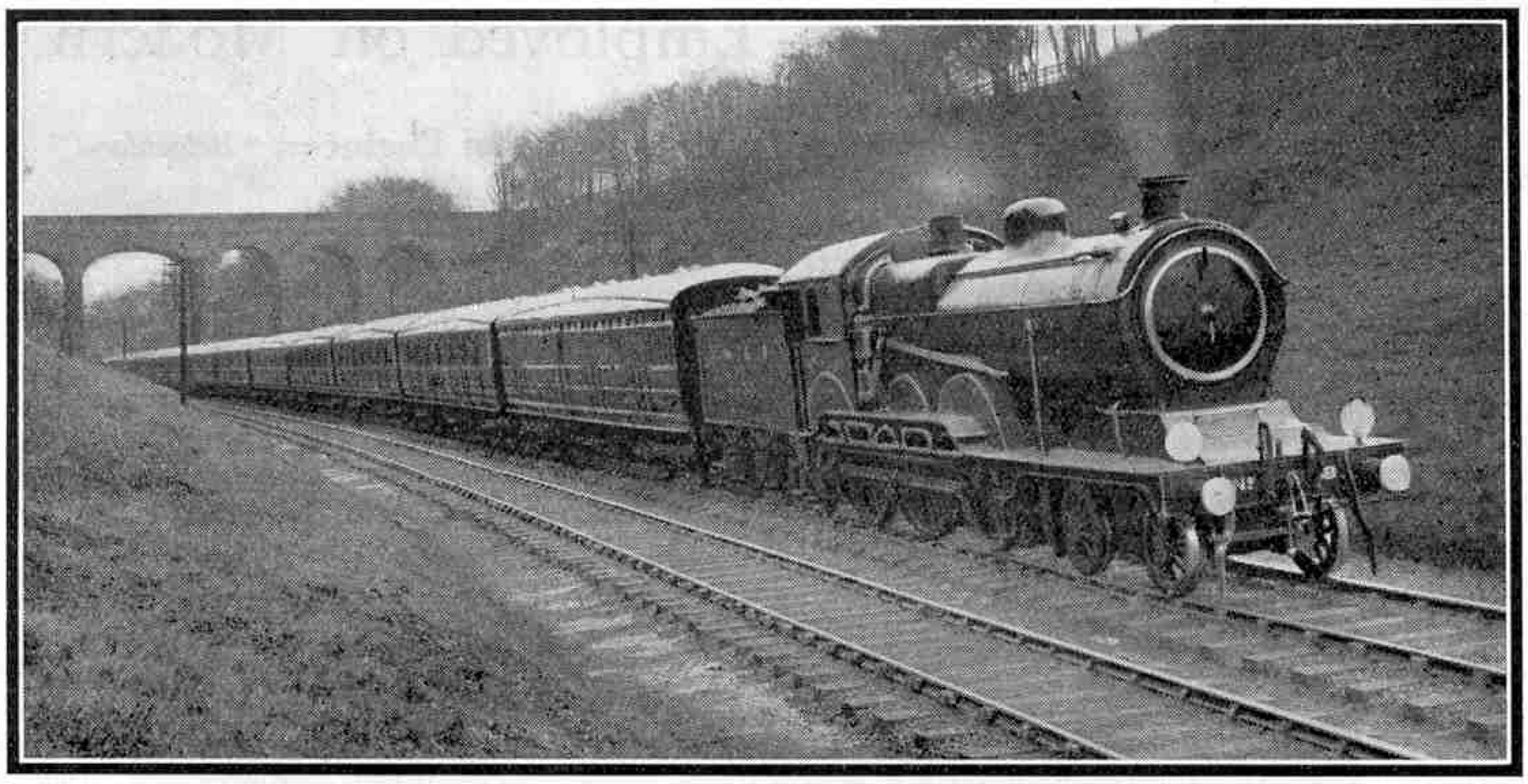
But as regards the engine itself, the boiler-barrel is only 5 ft. 1 in. in diameter and 12 ft. 6 in. in length, which are comparatively small dimensions for a present-day 4–6–0 locomotive. These engines probably owe their successful steaming to a firebox of generous dimensions; it is of the Belpaire type, with a firegrate affording 26½ sq. ft. of area. On a journey of this kind it is impossible to scrutinise coal consumption too narrowly. Quite possibly the engine may burn 60 lb. of coal a mile on the way down and she will almost certainly be "thrashed" in some degree in order to keep time. But the run is soon over, and a little thrashing on this short run is cheaper than the provision of a "pilot," or assisting

Leading Dimensions of 4-6-0 Locomotives, "1500" class, Great Eastern Section, L.N.E.R.

Cylinders, Diameter	...20 in.
,, Stroke	...28 ,,
Driving Wheels, Diameter	6 ft. 6 in.
Heating Surface, Fire Tubes ...	1,123 sq. ft.
,, ,, Flue ,, ...	366 ,,
,, ,, Firebox	144 ,,
,, ,, Superheater ...	286 ,,
,, ,, Total	1,919 ,,
Firegrate Area	26½ ,,
Working Steam Pressure ...	180 lb. per sq. in.
Tractive Effort at 85% Wkg. Pressure	22,000 lb.
Water Capacity of Tender	3,700 gals.
Coal ,, ,, ...	4 tons
Adhesion Weight of Engine ...	44 ,,
Total ,, ,, (in working order)	64 ,,
,, ,, of Engine and Tender (full)	103¼ tons
Length of Engine and Tender (over buffers)	57 ft. 7 in.

engine, for which I am sure that those enthusiastic engine-crews at Parkeston would scorn to ask, no matter what was the load behind them.

The big suspended clock in the middle of Liverpool Street Station is now on the stroke of 8.30, and we must hurriedly get in. We will ensconce ourselves in the front coach, as the voice of our steed in "full cry" is one of the thrills of this journey that must not be missed. Steam is already blowing-off hard from the safety-valves when the signal is given to start, as one of the hardest pulls we have to encounter begins but a brief three-quarters-of-a-mile out of the terminus. Regulator wide open and 50 per cent. cut-off or more will be the order of the day, at least until we have surmounted the ½-mile at 1 in 70 up to Bethnal Green Junction, and the vocal efforts of the locomotive will be proportionately loud.



Courtesy] "*Hook of Holland Express*" on Brentwood Bank [*L.N.E.R.*

From Bethnal Green the gradients are slightly in the engine's favour as far as Stratford, but the drastic speed reduction over the curve through the platform loses us much of the momentum we have gained by attaining 50 an hour or so as we swung round Bryant and May's great match factory at Bow on to the straight. The mile from here to Stratford is one of the busiest on the system; it has six, and for part of the distance eight parallel lines, spanned by a whole succession of complicated signal gantries, and if we get through without a signal check we shall be lucky.

The section between Bow Junction and Stratford is, indeed, one of the worst obstacles to the electrification of the Great Eastern suburban lines of the L.N.E.R. All the trains from the Fenchurch Street direction, getting across to the slow lines, have to cross the main lines "on the flat," and to get any value out of electrification by the provision of more frequent train services would certainly entail the provision of "flying" junctions here, at a cost which alone would run into millions sterling of money. Such facts as this are often forgotten by those who imagine that electrification is a comparatively simple matter.

But by now we are gathering speed again. It is obvious from the continuous roar of the exhaust, as we dash past one after another of the string of suburban stations, that the engine is still being worked hard, probably at about 40 per cent. cut-off, and with regulator partly open. Actually the times allowed in the working time-table for this express to pass Stratford, Chadwell Heath and Shenfield are "tight" almost to the verge of impossibility, with such a load. For the four miles to Stratford the booking is eight minutes; then the next six miles to Chadwell Heath, up faintly rising grades all the way, and including the recovery from the slack through Stratford, are only allowed seven minutes, representing an average speed of 51.4 miles an hour. Still worse, the 10¼ miles from Chadwell Heath to Shenfield, which includes the gruelling rise of three miles up Brentwood Bank, are allowed no more than 13 minutes, at an average rate of 47.3 miles per hour. If it is a fine night and we get a perfectly clear road we may just do it—by a prodigious effort that will awaken the echoes far and wide over the countryside—but quite possibly we may be a minute or so "down" through Shenfield.

This is one of the fortunate nights, and when at last we have threaded our way up to the deep cutting past Brentwood, with regulator fully open and very likely quite 60 per cent. cut-off, under the handsome "Seven-Arch Bridge" to the signal box at Ingrave, which marks the summit of our practically unbroken climb from Stratford, we have just the 1¼ minutes left in which to breast Shenfield at the scheduled time of 8.58 p.m.

At last our driver breathes more freely; once past Shenfield Junction we are well out of the London suburban area, and may expect a clear road now for the rest of the way. The fireman, whose efforts have been unceasing up to this point, probably snatches a moment's rest. But their is little rest for the engine; cut-off has now been brought back to 30 per cent. or so, and the regulator has been moved to about half-open, but this is still "going some." We are accelerating rapidly, and on the 9½ miles from Shenfield to the county town of Chelmsford, only allowed 10 minutes, we shall very likely just cross the "seventy" line before we slow down for Chelmsford curve.

Away we go again, noting on the left of us—if it is still light—the two great wireless masts of the Marconi Company's works, from which the earliest British high-power broadcasts were sent out, before the erection of the present Daventry station. The rising grade up which we have to recover speed is fortunately but short, as for the next 22 miles to Colchester the time-table only concedes 23 minutes to our hard-worked steed, and the actual time taken is not infrequently less than 22 minutes if the train has been late past Shenfield.

The short down-grade to Witham Junction gives a slight fillip to the speed, bringing us up to 66 or 67 an hour, and the rise from Kelvedon through the Essex fruit orchards up to Hill House signal-box means a drop in speed again to between 50 and 55 m.p.h. Thence we hurry over sharp undulations until we (*Continued on page* 526)



"Manning the Ship"

Only Experts are Employed on Modern Liners

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

This is the third of a series of talks, originally broadcast from the "Belgenland" when in the Bay of Bengal last year, and printed here by courtesy of the Editor of "The Ocean Ferry."

The "Belgenland" is the largest vessel to complete the round voyage of the world. She made the trip in 132 *days, at a leisurely pace to permit her passengers time to travel in ourteen different countries and to visit* 60 *cities!*—EDITOR.

* * * * * *

OVER 600 men, officers and crew, make up the "*Belgenland's*" ship's company under the command of the captain, whose legal title is the master of the vessel, and to whose authority all on board must defer, his lawful commands being obeyed by all, while the ship is at sea or in a foreign port. He represents at all times, both the owners of the vessel, and the government of the country under whose flag and protection the vessel sails, and his decision upon all matters at sea is final.

It is a great responsibility, and one with which no man is entrusted until his competence as a seaman and a navigator, his abilities as an executive, his behaviour in emergencies, and above all, his character have been tested. Such a test lasts through long years of experience, and he has often to wait long periods before he can consider himself to have been proved worthy of the trust reposed in him by the owners of the vessel.

In this connection it may be stated that in such a shipping company as the International Mercantile Marine the senior officers of all departments, while rising from the junior ranks, have also been well tested in regard to their competence and character before promotion comes to them.



The "Old Man" takes the Sun

The skill and authority of a modern liner's personnel is embodied in the master, or the "Old Man," as he is called in common seagoing parlance. On him rests not only the responsibility of navigating the ship, but also for the management of an intricate business organisation afloat, with a staff of more than 600 people

Under the master, the complement is divided into three departments:—the navigating, or deck; the engine, or technical; and the passenger, or victualling.

Then in addition there are the pursers, the officers who take charge of the financial and commercial matters, and also of the social or entertainment functions. On the "*Belgenland*" the pursers have a staff of seven assistants to carry on the routine duties of their office.

There are also two surgeons, and two trained nurses with a hospital attendant to look after health of the passengers and crew. This, of course, also refers to the "*Belgenland,*" as do all the following particulars. Other vessels have similar arrangements, differing only in detail according to the size of the vessel, organisation, etc.

In the navigating department, there are about seventy men, of whom seven rank as officers. The executive chief officer keeps no watch, but is held jointly responsible with the master for the safe and proper navigation of the vessel, and for the discipline generally, and cleanliness of his department.

All such matters as the condition of the lifeboats, of the rigging, and of the cargo holds, and the distribution of fresh water, come under his care. The other six deck officers, three of whom are seniors, responsible for their watches, are divided into three watches of four hours each on duty. The junior officers are also four hours on duty, and relieve each other at the middle of the senior officer's watch, so that there is a new officer on watch on the bridge every two hours—a wise precaution, especially in heavy weather.

Stationed with the officers on the bridge are three

quartermasters, who take turns of two hours each in steering the ship. They are selected from among the most capable sailors, and are rated as petty officers. There are two chief petty officers who take alternate watches, acting as master-at-arms and patrolling the ship, reporting to the bridge at appointed times.

The routine work, such as washing down, keeping decks and rigging in good order, etc., is carried out by sailors under the boatswain or his two mates, under the directions of the executive or watch officers.

There are six look-out men, all of whom are tested for colour-blindness. They are stationed on duty in the crow's-nest on the foremast, or at the bow, and are changed every two hours.

There are three wireless operators, who are on duty for four hours alternately. Their technical skill, and untiring efforts in overcoming adverse atmospheric conditions enables a vessel to keep almost, if not altogether, in daily touch with current events, even though the ship may be on a "round-the-world" cruise. Their contribution to the success of such a cruise, in clearly communicating the latest arrangements and requirements between the ship and the shore, is no small one.

The carpenter and his mate attend to the upkeep of the woodwork about the deck and in the holds. They look after the fresh water and sound the ship. Sounding consists of testing twice a day every compartment in the bottom of the ship to see how much water is in it. They also keep all the lifeboat gear oiled and in good condition.

While there are a few other special jobs, most of the remainder of the deck department crew are sailors who carry on the work as directed by the officers or boatswains.

All the navigating officers are thoroughly trained seamen, having served a five years' apprenticeship, and followed the sea from their early youth. Each holds a master mariner's certificate of competency from the Government, so that they are qualified to take command of the ship, if necessary, in so far as the Government requirements are concerned.

The senior navigating officer, before leaving the bridge at the change of the watch, passes over to the officer relieving him, the direction of the course on which the ship is steering, the position of the ship by the latest observation, any news about weather or other matters received by wireless. He also informs him which ports or doors are open on the side of the ship, gives him the orders from the captain, or other information about the navigation or safety of the ship.

In the engine department there are one hundred and four men, with the chief engineer at the head. All engineers rank as officers. The total ranking as engineers is thirty-eight.

The senior second engineer keeps no watch, and takes executive control of the department. The performance of the machinery generally largely depends upon his competency, care and watchfulness.

The next three ranking engineers are engineers in charge of the watches, and each of them has six engineers in charge of the engine-room or boiler-rooms, and an electrician on watch in the dynamo-room. There are five electricians, of whom three keep watches of four hours each, while the chief electrician supervises his department, and has one electrician to assist him in the work of upkeep and repair to his machinery at sea and all ventilating and heating arrangements are under his care.

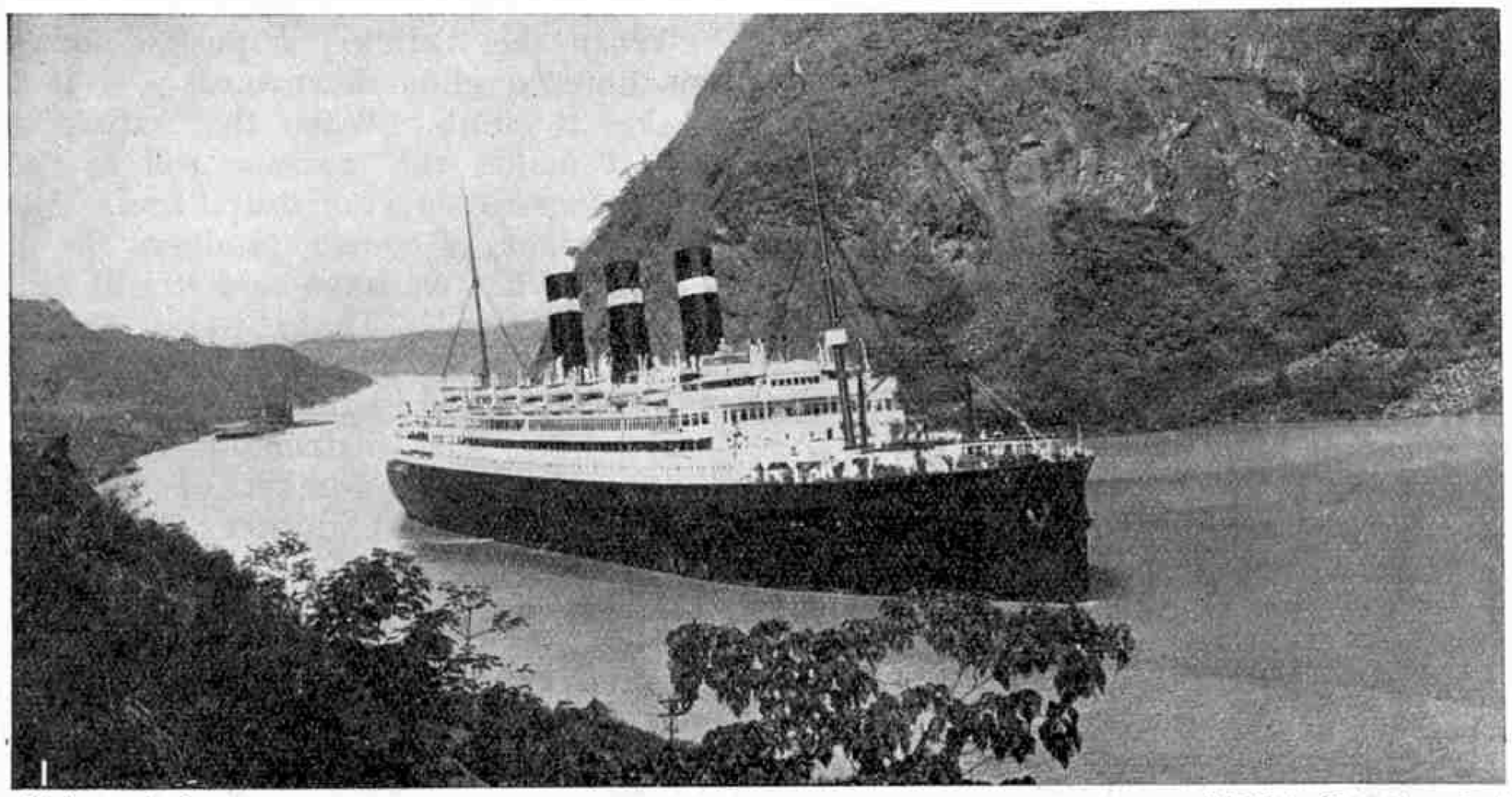


Photo courtesy] ["*White Star Magazine*"

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

He is in charge also of the technical side of the broadcast system, and microphone transmitters through which the orchestral music, lectures, and other information is conveyed to the different parts of the ship. Incidentally, the lighting effects for the theatrical and vaudeville entertainments were designed and the apparatus was constructed by the ship's electrical staff.

There are engineers in charge of the refrigerating plant, the Diesel engine, motor-boat engines, deck machinery, and on day duty on overhauling and upkeep work on auxiliary machinery. There are three sanitary engineers in charge of all apparatus for this purpose. They are responsible for carrying out necessary repairs at sea.

All the engineers, electricians and joiners are trained mechanics, having served an apprenticeship of at least five years to their trades in the workshops, and many of the staff have taken courses in the technical colleges. I may add that twelve of the engineers hold first-class certificates of competency, the Government qualification required to act as chief engineer of any ship afloat, and several have second-class certificates.

The remainder of the complement of the engine department consists of a writer, who attends to the clerical work; two storekeepers, twenty-three greasers or oilers, on watches of four hours each. A similar watch is done by the eighteen burner attendants and twelve cleaners in the stokehold, who replace the firemen and trimmers of our coal-burning days. The combustion, proper mixture of atomized oil and air, is regulated by the engineers.

There are also six messroom stewards to look after the engineers' quarters, and two messmen look after the meals for the engine-room crew.

Learning to Fly

Impressions and Sensations of a Beginner

By John Leigh

FLYING an aeroplane is not like any other method of locomotion. It is nearest, perhaps, to sailing a yacht or riding a horse. Although in an aeroplane there are certain levers the purpose of which we shall describe presently, these have not the same precision as, for instance, the steering wheel of a motor-car. To make driving a car comparable with flying an aeroplane you would have to make a tremendous amount of play in the steering gear, flatten all the tyres, and drive at sixty miles an hour on a wet and very slippery surface!

Fortunately, when you are up in the air you have plenty of room, and you could not hit anything if you wanted. That is why flying is really so safe!

The pilot of an aeroplane has three dimensions to deal with instead of the motorist's one. This gives him more to think about at the beginning of his flying career but, strange as it may sound, the controls in the 'plane are much simpler than those of even the smallest car.

The Controls

The controls in the de Havilland "Moth" and the Avro "Gosport" are typical of all the small commercial machines. They are (1) The "Stick," or "Standard"; (2) the Rudder Bar, and (3) the Throttle Lever. That is all.

The "Stick" stands up in the centre of the cockpit, with a handle or grip conveniently situated for the hands of the pilot. The rudder bar is fixed low down in the front of the cockpit so that the pilot can rest both of his feet upon it. The throttle lever is fixed to the side of the cockpit close to the pilot's left hand.

The action of the rudder bar is very simple. It is pivoted at its centre and connected to the rudder by a tight wire at each end. The pilot rests his feet at the extremities and pushes with his left foot to turn the plane to the left.

The "stick" is not quite so simple. It does two things. First, it operates the ailerons. These are hinged flaps at the trailing edges of the wings, and they are controlled so that as one goes up the other goes down. Second, the "stick" controls the elevator, which is the hinged rear portion of the tail plane.

When the "stick" is moved sideways it moves the ailerons only, the elevator is not affected. When, on the other hand, the "stick" is moved backward and forward, it acts solely upon the elevator. If it is moved diagonally it acts upon ailerons and elevator simultaneously.

Perhaps all this sounds rather complicated. In practice it is not, as we shall now see. The effect of the controls when the machine is flying is as follows.

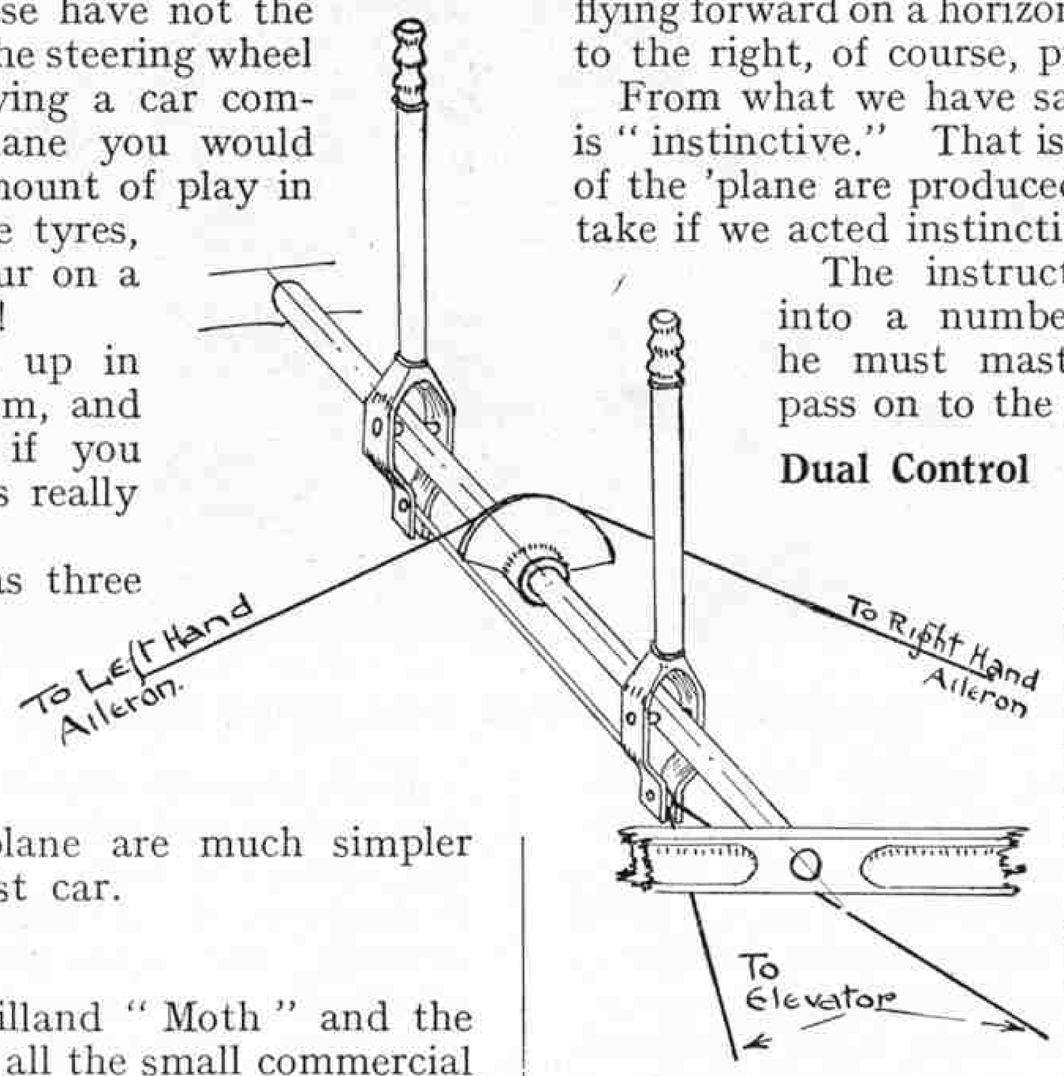
When the "stick" is pushed forward it causes the machine to glide downwards; if it is pulled back it makes it climb. When the "stick" is moved to the left it makes the machine roll to the left, while still flying forward on a horizontal keel. Moving the "stick" to the right, of course, produces the opposite effect.

From what we have said it will be seen that control is "instinctive." That is to say, the various movements of the 'plane are produced by actions such as we should take if we acted instinctively.

The instruction of the pupil is divided into a number of progressive stages, and he must master each one before he may pass on to the next.

Dual Control

Learning to fly was enormously simplified by the invention of "dual control." Standard training machines have two cockpits, one behind the other, and each cockpit is furnished with all three controls. The two sets work together so that the 'plane may be controlled from either cockpit. The manner in which the "sticks" are made to follow each other is shown diagrammatically in the accompanying sketch.



Having had all these principles explained to us, let us imagine that we are now commencing our practical instruction. The pilot-instructor always sits in front and talks to the pupil through a speaking tube.

First of all we shall "taxi" about on the ground in order to get accustomed to the working of the controls. Then we shall have at least an hour's joy riding in about three separate "flips." During the last one the pilot will playfully "stall-turn" or "nose-dive" us just to see how we like it! After this preliminary business we feel more at home in the 'plane and in the air, so that we can give our undivided attention to what the instructor has to say.

The First Lesson

He will now take us up to about a 1,000 ft. and demonstrate the action of each control separately, and ask us to copy him. This is soon done with, as the previous instruction has acquainted us with the purpose of the controls. So we at once commence to practise. The instructor puts the 'plane on a straight course and we learn how to fly straight and level by aiming at some mark on the horizon. The beginner makes most of his own difficulties during this by moving the controls too much to correct slight deviations.

In calm weather a light 'plane will fly straight and level by itself for quite a long time, and when I was at this stage in my training I innocently proved this.

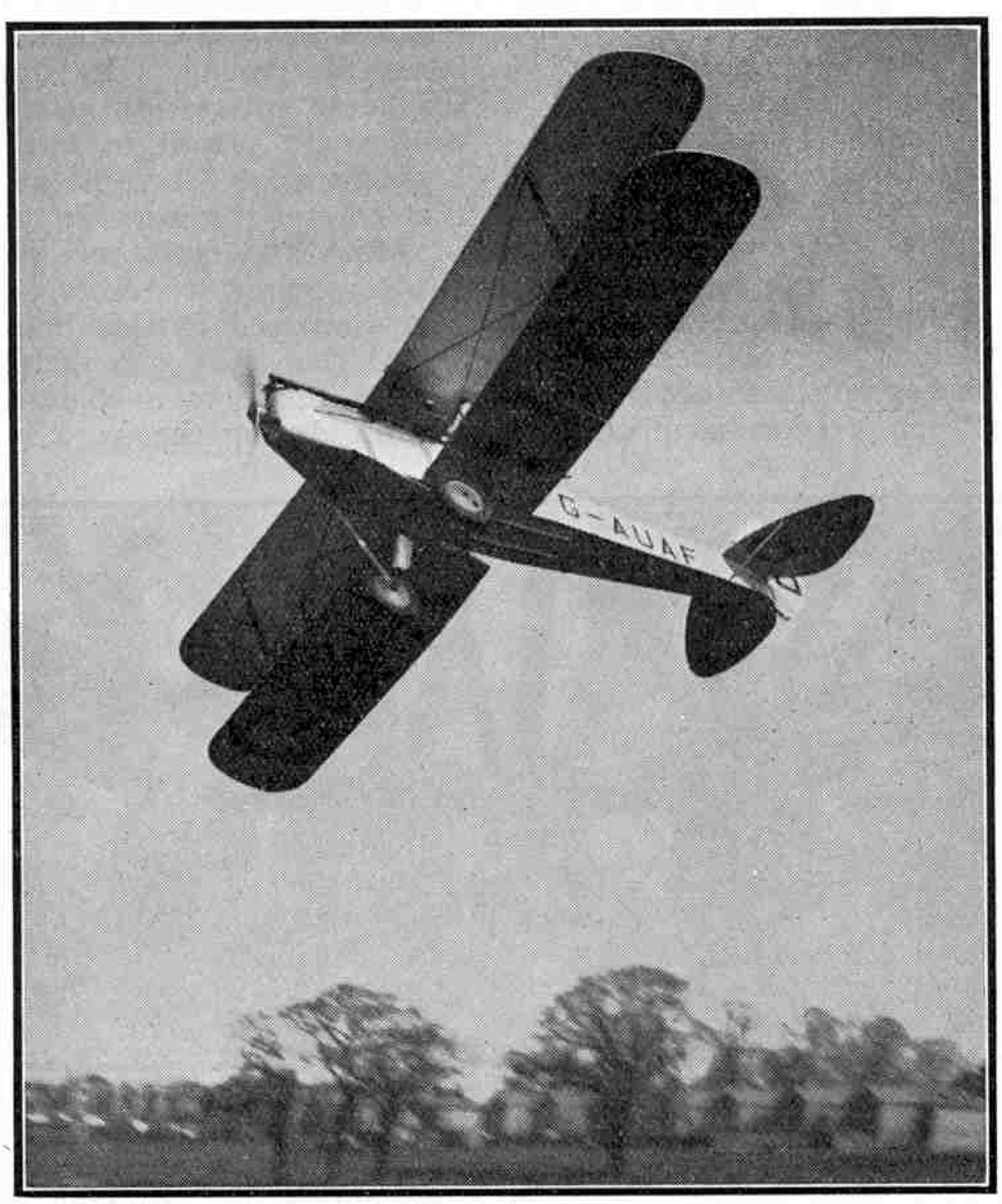
There comes a point when the pilot signals that he is leaving the control entirely to the pupil. I missed the signal and was looking complacently over the side. At the end of the straight course of several miles the pilot said to me, through the tube: "Right ho, I'll take her round now, you did that very well!"

So I passed on to the next stage, which consists of turns. If we were to try to turn in the air by using the rudder alone, the 'plane would slip sideways through centrifugal force. It is necessary, therefore, to put on "bank," taking care not to move the elevator. Proficiency in easy turns comes with practice. Very steep, sharp turns are difficult because the elevator then acts partly as a rudder, and *vice versa*.

Gaining the Air-Sense

Sharp turns are not needed by the beginner, however, and so he soon passes on to the stage of "trickling" about in the air at a constant height in order to gain "air-sense."

We are now quite as proficient to ramble about over the aerodrome as any motorist is to "tootle" about on the roads, but we are yet some distance from acquiring our licence. When the instructor is satisfied that we can handle and hold the 'bus, he will put us on gliding and climbing. Now we must be very careful not to climb so steeply that we lose flying speed and "stall." We suddenly develop a passionate interest in the air-speed dial. On the "Moth" it is unsafe for a beginner to get below 50 miles per hour, and it is not advisable to exceed 90. The instructor drills it into us that we must always put nose down before throttling down, and always push throttle on before pulling out of a glide.



Copyright] ["*Flight*"

The de Havilland "Moth" in flight. Fitted with a 27/60 h.p. "Cirrus" engine, this light aeroplane has a top speed of 90 miles per hour

Our wings, we feel, are by this time beginning to sprout, so we shall now try to kill our instructor and ourselves on "take-offs" and landings. Instructors are wary birds, however, and so far they have frustrated all the attempts of nervous novices. There is no need to get frightened either in rushing along the ground to get up flying speed or in soaring down again. Dual control and the instructor will look after us, so we can concentrate upon mastering the simple rules and gaining the judgment that makes the fine pilot.

"Hitting the Deck"

When we can take-off cleanly and "hit the deck" with a three-point landing, that is, with two wheels and tail-skid together, we practise approaching the aerodrome. The pilot leaves us to it. Good Heavens! is that little thing down there, looking like a lady's handkerchief, the 'drome? But we soon develop accuracy and glide down on to the ground as easily as we steer into the garage.

Occasionally a learner, after going satisfactorily through all the stages of instruction, is attacked by a peculiar stupidity in his landings. One man in this club recently went up for his first solo flight and it seemed as though he simply could not "hit the deck." Four times he tried to land, and each time he either overshot the 'drome or else had to put on his engine again in order to save a stall.

The ground engineer rushed frantically up to the anxious instructor and gasped: "He's only got enough petrol for two hours' flying, sir!"

Fortunately the unlucky member made a perfect landing on his fifth attempt.

Passing Your Test

Before you can get your "A" licence you must pass a fairly easy test. This consists of tracing a figure eight over a mark on the ground, several times. Then you must climb to a height of 6,500 ft. with an instrument called a barograph slung round your neck, and glide down again with your engine throttled back. And let us hope that you are more fortunate than a friend of mine who patiently climbed up to 7,000 ft. at 25 shillings per hour, only to find when he landed that the barograph had stopped registering at 500 ft.!

First Flight "On Your Own"

When you have obtained your "A" licence you will be qualified to take up an aeroplane by yourself for private purposes. You have, of course, already been up "solo" during your test flight so that the sensation of being all alone among the clouds will not be entirely novel. None the less your first pleasure flight "on your own" after you have qualified will be a wonderful experience.

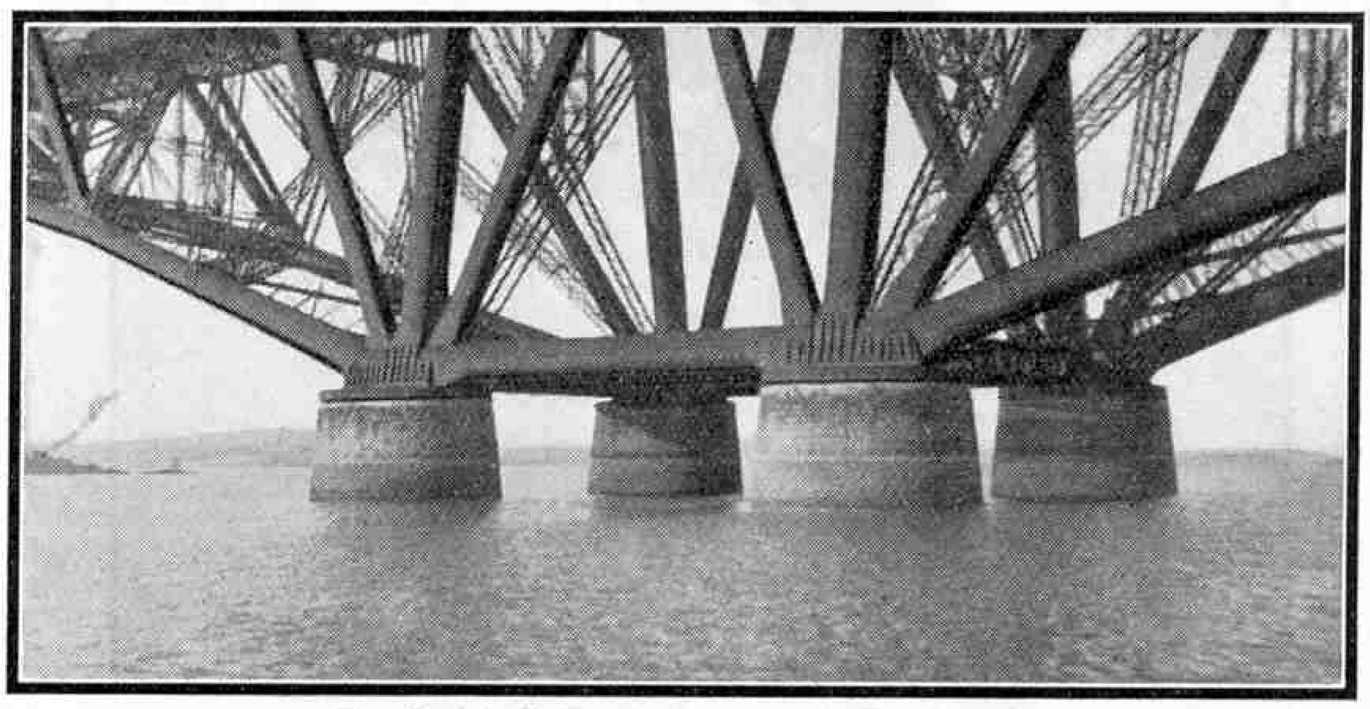
It is advisable that the first few solo flights should be made in good weather. This, of course, does not mean that you should be only a fair weather pilot, but until you have gained a full sense of self reliance it would be folly to risk needlessly your life or at the least a valuable piece of mechanism.

During your first few flights you will enjoy a new charm and exhilaration. You will feel the glow that comes to those who conquer nature and you will taste the peculiar joy of utter detachment from man and mundane things.



Unique View of the Forth Bridge

The accompanying photograph was taken from the deck of a little steamer that makes short pleasure trips from South Queensferry on the river Forth during the summer season. This trip enables one to obtain a unique and impressive photograph of the great bridge. The four massive granite cylinders rest on caissons previously sunk by air pressure to a good bearing on the solid rock. The four columns together form the pier. All the parts in the photograph that are tubes are known to engineers as "compression members," as the forces acting upon them tend to squeeze them up. The spidery-looking parts that seem so light in comparison with the others are the "tension members," the forces acting upon which tend to cause them to lengthen. A few of these members may have to withstand compression at certain times and tension at others. The big connections over each granite base are called "skewbacks" and were very difficult pieces of work to fit together.



The South Queensferry Pier, Forth Bridge

R. D. GAULD (London, S.W.19).

How a Dye-Works is Run

The variety of garments and articles of every description received daily at a Dye-works is very remarkable. Some of these come in for general renovation, including dyeing, while others come for dry-cleaning only.

Let us follow in imagination certain garments sent in for general renovation. First of all the girls in the sorting department separate the dyeing orders from the cleaning orders and enter in a ledger descriptions of the various articles, at the same time giving to each a reference number which is printed on tape and securely sewn on to the article. This reference number, when the various operations are completed, enables the clerks in the despatch office to forward the garments to their respective owners without the possibility of mistakes.

The work then passes to the tacking room, where any rents and tears are mended in order to prevent further damage by fraying during the subsequent processes. Next comes the cleaning stage, in which the clothes are put through an ingenious machine that contains a soapy liquor free from soda. This removes all grease and dirt and leaves the work prepared for dyeing. The dyeing process is, of course, the most interesting part of the proceedings. The clothes are placed in large wooden vats, known as "paddle-boxes" because of the paddle-like attachment that rotates the work in the dye solution. The water in which the necessary quantity of dyestuff for the shade required is dissolved, is heated by steam. The men employed in this branch of the business are so skilled that they can match exactly a piece of cloth or any article to a coloured pattern.

After dyeing the work is rinsed to remove surplus dye from the fabric and "hydroed" in a machine called a hydro-extractor, which removes all excess of water by centrifugal force. The articles are now hung in the drying rooms or stoves until quite dry and are then transferred to the finishing department where girls press out the heavy cloths and tweeds with machines called "Hoffman" presses. The lighter fabrics such as silks and satins are pressed by hand ironers. The work now enters the packing and despatch department where girls skilled in the folding of different classes of work pack the articles into boxes and send them by post, rail or road to their various destinations.

If garments are not to be dyed but merely dry-cleaned they pass through the sorting and tacking departments and then go to the dry-cleaning section known as the benzine house. This is a building made thoroughly fire-proof on account of the highly inflammable nature of the cleaning liquid. The clothes are put into machines fitted with revolving wooden drums. The benzine is then run into the machines and the drums are revolved for a sufficient length of time to remove from the material all dirt and grease. The garments are then hydro-extracted, dried and finished in a similar manner to the dyed garments already described. A. J. E. Moss (Dublin).

A Chat on the Footplate

A short time ago, while wandering about Liverpool Street Station, I was fortunate enough to come across a friendly driver who invited me to come up on to the footplate of his 4–4–0 engine. My driver friend pointed out to me the various controls, gauges, etc., and explained their working. The only gauges illuminated were the

pressure and the water gauges, which were illuminated by oil lamps shielded from the eyes of the driver and the fireman. The driver told me that he liked to have as little light as possible in the cab in order to enable him to observe his signals better. I noticed how conveniently placed were all the main controls, and I was specially impressed by the roominess and comparative comfort of the cab, the roof of which covered the entire footplate. There were the usual glass windows in front and two windows on each side that could be raised or lowered as desired.

I asked the driver what the conditions were like on a very hot day and he replied that the heat in the cab was often so oppressive that they were glad of the opportunity to lean out of the windows. On the other hand, in cold weather they were hot below the waist, but above they were almost frozen owing to the numerous draughts.

At that moment two engines came into the station hauling a heavy train and the first engine was making a tremendous noise and slipping badly. The driver said that the engine behind had still got its brakes on, probably because there was not sufficient air to release them.

W. HARBORD (Normandy, Nr. Guildford).

A Visit to Crewe Works

A short time ago I had the good fortune to be one of a party that visited the L.M.S. works at Crewe.

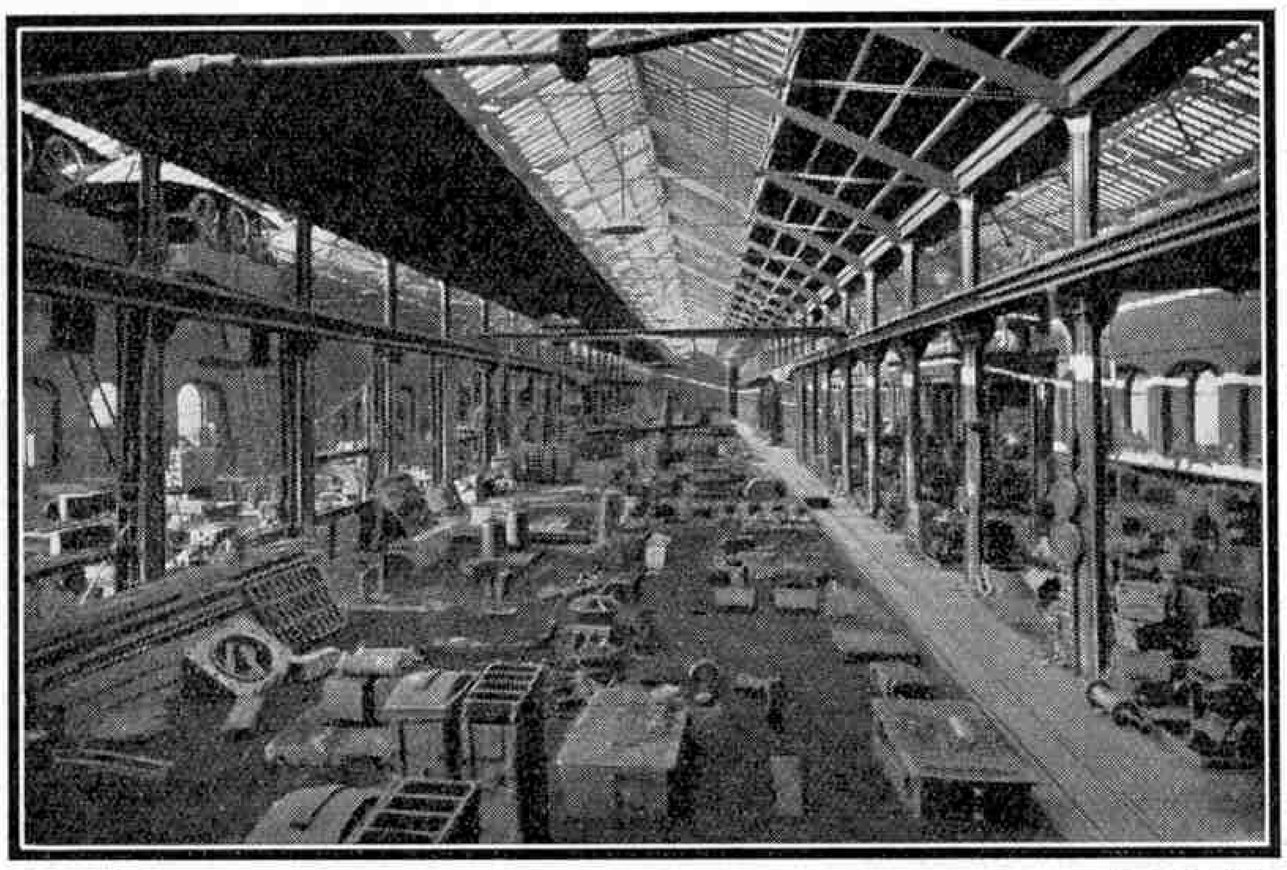
First we inspected the carpentry workshop, where circular saws were cutting through wood as though it had been so much cheese! Later we saw a machine of wonderful design that sharpened each side of the teeth of these saws. Next we went to the chain-making shop and saw links being forged and chains tested. Passing on to an engineering shop we saw rails being planed by automatic planes to make points. The rails were first fastened together and then planed down to make the "frog" of the points. We were greatly impressed by the pig-iron furnaces, which are supplied with the materials they require by a magnetic crane. A stoker lent me his dark spectacles and opened the door of a furnace, disclosing a blinding sea of molten iron.

In the rail shop a red-hot block of iron was placed between two grooved rollers and rolled backward and forward, becoming longer and narrower until at last it was the shape of a rail. It was then passed along on rollers to a sawing machine which, with a whir and a shower of sparks, cut it into the required length.

Next came the boiler shop with its deafening roar of riveters at work. Everywhere men were fixing rivets into place in boilers and in metal plates, and it gave one a headache to stay there long. We were glad to leave its din and go to the quieter assembly and repair shops. Numerous engines were there in various stages of repair or completion, while above them overhead cranes carried parts, covered as a rule with mystic chalk marks. There was also a huge lathe which, its proud "boss" told us, was the largest of its kind in the world.

Subsequently we passed on to the foundry and were shown moulds being made and filled. They were formed of wet sand and were made by pressing down a wooden cover. Men walked through clouds of steam, wheeling buckets of molten iron as unconcernedly as we might trundle a wheel-barrow! We then passed on to the forge where great drop-hammers, hydraulic and steam, shook the ground. Finally we visited the two power-houses that generate the electric current that is used to such a great extent throughout the works.

P. N. BARNARD (Prestwich).



Courtesy [*L.M.S. Rly.*

The Foundry, Crewe Works

Falls of Clyde Harnessed

The great hydro-electric developments at Kinlochleven have been referred to on several occasions in the "*M.M.*" and probably readers will be interested to know that the Falls of Clyde are now being harnessed successfully to supply power to a considerable area in South Lanarkshire.

In the four miles of its course above Lanark the Clyde descends from 500 ft. to 200 ft. and forms the four celebrated falls of Clyde, Bonnington, Corra, Dundaff and Stonebyres. At Bonnington the river makes a spectacular double fall and then rushes for about half a mile through a chasm between perpendicular cliffs some 70 ft. in height, amidst picturesque and imposing scenery, until at Corra it falls into a deep pool from a height of 84 ft. Just above the falls at Tulliford a weir of special design has been constructed. It consists of three automatic tilting gates carried on knife-edged pivots. Each gate is 38 ft. in width and is provided with floating counterweights arranged so as to maintain automatically a constant water level in the river. Any increase in level due to floods depresses the gates by a corresponding amount, thus allowing the excess water to flow away until the river is restored to its normal height. The tilting gates then return to their previous position.

The water trapped by the weir is diverted through an underground aqueduct 10 ft. in diameter. This aqueduct finishes in a surge tank, from which two steel pipe lines 6 ft. 6 in. in diameter conduct the water to the power station, Bonnington, near the Corra Falls. After passing through turbines the water is returned to the river which continues its course to the Stonebyres Falls where a second power station is situated. By means of transmission lines the new stations are linked up with the existing power plant at Motherwell, and as a result Lanark will become the centre for the distribution of electrical energy for the development of the Douglas coalfields.

W. LING (Feniscowles, Blackburn).

Famous Trains—(*continued from page* 519)

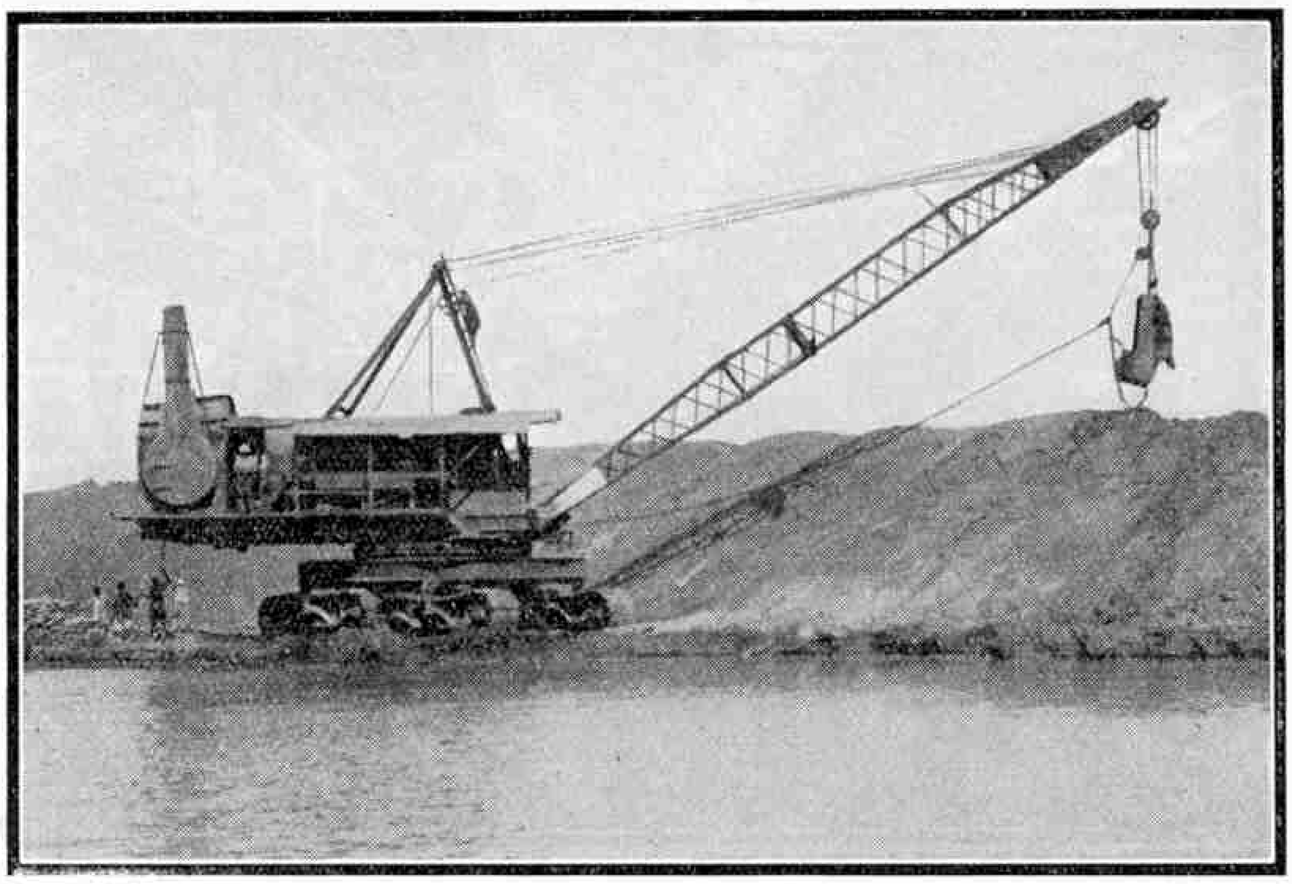
get on to the steepish descent to Colchester, which may produce another "seventy" as we fly over Lexden Viaduct, with the town of Colchester crowning the high ground on our right. On go the brakes again, for Colchester Station is sharply curved; and now we have to recover up a nasty little rise to Parson's Heath signal-box. Then, once through Ardleigh, comes the steepest descent of the whole journey, down to Manningtree. Were we continuing along the main line to Ipswich, the driver might forget his troubles and "let her go"; but we shall not have risen much above 60 miles an hour when the brakes go grinding on hard again, as we have now to slacken very severely to 20 miles an hour, in order to take the curve on to the Harwich branch.

Yet once again the engine has a steep incline up which to recover speed, and mostly rising grades on to Wrabness; indeed, this last stretch of 9½ miles, only allowed 12 minutes from a 20-miles-an-hour slack to the dead stop at Parkeston Quay, is perhaps the most difficult stage of the whole journey. If half-a-minute, or possibly a minute, has been "snatched" off the booking of 42 minutes for 39¼ miles from Shenfield to Manningtree—little enough, in all conscience, with the Chelmsford and Colchester slacks—it will prove more than useful now.

Once past Wrabness, all the difficulties of the journey are at an end. The fireman is now beginning to rake out the fire that he has been maintaining with such strenuous efforts throughout the journey, in order that there may not be too much when the engine reaches the shed for the night. It is growing dusk, and all the myriad lights of Parkeston Quay bear into view as we swing round the wide curve—doing just about a mile-a-minute—leading to the Quay Station. Brakes go on again, but for the last time, and punctually to the minute, at 9.52 p.m. we draw up at the long platform.

No time is to be wasted here, as the Antwerp train is due in 10 minutes behind us, and before that our passengers must be off the platform. A shunting engine has whisked off the two vans at the rear and taken them round on to the Quay itself, opposite the Hook of Holland steamer, and our engine and train have moved off to the carriage sidings. There is just time to hurry up to the engine and give our warmest congratulations to driver and fireman. We could tour the country without noting anywhere a finer feat of locomotive handling than we have witnessed to-night, and as we see our foreign visitors step on board, we realise that our engine crew have at least done their best, in a very literal way, to "speed the parting guest."

At Work in the Sudan



An interesting photograph (sent by one of our readers, Mr. C. Rue, who is engaged on the Canal Extension work) showing one of the big American drag line steam navvys that are operating in the Sudan on the extension of the Gizira Canal

Revolution in Gear Changing—(*cont. from p.* 514)

connection with the manufacture of cement, paper, electric cables, cotton, etc.

Apart from motor-cars and motor-cycles and other forms of transport, immediate applications are in view for the gear in various branches of the textile industry; in the woodworking, gas-making and rubber industries; in connection with conveyors, lifts and winches; for the driving of machine tools and in printing, die-finishing, embossing, linoleum manufacture, general textiles, etc.

In each of these industries the gear has numerous subsidiary applications. In the textile industry, for instance, it may be employed in connection with machinery for scouring and bleaching, mercerising, dyeing, tentering, singeing, and cloth wrapping—indeed the gear may be used to advantage in almost every section of every trade in which machinery is used.

The Story of Imperial Airways

Imperial Airways Ltd. have just issued an exceedingly interesting account of their activities in the form of a booklet entitled "*The Air Way*." This booklet deals briefly with the early days of commercial flying in this country and passes on to trace the history of the principal operating companies responsible for opening up the air routes between Great Britain and the Continent, culminating in their fusion into one great State-aided enterprise—Imperial Airways Ltd.

The recent history of Imperial Airways is too well known to our readers to require repetition here, but it is of interest to learn that during the first two years of the company's operations, from April, 1924 to May, 1926, their machines flew 1,830,465 miles over the Continental routes, carrying 26,379 passengers and 1,596 tons of general merchandise.

The booklet describes in detail one of the great air liners of to-day and also describes and illustrates a flight from Croydon to Paris, and various trips to Switzerland, Brussels, Cologne and Amsterdam. A special chapter is devoted to the wonderfully efficient system that has been built up to ensure safety. Not only are the most elaborate precautions taken to make certain that the machines are mechanically perfect, but in addition, from the moment that a machine leaves the ground until it arrives at its destination it is followed mile by mile on a chart by experts who are constantly in touch with the pilot, advising him as to weather conditions ahead and guiding him continually when visibility is poor. "Safety in the Air" may be said to be the slogan of Imperial Airways.

This booklet has been prepared specially to be supplied to passengers on the company's machines but as a special concession to the "*M.M.*" Imperial Airways Ltd., Air Port of London, Croydon, will present a copy to any reader who applies, mentioning the "*M.M.*" and enclosing a 1½d. stamp for postage.

Interesting L.N.E.R. Booklets

In continuance of their enterprising publicity policy, the L.N.E.R. have published an ingenious form of guide-book entitled "*On Either Side*," describing the scenery and the principal objects of interest to be seen from the main line between London and Edinburgh, Edinburgh and Inverness via both Aberdeen and Dunkeld, and Edinburgh, Fort William and Mallaig.

The traveller is asked to imagine himself seated facing north with the guide-book open as he leaves King's Cross. In the centre of each page is a broad red line marking the track as it runs north, and on this the principal places of interest passed are described and illustrated. It is thus possible for the traveller to observe both sides of the line with the certainty that he will miss nothing of interest, as he otherwise would be liable to do.

Another interesting booklet issued by the L.N.E.R. gives details of some 550 camping sites in various parts of the country with sufficient details in each case to enable a good idea of the nature of the site to be obtained. The booklet gives also particulars of the liberal concessions granted to camping parties.

The above-mentioned booklets may be obtained free of charge at any L.N.E.R. Enquiry Office or from the Passenger Manager, Liverpool Street Station, London, E.C.2.

A Tragedy of the Khyber Pass—

(*Continued from page* 529)

rest and food, the Afghans succeeded in separating the married men, women and children from the military column, who went on ahead. The former were detained in the hands of the Afghans until mid-September, when they were rescued from an internment camp in the hills by a relief force.

On the 10th the advance guard passed, under fire, through the 10 ft. wide gorge called Tunghee Tariki, and having won through, those who were left halted to await the main body of male camp followers. But they waited in vain, for the main column was trapped by the Afghans, who swarmed down upon them and converted the gorge into one huge grave.

Gundamuk was reached on the morning of the 13th by the remains of the advance guard, now consisting of only 20 officers and 45 European soldiers. With the Afghans still on their trail the harassed men pushed on, their number steadily decreasing until only four officers remained. When within four miles of Jalalabad and safety three of them were overtaken by the Afghans and killed, and in the late afternoon Dr. Brydone, wounded and half dead, rode through the Cabul gate of the fort—the sole survivor to reach Jalalabad. Ninety-five prisoners were recovered later.

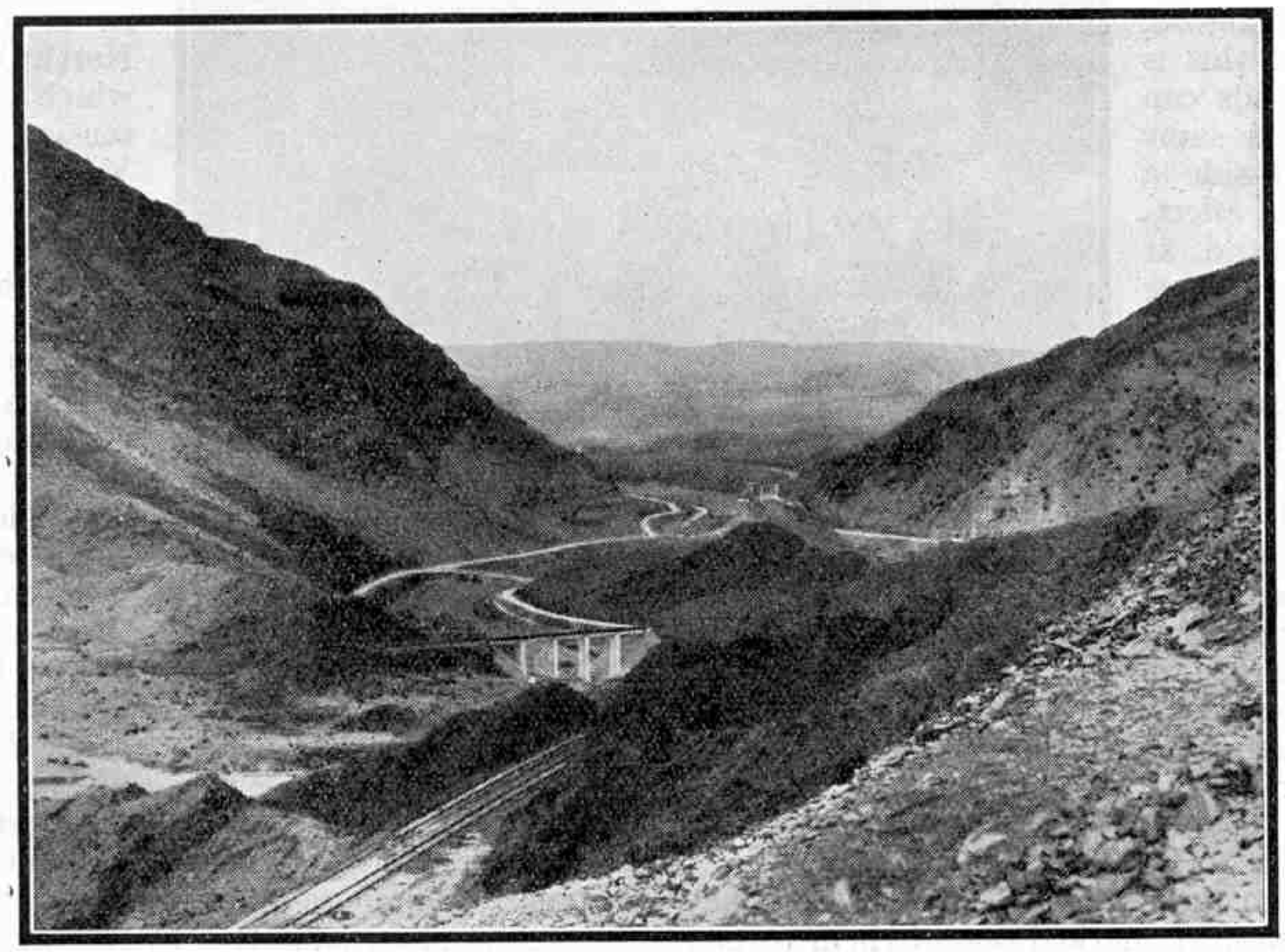
It was not until 16th April, 1842, that a relief army reached Jalalabad, after a grim but successful fight for the Khyber Pass. A detachment then set out to recover the women from Bamian, in the hills, and this was accomplished by the following September.

The Silent Marches of the Khyber Pass

Building a Railway at the Gate of India

by Syed Ali Khan

THE Khyber Pass, which separates India from Afghanistan, is a region of classical importance, and yet most people know little about it. Even before the Mohammedan era—close upon fourteen centuries old—Alexander's legions marched through it eastward to the Golden Hindustan. The Buddhist monks followed in the wake of the Grecians, then the Persians, Moghuls and others, until up to this day the Pass has not ceased to be an artery of commerce and the greatest highway of old Asia.



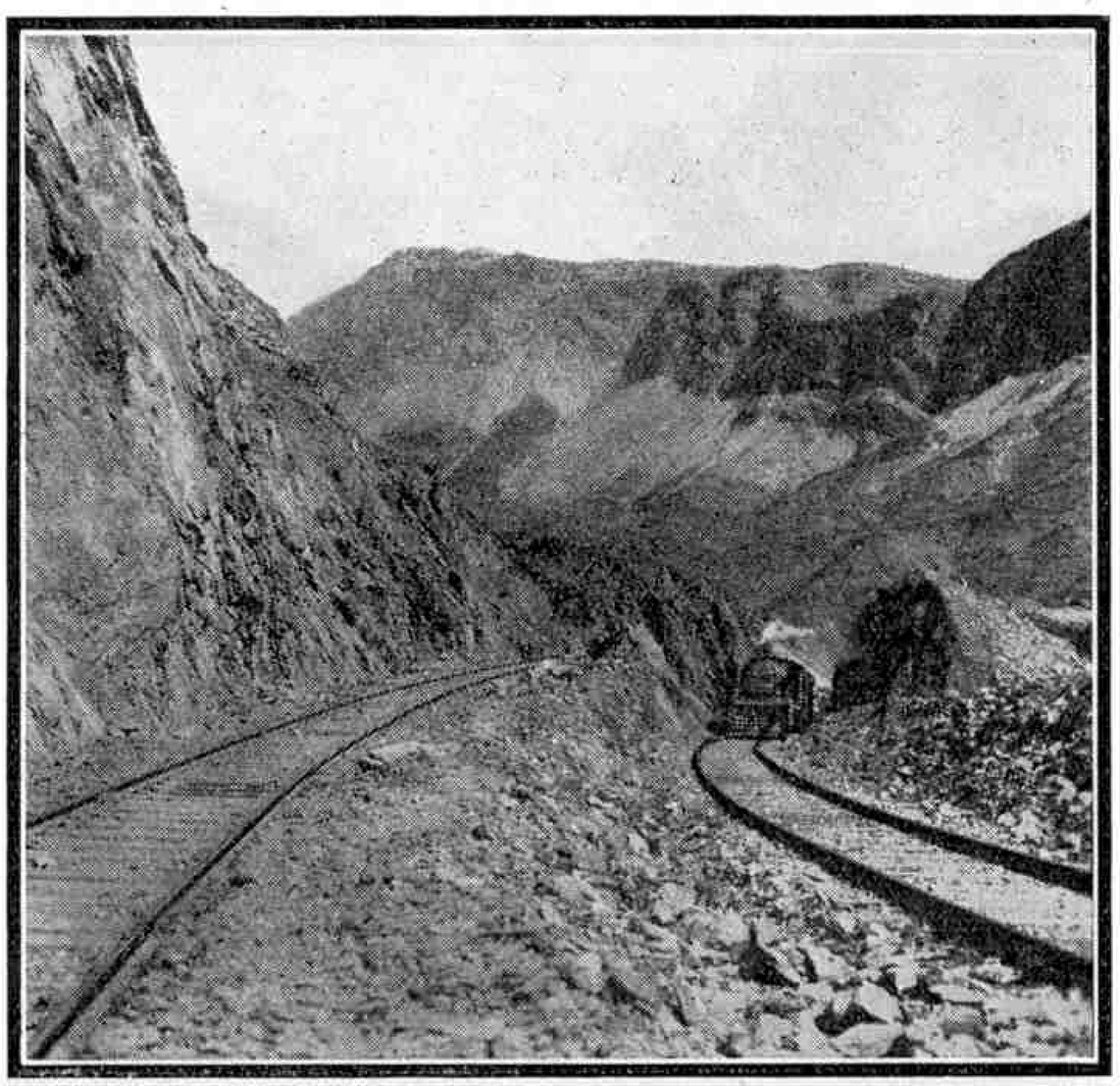
The Khyber Railway and the road through the famous Pass

In the lap of the sun-baked rocky mountains of the Western Frontier Province, the Khyber Pass guards the gates of India, and it is in this, the most difficult region, that an engineering triumph has been achieved by building a railway through it from Peshawar to Lundi Kotal on the Afghan Frontier.

Although building a railway in the Khyber Pass might not, in the opinion of some people, have entailed such great engineering difficulties as have been encountered, for instance, in Italy or Switzerland, there are other special difficulties that have had to be overcome. The safety of the line, both when it was under construction and now that it is completed, is the most difficult problem. The whole Pass does not belong to the British Government—if, indeed, any of it belongs to England at all—for its Western Gates touch the Afghan Frontier, and the entire line is laid in what is called the "Independent" territory of the Afridis and other warlike tribesmen who own neither the British nor the Afghan overlordship.

Let us examine the nature of the Pass in which the Railway now runs. Travelling on level road from Peshawar, the capital of the North West Frontier Province, in a westerly direction for about 10½ miles, Jumrud is reached. This might be regarded as the Eastern Gate of the Khyber Pass, and up to this, apart from one or two gradients, no great engineering difficulties are encountered. The ground is fairly level, and a portion of the track runs along the dry bed of a former river.

Hills begin at Jumrud, and the line passes in a most extraordinary zig-zag fashion at varying heights and, as it winds round the hillsides, many Afridi villages may be seen. These lend the only bit of colour to be had in that bleak and barren region. Here and there a tunnel is constructed but, if one stops too long to examine the work of the labourers on the line, one may run the risk of stopping a stray bullet. It is always possible that the tribesmen may be whiling away their time by "potting" at each other from behind the stone boulders in the valley below to the hill-tops above!



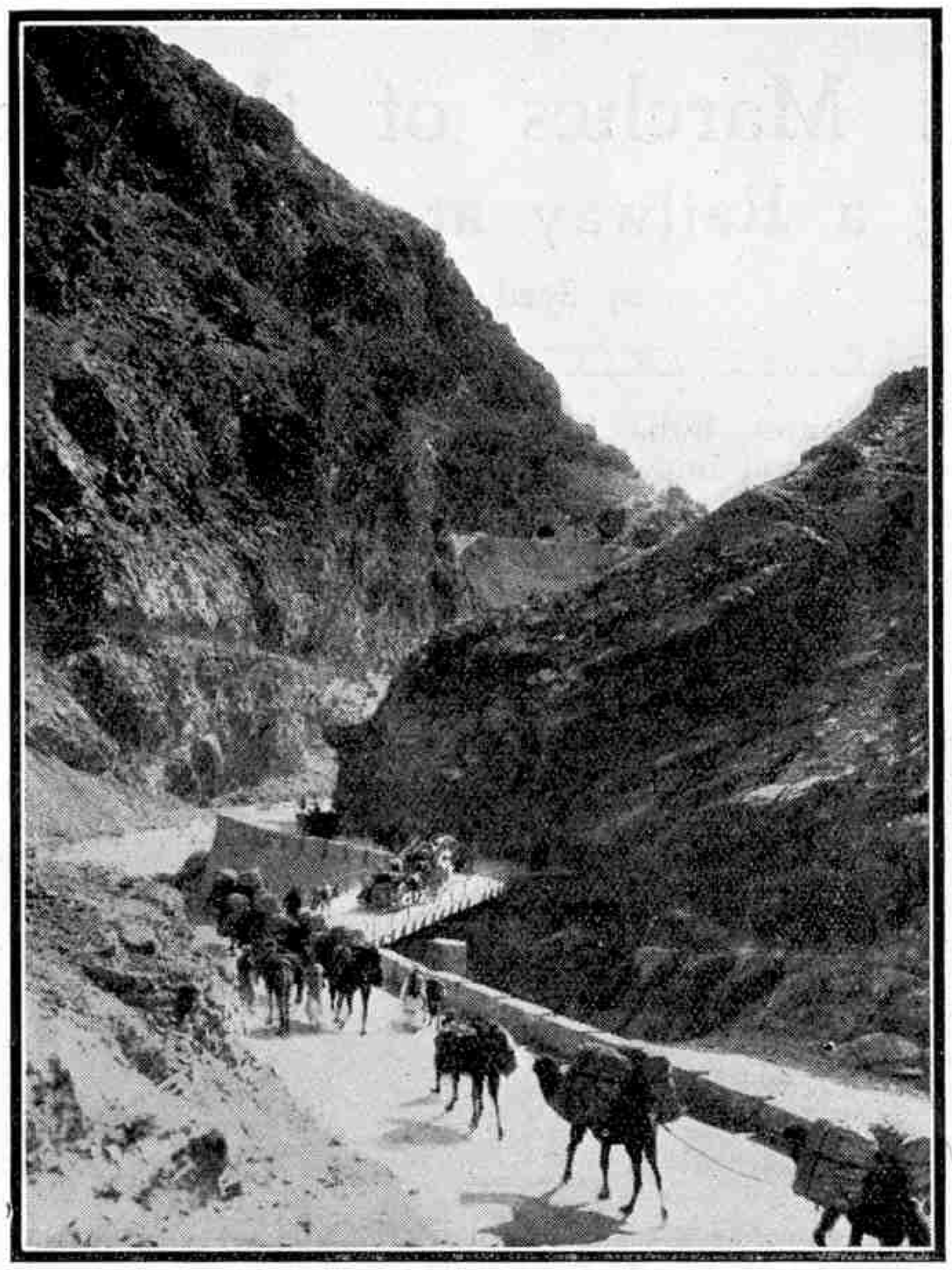
Ascending a stiff gradient in the Mountains

Again, one might notice that the line has taken an awkward bend, apparently to avoid a certain patch of ground, and, on closer examination, one discovers that this area is dotted

with strange-looking mounds, at the foot and head of which curiously shaped stones are placed. These are the graves of the Frontiersmen, and the area is a graveyard that no man dare violate, hence the turn that the railway line has taken. Further, one notices that the hills show more difficult curves and frequent tunnelling is found to be necessary, while the line takes zig-zag turns. The effect of this is that two or three roads can be seen at one and the same time, giving the hill-side a very pretty terrace effect.

Just before Ali Musjid, at a distance of a little over five miles from Jumrud, precipitous cliffs confronted the engineer and were dealt with by a system of tunnelling. Here the elevation ranges from 700 ft. to 2,000 ft. and the bends are extremely abrupt. In the rocks above the level camping ground are located workshops for repairs.

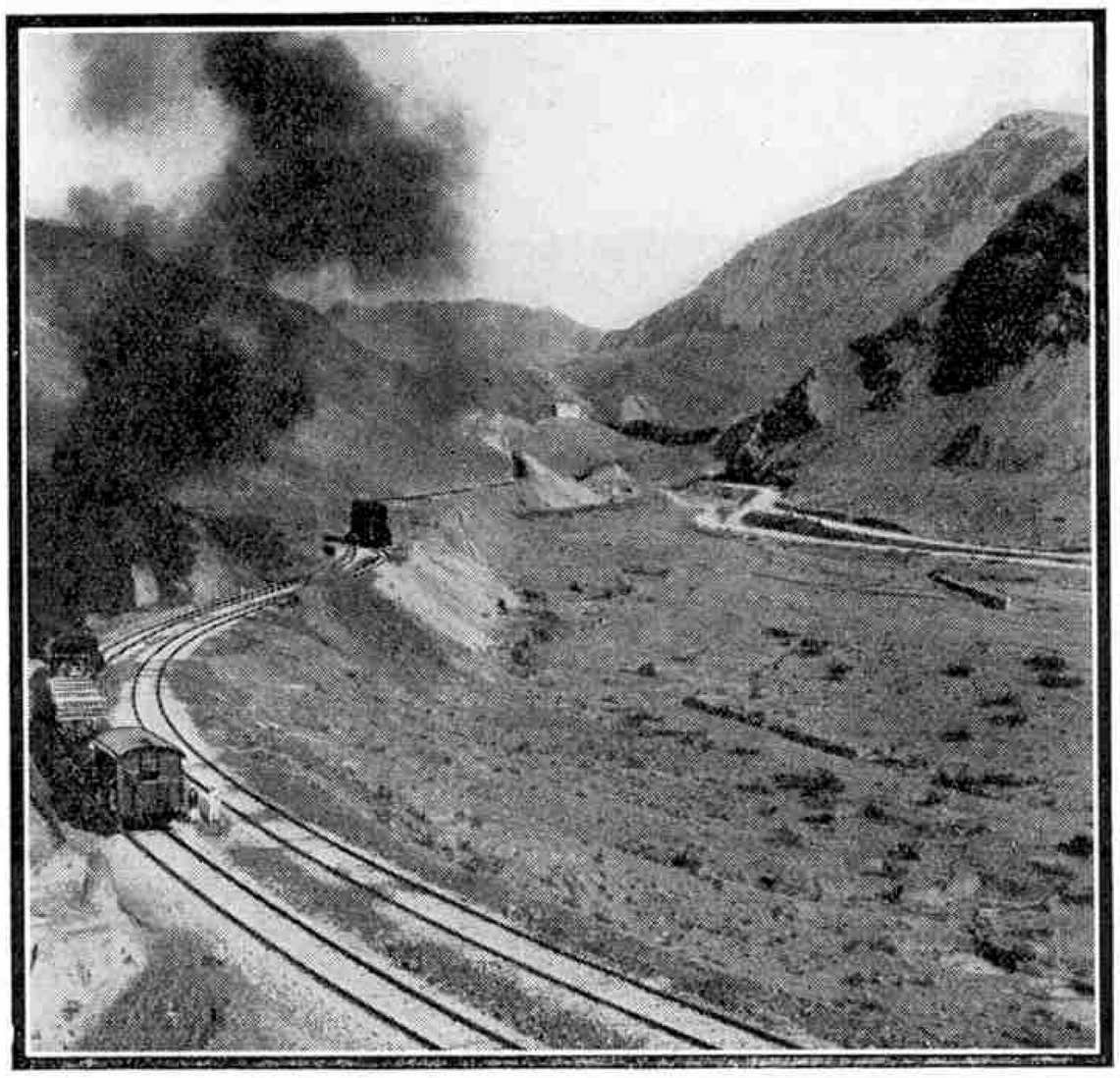
Here and there one may see many an unsophisticated Afghan camel driver halting to hear the noise of the "mysterious" engines. The machine is a marvel to these sons of Old Asia. "They move all by themselves," remarked one of them to me, "as if they had life." "Perhaps it is some evil genii!" observed another, and both walked away on their weary trail, their camels lumbering along behind them on the high-road of Central Asia.



One of the gorges in the Khyber Pass. Notice the railway tunnel, next to which is the caravan route and military road. The camels are on their way to Central Asia

It is beyond Ali Musjid, westward in the direction of Lundi Khana, that the narrowest part of the gorge is met. Here, just below the plain of the Ali Musjid, the river of the same name winds between cliffs some 2,000 ft. in height, and the passage by the caravan route is not much wider than 15 ft. Clearly the line had to ascend and descend frequently while passing that region, and a great many tunnels have been blasted.

Another difficult part of the Pass is the district of Lundi Kotal, where the whole scene is one of defiles and high cliffs. For a few miles high cliffs and deep gorges continue, until gradually the region opens out just before Lundi Khana is reached. This is the terminus of the railway.



Another view of the Pass and its railway, showing the desolate nature of the country through which it runs

The real value of the Khyber railway with regard to commerce and industry is obvious, as it practically connects the Central Asian markets with India, and in a measure shortens the land route between Europe and India. Its connections with other and older railway lines in British India are great factors of economic value. On the south, for instance, it is connected with the North Western Railway, of which this is but an extension, and follows the Indus Valley in its downward progress to Karachi. In this manner it serves Thal, Bannu, Tank, in Waziristan. Near Sukhar, the line branches off to Quetta, in Beluchistan.

Much of the policing of the line is deputed to the sons of the Pass, who have not allowed themselves to suffer economically, at any rate, through the railway in their country. These people of the Khyber Pass, though fond of blood feuds and brigandage, are yet the most lovable race of men in that, the last stronghold of the Ancient East. Warlike, intensely religious, proud and hospitable to a fault, they often amuse themselves by raiding the city of Peshawar. They are past masters in the art of scouting and raiding, but sometimes their raids are taken with good reason.

By far the most interesting narrative of raiding ever given to me was by an old man, among the hills of that far and wild frontier.

"It was like this," he said, stroking his henna-coloured beard. "A Hindu money-lender in Peshawar had lent the Elder of our clan 1,000 rupees. Thrice my Elder sent me with a thousand and a hundred rupees to the Hindu, during the year, to pay off his debts, and thrice was the money returned as the creditor said that he was in no great hurry for the money. But after the third year the Hindu demanded twenty-nine thousand rupees as principal and interest.

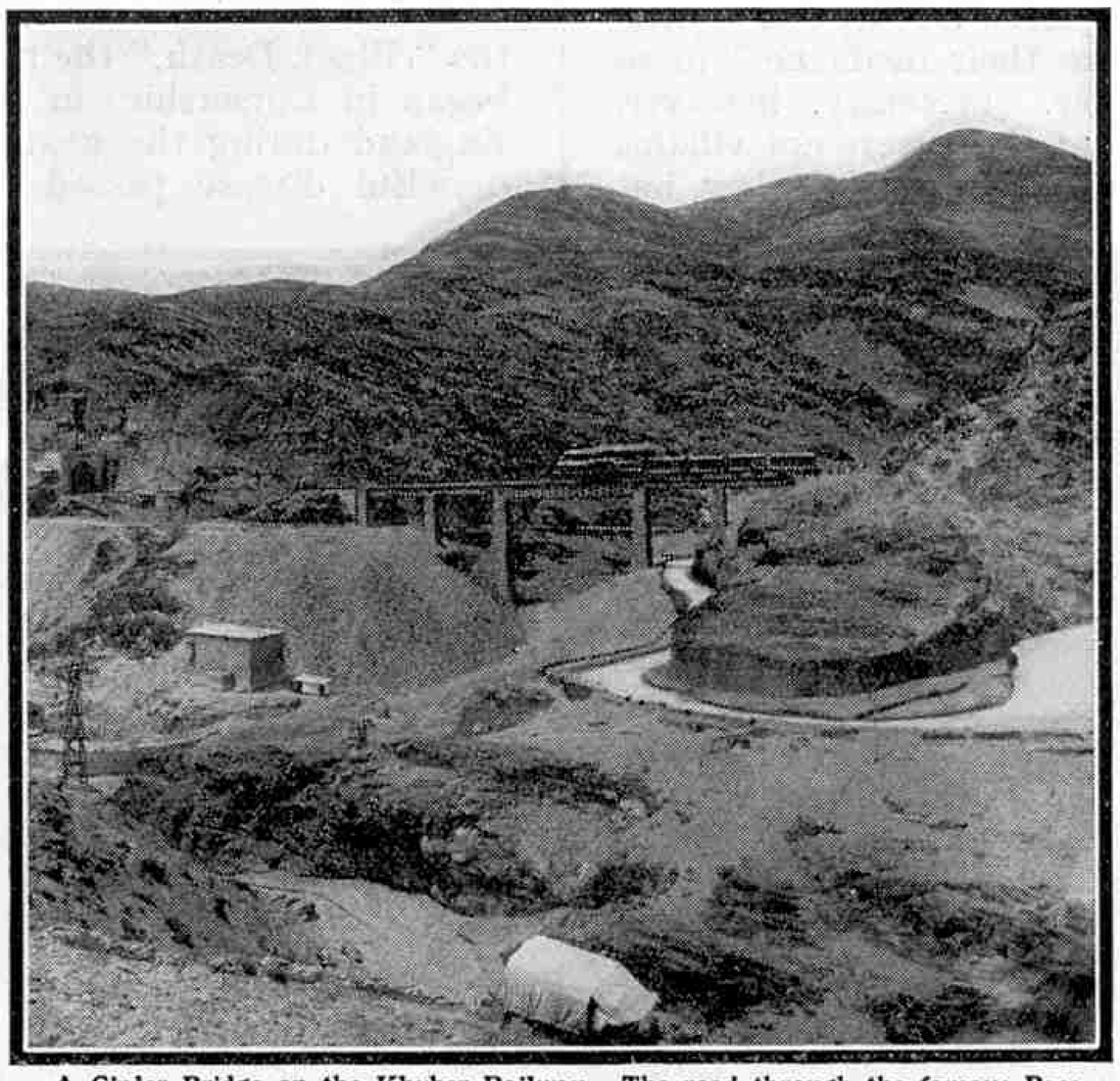
"Upon the Elder's protest, the Hindu put in an application at the English Court, claiming the sum and adding that, in case of default of payment, our clansmen should be arrested,

as they came from independent hills to Peshawar for their weekly purchases of salt and other provisions. Thereupon the Elder sent me with four thousand rupees to pay off his creditor, which he accepted as a part payment. For the balance of twenty-five thousand he had me arrested, but I escaped to my native glen.

"Thereupon the Elder decided to take the law into his own hands, and one day a hundred clansmen entered the bazaars in a bridal procession. We carried the litter of the bride with great pomp through the Hindu streets till the procession arrived at the door of the money-lender's house. The bridal litter was placed on the ground, its curtains were hurriedly removed, every man got hold of his rifle, and a hundred men, yelling and shouting, ransacked the Hindu's house. We locked the Hindu's women-folk in a room, beleathered the Hindu himself and dug up his money chests and, within half an hour, we were in the heart of our independent territory. It took six of us to drag along the Hindu in the litter.

"When the other men of our party, who were left to exchange bullets with the pursuers, had returned, we placed the gold, silver, documents and the Hindu before the Elder. The spoil was divided there and then; but no one would buy the Hindu money-lender as a slave—he was too fat to be of any use! We decided to hold him at ransom for thirty rifles.

"After six days the rifles were duly placed on the frontier of the independent territory and, as we picked up the weapons and pushed the fat money-lender beyond our limit, I was thankful for not having bought him as a slave!"



A Girder Bridge on the Khyber Railway. The road through the famous Pass is also shown in this photograph

A Tragedy of the Khyber Pass

Afghan War Episode Recalled

The Khyber Pass has been the scene of many wild deeds, and desperate fighting took place there during the Afghan Wars. One of the most terrible disasters that comes to mind was that which befell a British force there in 1842, during the first Afghan War. The suppression of Afghan disorder in 1838-9 culminated in the occupation of Cabul on 7th August, 1839, by British troops. Quietude being restored, a small British force was left in charge and the remainder returned to India. On 2nd November, 1841, the revolt broke out again, however, with the murder of Sir A. Burnes and other British officers.

The position of the isolated garrison was perilous. There were no surplus food supplies, and as the Afghans became more and more aggressive, the situation became desperate. Sir William Macnaghten, the British envoy, was invited to a parley outside the fort, and on 23rd December, despite many warnings, he went out with three officers to confer with the Afghan chiefs. At the appointed place he was seized, carried off and killed, and of the officers two were rescued and got back to the fort.

The Afghans knew that they had the upper hand, and the British residents, short of food and uncertain of their fate, were constantly abused. At length terms were agreed to on New Year's Day, 1842. The treaty required the British garrison to evacuate the country within 24 hours, but guaranteed them transport and a protecting escort.

An air of tragedy and impending doom brooded over the impoverished garrison, for everyone instinctively distrusted the treaty. Snow fell almost continuously, rendering the passes daily more formidable, yet every day the Afghans made some excuse for withholding the promised guard of protection. On the dreary morning of 6th January, 1842, this was forthcoming, however, and at 9 a.m. the advance guard of the British moved out of the fort. Behind the 4,500 soldiers—690 Europeans, 2,840 native soldiers on foot and 970 native cavalry—came a long column of some 12,000 camp followers, among whom were many women and children. In the rear was the camel baggage and food train. The horse artillery took with them their full complement of six guns and three pieces of the mountain train.

No pretence was made by the Afghans to observe the full terms of the treaty, and while some took possession of portions of the garrison as they became empty, others congregated at vantage points and fired down upon the luckless advance guard outside the fort awaiting the arrival of the entire column before moving off. When at length all were clear of the fort, the procession slowly began its terrible march toward the passes and promised freedom, leaving behind one officer and 50 men dead in the snow, and two abandoned guns.

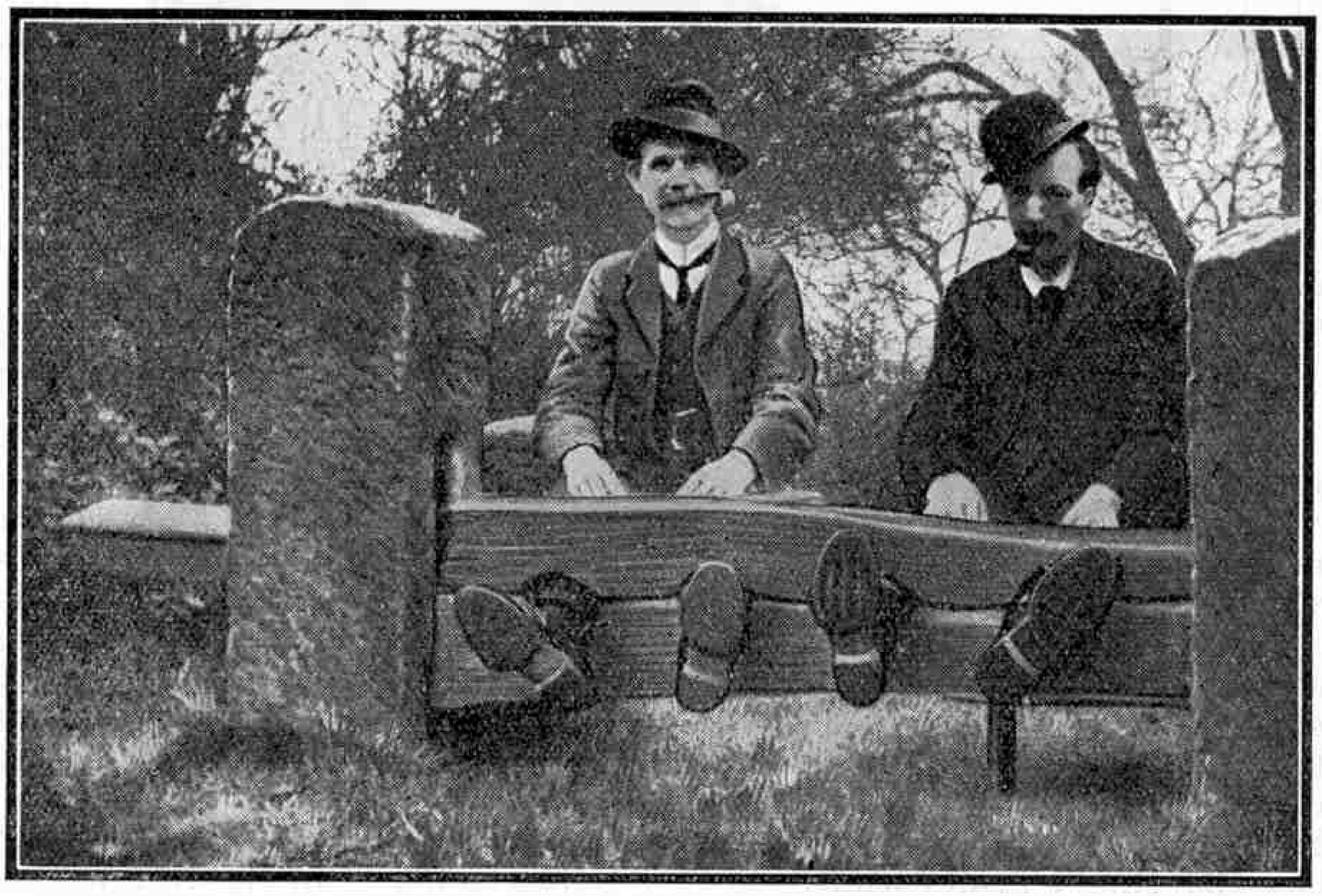
The next few days were a terrible repetition of each other. The rearguard was almost destroyed by the attacks of pursuing Afghans, and one by one the guns had to be left behind. Most of the food had been lost and water was almost unobtainable, for the water-carriers were often fired upon while fetching it. Every day the Afghans, keeping pace with the desperate procession, manned the heights on each side of the passes and took heavy toll of the advance guard. On the 8th January the disorganised column, diminished by hundreds either killed or frozen to death, staggered through the narrow gorge of the Khoord-Cabul Pass, some five miles in length. Here the columns were fired upon from above at 50 yards' range with terrible effect, and when at length the pass was traversed 500 soldiers and more than 2,000 camp followers were left behind dead.

Under the pretext of providing (*Continued on page* 526)

In the Stocks:

A Quaint Punishment of Bygone Days

WHEN we received the photograph reproduced on this page we felt deeply sorry for the two gentlemen compelled to "take their medicine" in so public and undignified manner. Presently, however, we were relieved to discover that these were not villains of the deepest dye, fallen into the clutches of the law, but merely two respectable, law-abiding holiday-makers satisfying their curiosity regarding what it feels like to be "in the stocks"!



Stocks, like whipping-posts, ducking-stools and other similar quaint forms of punishment have long ceased to be used, but a few centuries ago they were very familiar sights. Most of these ancient methods of administering justice were directed toward punishing an offender by exposing him to shame and ridicule, rather than inflicting upon him actual physical pain.

As a rule stocks were built to accommodate two persons but occasionally they were built to take three or four people side by side. Their construction was simple. They consisted of two upright square stone posts, firmly embedded in the ground a few yards apart, and joined by two thick boards placed on edge and slotted into place by means of a groove cut in the inner side of each post. These grooves were sufficiently wide to allow the boards to be moved freely up and down. Pairs of round holes were cut in the boards in such a manner that half of each hole was in the upper plank and half in the lower. Some districts adopted a portable type of stocks that could be moved to different places in the locality as occasion demanded. When not in use these stocks were generally kept in the church porch!

Upon being led to the stocks, the victim was made to sit upon the hard seat provided, the upper board of the stocks was raised and his feet were pulled through. The board was then lowered so that the upper halves of the holes fitted over his legs as the latter rested in the lower halves. The boards were then securely padlocked and, as the holes were too small to allow the culprit to withdraw his feet through them, escape was impossible. Thereafter the prisoner, during the period of his internment, provided a favourable subject for the gibes of all onlookers and passers-by, and a really first-rate target for the missiles of mischievous boys!

One of the earliest references to stocks in this country is made in the famous "*Statute of Labourers*" passed in 1349-50. This law came into being as the result of the "Black Death," the terrible epidemic of plague that began in Dorsetshire in August 1348, and swept over England during the next twelve months. Before this dreadful disease passed away from the country the population of five millions was reduced by almost one half.

Industry of all kinds was completely disorganised by the shortage of workers resulting from the ravages of the "Black Death," and the "*Statute of Labourers*" was an effort to bring order out of chaos. It fixed rates of wages, forbade labourers to leave their parish to seek work in another parish, and debarred employers from dismissing men and employing at cheaper rates others from outside districts. Those who refused or neglected to carry out the provisions of the Act were to be punished by periods in the stocks, and every parish authority was required to build immediately stocks to accommodate two persons. The Statute authorised stocks to be used also for the correction of vagabonds in general, including Sabbath breakers. Prisoners in the stocks were allowed a diet of bread and water but woe betide anyone caught giving them anything more appetising!

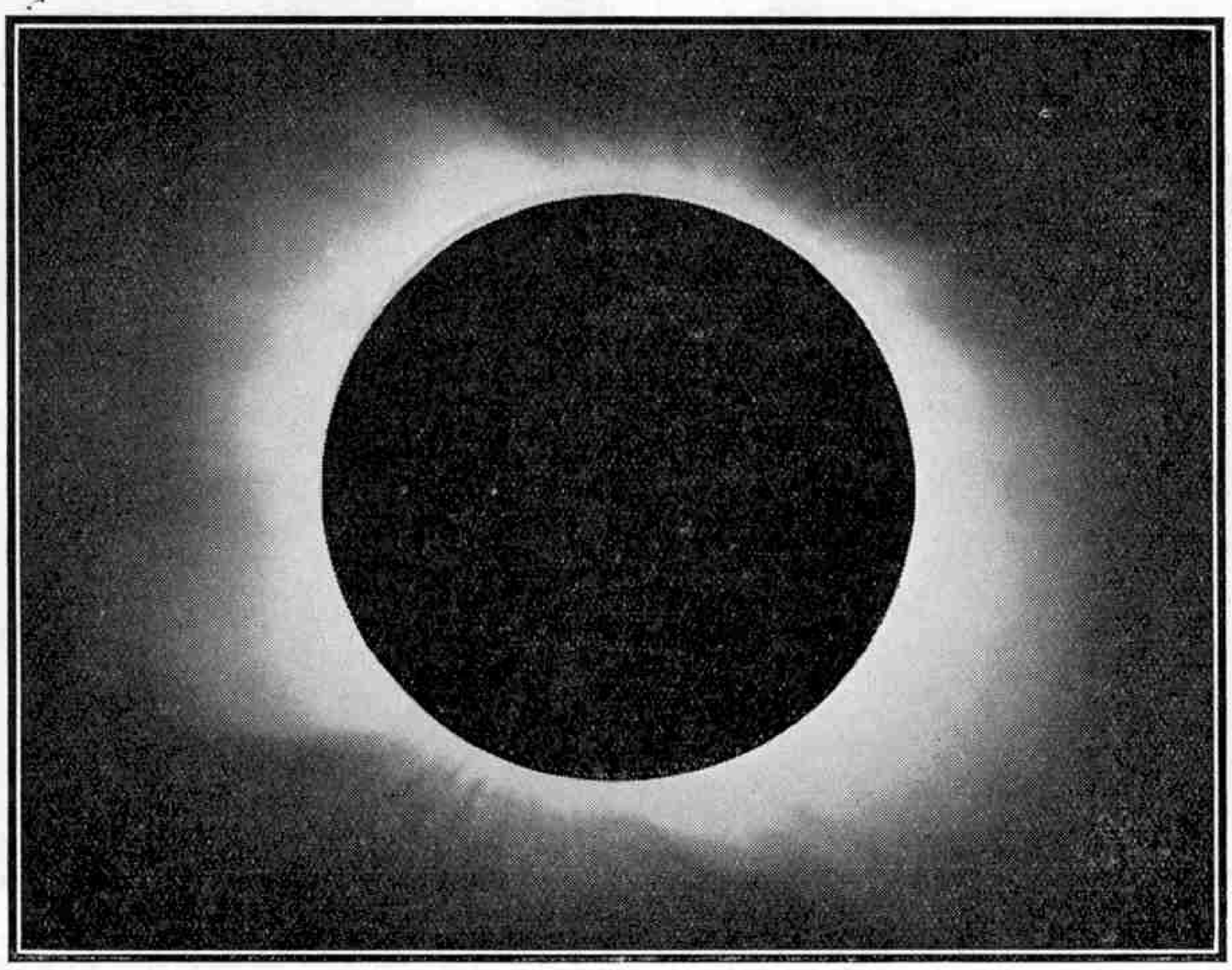
The stocks at Lymington in Somerset, according to the historian Cavendish, once confined the legs of no less a personage than the future Cardinal Wolsey. At that time, about 1500, Wolsey had recently become Rector of the Parish and on one occasion is said to have dined too well at a village feast, thereby incurring the disapproval of the local Justice of the Peace, Sir Amias Paulet, who sent him to the stocks. Wolsey bitterly resented this humiliating experience, and some 15 years afterwards, when he became Lord Chancellor, he had Paulet brought before him in London, rebuked him severely and forbade him to leave London without special permission. This rigorous internment of the squire is stated to have been maintained for five or six years!

During the era of Puritanism in the 16th and 17th centuries the stocks throughout the country were in great demand, for in addition to the sins already punishable by this means was added the sin of bad language. If an exasperated individual (*Continued on page* 539)

Our Eclipse Competitions

Something Worth Watching

As 29th June draws near the all-absorbing topic is the eclipse. Judging by the number of letters we have received asking for advice on the best place from which to see the eclipse as a total one, "*M.M.*" readers in large numbers will join in the great trek that will undoubtedly take place in the early hours of that day. Some have already arranged accommodation for themselves within the belt of totality to avoid all risk of being unable to reach a suitable place for observation. No less interest has been displayed by those readers who must of necessity remain in places where the eclipse will only be partial, and we have, therefore, arranged an interesting series of competitions in which all readers will be able to compete. Full details of these are given below.



Entrants to these competitions will derive great assistance from a study of the eclipse articles that have appeared in the "*M.M.*" since March. As remarked in this month's issue, the chief thing is to know what to expect, so that the time of totality may be used to the best advantage. The panel on page 482 will give further help in this respect as it gives a short and compact summary of the phenomena that will be visible in the order in which they will occur.

One important point that we wish to emphasise is that the entries of those who live outside the belt of totality will receive just as much consideration as those of their more fortunate rivals. The conditions have been so framed that all have an equal chance, and as usual there will be two sections in each competition, one for those aged 16 and over and the other for those under 16. Prizes to the value of 10/6 and 5/– will be awarded for the best efforts in each section of the three competitions. In addition to these there will be a number of consolation prizes.

Competitors should study the conditions of each competition carefully and should not forget to see that their names, addresses and ages are attached to their efforts. Any reader having the ambition to win first prize in all competitions is quite at liberty to attempt the feat. Entries must be addressed to "Eclipse Competitions," Meccano Magazine, Binns Road, Old Swan, Liverpool, and must reach this office not later than the first post on Monday, 11th July. Entries for each individual section must be prepared on separate sheets of paper from those submitted in the remaining sections, but entries to the three sections may be sent in one envelope.

Part 1. Drawing Contest

This competition should provide much scope for ingenuity. Drawings submitted may present the eclipse itself, showing the corona and the prominences particularly, or they may show the general scene. Colours may be used but it must be remembered that the merit of the drawing will decide the competition so that a poorly coloured drawing will not have preference over a good plain one.

Whatever the actual nature of the drawing planned careful preparation should be made beforehand. The general outlines should be sketched in advance so that the whole of the short time of totality is available for the study of the effects peculiar to the eclipse itself.

Part 2. A Description of My Experiences

Many interesting things no doubt will be observed by readers on 29th June—incidents of the journey to a point of vantage, the changes that take place during the early stages, the attitude and remarks of the spectators—in addition to the phenomena described in the "*M.M.*" articles. These should afford abundant interesting matter to enable any reader to write a description of his experiences of the eclipse, and this accordingly will form the subject of the second special eclipse competition.

The description should not exceed 1,000 words in length and the name and address of the entrant should appear on the back of each sheet used.

Part 3. Photographic Contest

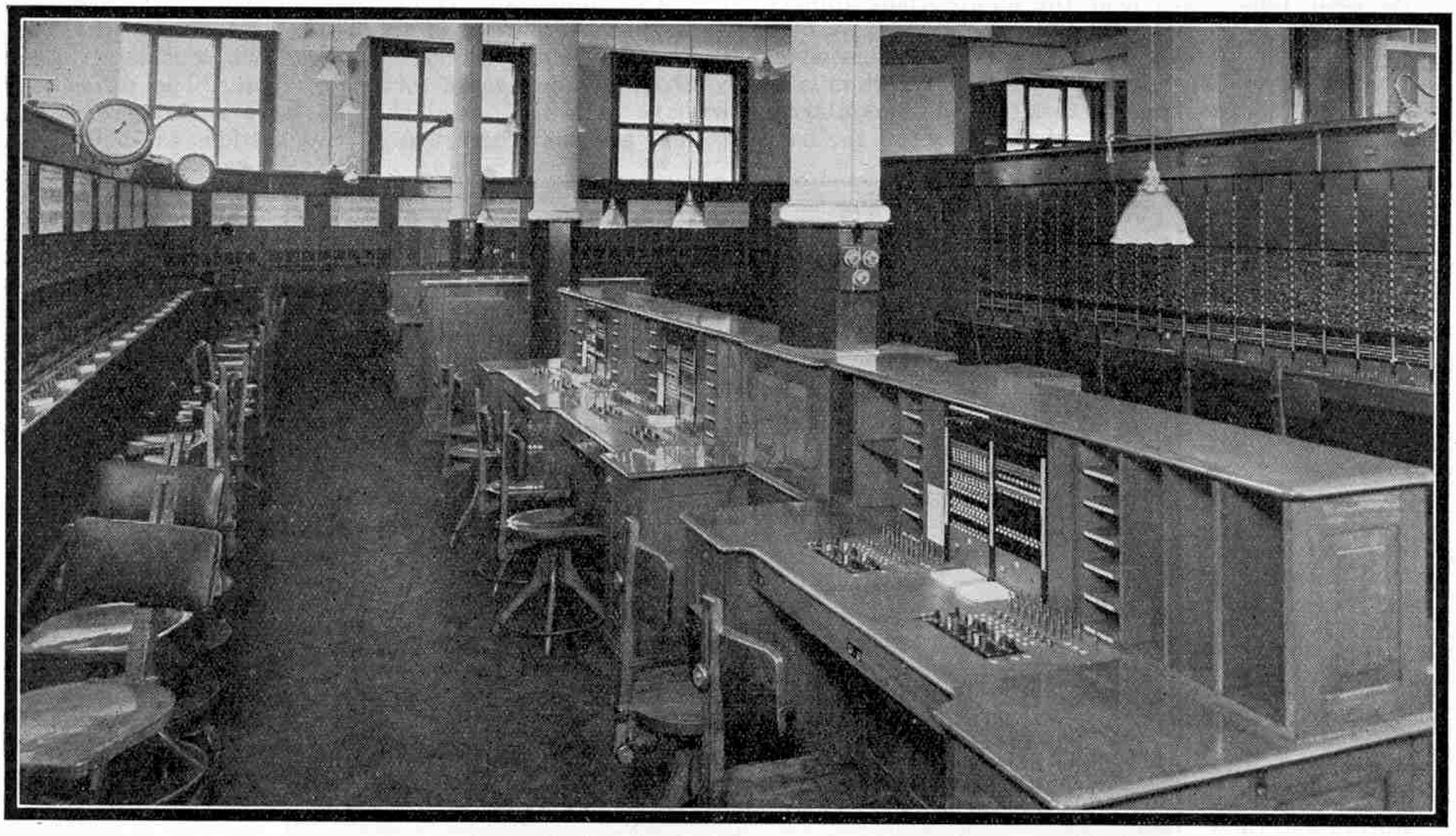
The third competition is a photographic one, prizes being offered in two sections for the best photographs of the eclipse taken by the unaided efforts of readers. While a solar eclipse is a subject somewhat outside the usual range of amateur photography, it is possible with the aid of some ingenuity to obtain an interesting photographic record.

The advice given on the subject in this month's eclipse article should be carefully studied and, as in the drawing competition, preparation should be made beforehand in view of the short time available at the eclipse itself. To obtain results of value it is essential that the only thing competitors must leave themselves to do at 6.24 a.m., on 29th June, is to make the exposure.

A Visit to a Post Office

Telephones, Telegrams, and Letters

by F. B. S. G.



Typical layout of a Telephone Exchange Switchroom. Extending from the left of the photograph is shown the Subscribers' Switchboard used for making connections in local calls—extending from the right is the Junction Switchboard. In the centre are shown the monitors' desks for enquiries, etc.

THE appearance of even one of the largest of the General Post Offices in our provincial cities would not lead us to imagine that it was a hive of machinery, yet within each of these buildings are machines so wonderful and so human as to fill the casual observer with amazement.

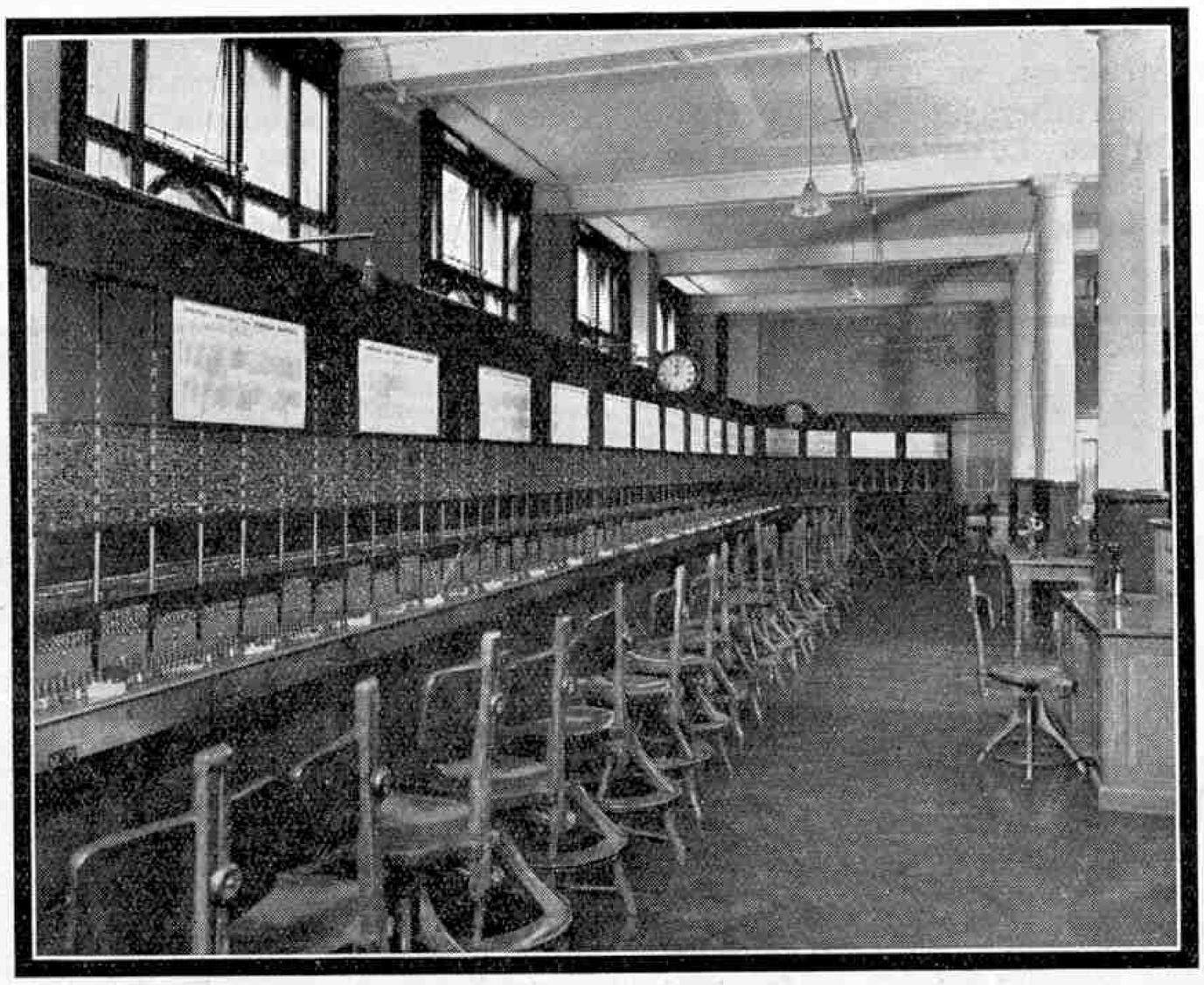
Let us imagine ourselves making a visit through a few of the many branches of a large Post Office. Our first visit may well be to the trunk exchange where telegraphy is brought to the highest pitch of perfection yet possible. From the trunk exchange a local subscriber may be connected within a comparatively brief period with any town, village or hamlet in the country, and where wireless telephony has found a place in the exchange, a subscriber can be connected with a large number of places abroad with little more delay.

The trunk exchange is full of switchboards, plugs, levers, time recorders and other mechanisms. A system of automatic lighting shows the operators just the spot at which attention is required, and the moment the necessary operations are completed and the circuit disconnected these lights are immediately extinguished. By means of an ingenious extension of the local automatic telephone system automatic calling is possible between other towns and the trunk exchange. In order to achieve this the number in the other town is dialled off at the trunk exchange in the same manner as one would dial a local call on the automatic system in one's own house, and each large town has three or four dials or more. Such an arrangement is very important in the case of large ports such as Liverpool, to which constant access is necessary, as it saves considerable delay in the clearing of the lines that is necessary on the old system.

Another department full of mechanism is that known as the phonogram department. This is a room where telegrams are accepted by telephone and, in addition, in some cases are actually transmitted to their destinations in other towns by the same means. The system is an ingenious combination of telegraph and telephone. The room is filled with the usual array of switchboards, plugs, and so on, and twenty or thirty girls or youths sit at desks each with a telephone instrument. Where telegrams are not to be sent from the phonogram room to another town they usually come up from the instrument room by means of a compressed air tube. They are then distributed to the various operators, who ring up the local subscribers and read the telegram to them. A confirmation of this telegram is always sent by post the same day.

When the telegrams are to be sent from the phonogram room to another town the receiving clerk speaks on the telephone to the officer in charge of the central switchboard in the room, who connects with the trunk exchange in that particular town. Sometimes this can be done direct from this central switchboard, but more usually it is done through the trunk exchange of the Post Office telephone department. When the operator gets through, the subscriber in connection is connected up and is given the telegram over the telephone by the actual receiving clerk.

Our next visit is to the telegraph operating room. This is for dealing with ordinary telegrams, namely, those that are to be telegraphed from one town to another. The telegraph instruments are in some respects almost human. They are extremely complicated and it is an open secret that the inventor of one recent type of instrument found that the work was too much for his brain. By a great effort he managed to complete the apparatus, and then his mind gave way and he ended his life in an asylum. He was a martyr to modern applied science.



Another view of the Subscribers' Switchboard seen on the left in the preceding illustration

Three familiar types of telegraph instruments are the Morse Sounder, the Wheatstone Automatic and the Baudot Telegraph. The Morse sounder is most generally used for work to smaller towns. The Wheatstone has practically held its own for high speed work since its introduction in 1867, and the Baudot, invented by M. Baudot about 1870 is remarkably well adapted for commercial work.

The mechanism and method of operation of these instruments was described fully in the articles on the telephone in the "*M.M.*" for March, April, May, June, 1925, so that it is not necessary to go into the matter here. It may be said, however, that the Baudot instrument, sometimes disrespectfully referred to as the "Bow-wow," is capable of dealing with six messages in each direction at the same time, and thus one instrument can be working upon twelve separate messages throughout the day. Post Offices do not always employ the twelve-message Baudot however. A quadruplex instrument appears to be the favourite, and for ordinary purposes this gives sufficient telegraph facilities, as four messages make possible a total of eight on one wire. Where there is very heavy work between two centres, however, the twelve-message Baudot would be installed in order to cut down the number of lines required.

Readers probably have received many telegrams from Baudot instruments without being aware of the fact. Such telegrams arrive on ordinary telegraph forms, but the usual written message is replaced by a printed message on a tape pasted on to the form. All messages from the Baudot instrument are ejected on long tapes absolutely ready to send out to the public, no translation being required as is the case with the Wheatstone instrument. All that is necessary is for the tape to be cut off at the end of the message, cut again into suitable lengths, pasted on the form and despatched in the ordinary manner.

The speed of working with a Baudot Type Printing Telegraph is somewhere about thirty words per minute. Reckoning six operators to one instrument, it is evident that 180 words per minute may be transmitted on one wire by the instrument in one direction. Adding to this another 180 from six operators at the other end of the line and the vast possibilities of this instrument will be realised. A prominent telegraphist, when asked recently how many separate messages could be transmitted by one operator, said that 84 messages of over 12 to 15 words each had been done by one operator on this instrument in an hour, but he added that 60 messages was a more general speed.

Passing on now to the sorting office we find that there is comparatively little machinery here. The busiest hours are between 6 and 9 each evening with the exception of course of Sunday. In busy Post Offices, in order to economise in the carrying about of correspondence and parcels, one or more automatic conveyors are employed. These lead from the parcel counters and from the central letter-box outside or inside the Post Office. These conveyors are ingeniously contrived endless bands and by means of them correspondence may be made to turn right-angled corners and, in some cases, even to travel up-hill to a sorting office above the level of the box in which they are posted. In certain offices parcels are disposed of in the same manner but in the smaller offices it is usual to wheel them in postal trucks or to carry them in bags from the counter to the sorting office.

The last piece of Post Office machinery that need be mentioned is that which assists the sorting office in the despatch of the mails. On one side of the office is a wide endless moving band sunk in a trough and usually operated by electricity. When the mails are ready for despatch each bag is thrown by a sorting clerk upon this moving band, while a despatch clerk stands by to enter in a book the destination of a bag. The band usually has many bags upon it at the same time and these are conveyed along out of the sorting office and on to a platform from which they are loaded into the Post Office vans waiting to take them to the station.

Why the Martians Declared War

A Peep into 4000 A.D.

By B. J. Bowyer

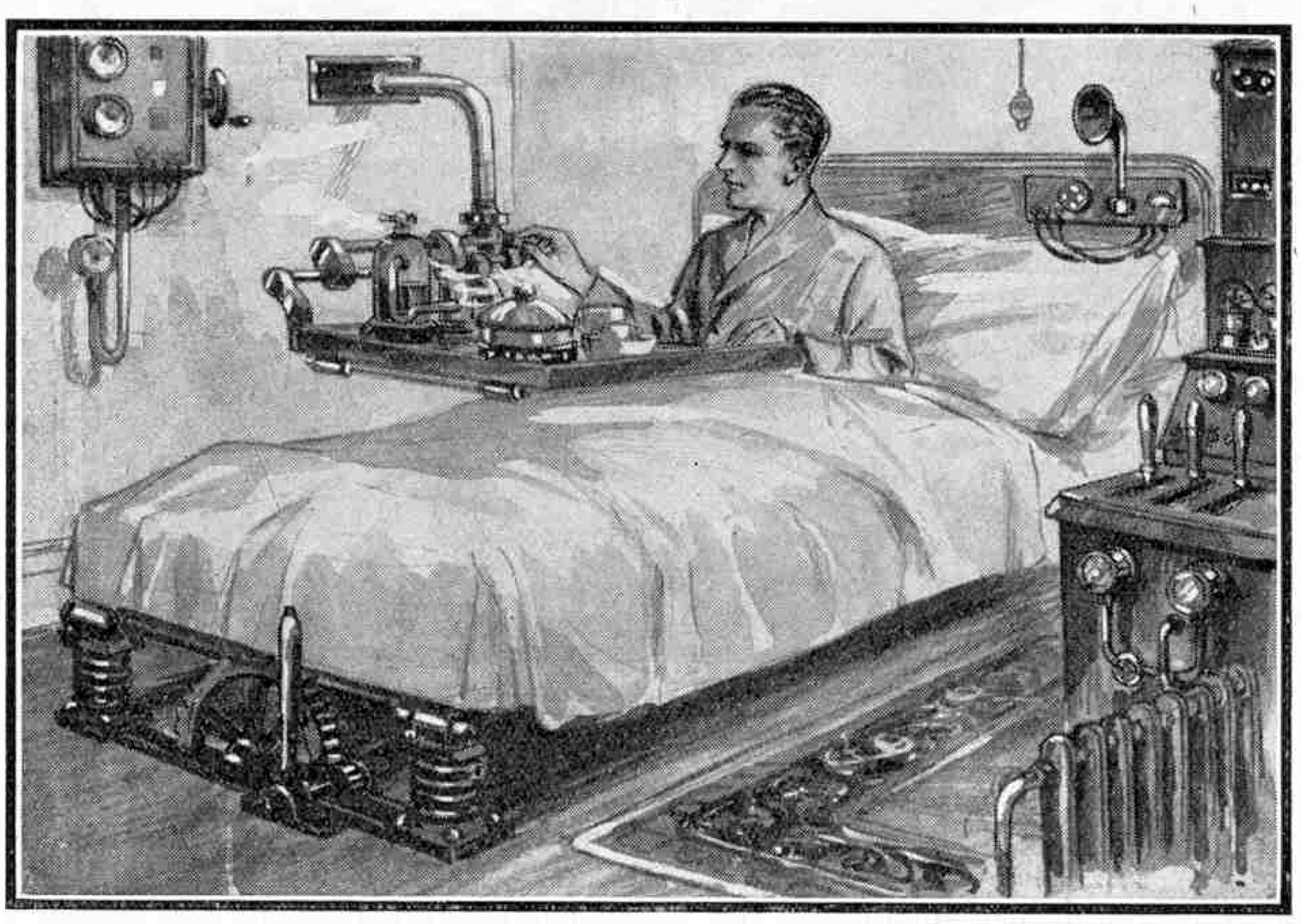
ZIP! Bang! "Your breakfast, sir."

"Oh, it's you, Carruthers! Please prepare the automatic bath for me, Lever 49."

"Yes, sir."

I finished my breakfast in bed on the first morning of January, 4000, feeling very satisfied with things in general. I had bought a new helicopter on the previous day and was looking forward to giving it a trial. Impatiently I pulled over Lever 49 and was shot, somewhat violently, into Room 90—the bathroom.

In fifteen seconds I was automatically washed and dressed and then, pulling over Lever 47, I stepped into a chute and descended to the ground floor at the aggravatingly slow rate of 40 miles per minute—the monthly current supply was beginning to fail.



I finished my breakfast in bed . . .

Carruthers helped me into my fur coat and I stepped in the "Springmeup." This is a bullet-shaped lift to convey people to a height of at least 500 ft. at an average speed of 100 miles per minute. Carruthers pulled over the lever and in a flash I was seated in my helicopter which, in accordance with my instructions, had been placed conveniently on the flat roof.

Once inside I pressed the speed button, let go the clutch and was whirled upward to 2,000 ft., at which altitude I changed into horizontal movement. I continued to press the speed button until the speedometer registered 200 miles per minute, and five minutes later I saw the shimmering coast of Italy. I live in Norfolk, 75th State, England, so that I was then some 1,000 miles from home.

I alighted on the roof of the house of my friend Signor Murphius. Then things began to happen.

I garaged my helicopter safely and stepped on to the moving pavement, which there is on a level with the roofs of all the houses. I intended to switch off on to the ground chute and enter at the front door of the house. The fates were against me, however. Just as I was about to switch over, the operator at the Office of Machinery took it into his head to accelerate my section and I was flung neck and crop on to the roof of another house. Worse still, this house had a revolving roof for ventilation purposes, and I felt as though someone was swinging me round his head.

At that moment the operators must have developed an absolute mania for accelerating, because a second later, before I could do anything to help myself, I was flung into a bath upon the next roof. To make matters worse this house was untenanted, and thus the bath contained a dirty accumulation of rainwater. When I climbed out I was covered from head to foot with mud and my appearance provided considerable amusement to a small crowd of interested onlookers.

My immediate necessity now was to reach the ground, but this was a serious problem because there was no machinery working in the house. Finally I succeeded by sliding down a drainpipe and then dropping on to a sloping roof, from which I was able to reach the ground by making a somewhat alarming jump.

* * * *

"Ah, that's better!" said Signor Murphius, after he had had me washed and dressed. I thanked him and soon we were spending a happy evening. Time passed so rapidly that it was midnight before I left his house and returned to my helicopter. In another five minutes I was warming myself before the radium radiator in my home.

* * * *

I had intended to keep the following day free for a trip in my flying "300" American Automobile. Business prevented me, however, and I travelled by the "Minute-and-a-half" train to London. Having transacted my business I paid a visit to the Main Stores Depôt to obtain some accessories that I required for my new 20-valve combined receiver and transmitter.

Returning home on the "Two-minute" train I switched in my set to America. I was promptly answered by the amateur station 2 GUY with the startling information that a message had just been received from Mars. The message said: "War has been declared on the Earth by the Elect Four for two reasons to be

stated later. We give you 120 minutes in which to prepare."

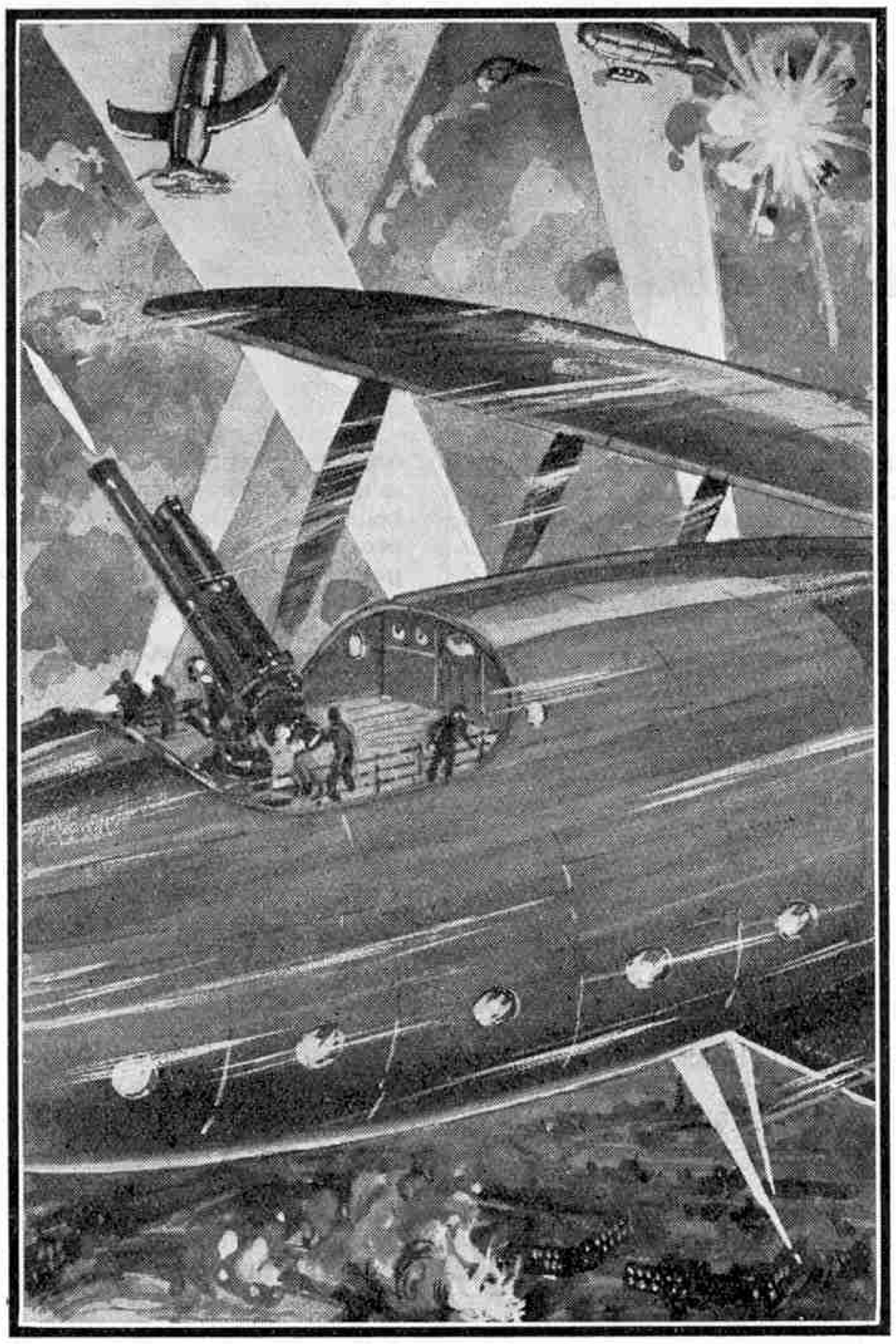
In frantic excitement I instantly conveyed this information to the War Ministry, but it was known there already. In another 60 seconds all the world knew of the declaration of war.

Immediately I began to consider what part I could take in the coming war and I decided that the best thing I could do would be to operate a fighting helicopter. I was backed up in this decision by my faithful Carruthers, who offered to come with me as bomber. Quickly we fitted the armament plates on to my helicopter, shut up the house and flew to London, arriving there just as the steady drone of the Martian aeroships was heard in the distance.

At the end of 100 minutes the Earth's forces were all gathered together on the Siberian Steppes, ready for immediate action.

* * * *

The manœuvres of the advanced squadrons of the Martian aeroships quickly made it evident that their idea was to wipe out London as a preliminary to destroying the British Isles. We were directed therefore to concentrate most of our forces on London. The first indication we received that the Martians were at work was a terrific explosion apparently some miles away. It was evident that the Martian death-ray had destroyed some important building, and we learned later that this was a gigantic munitions factory at a small town in Middlesex.



We had plenty of ammunition but not a Death-ray Apparatus

Subsequently we found out that the Martian death-ray burned and destroyed everything with which it came in contact. We employed a similar method of bringing destruction to the enemy's forces, but in addition we used high-power explosive that could be shot to a height of 6,000 ft. by means of a steel catapult gun.

* * * *

When the fighting began in earnest it was fierce beyond description, the combatants on the whole being fairly evenly matched. Carruthers and I had some very narrow escapes. One night we were just about to land when a Martian aeroship came whizzing round us intent on destruction. We had plenty of ammunition but unfortunately we had not a death-ray apparatus with us. After frantic circling for a second or two, a deadly-looking metal object came flying towards us from the aeroship, but I quickly accelerated and soon had put 10,000 ft. between us and the enemy. Carruthers then commenced active bombing operations, but our luck was out as the bomber went wrong after three shots, none of which took effect on the enemy.

We now had no means of escape left but flight, and a race for life ensued. I never felt so hot in all my life. In spite of all our efforts the aeroship gained appreciably upon us and kept on throwing out scorching rays, some of which did a good deal of damage to our machine. Then our fuel began to give out and we should have met with a terrible fate but for the presence of mind of Carruthers, who whipped out his portable wireless transmitter and sent out an "S.O.S." The response was immediate. Five of our bombing machines came racing to our assistance and in turn the Martians had to fly for their lives.

On another occasion our engine failed when we were in the thick of a skirmish. To add to our troubles the tail-end of the machine got entangled among the remains of an aeroship that came crashing down upon us. Fortunately I was able to steer clear of the wreckage and glide down to the ground, although we received a nasty jar on landing as our shock absorbers had been broken by the impact of the wrecked aeroship.

* * * *

The war came to an end on the 31st January 4000, when peace terms were signed, and for the first time the Martians stated their reasons for making war.

The Peace Terms provided for:

(1) No more war with the Earth during the reign of George XI., and

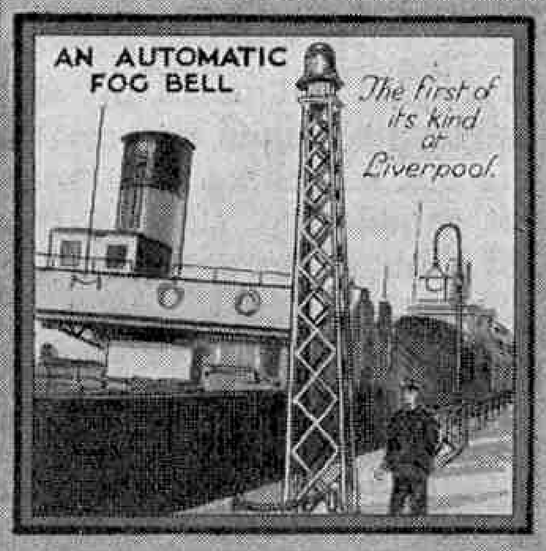
(2) The disarmament of both worlds.

The announcement of the two reasons for the war caused the greatest excitement. The first was that the Martians were disturbed because our scientists were discovering too many things about Mars and its inhabitants. The second reason was still more extraordinary. It was that the Earth was becoming far too gay, and the noise the people were making was proving a great annoyance to the sensitive Martians!

* * * *

Feeling the need of rest after the excitement of the war I decided to have a month's holiday at the seaside and Carruthers and I left Norfolk on 4th February 4000, for the Cornish coast on the "Sixty-Minute" train.

To-day I am peacefully smoking my pipe in the cool refreshing breeze from the Atlantic Ocean, and wondering what is going to happen next!



Of General Interest

Discovery of a New Star

The observers at Harvard University Observatory have confirmed the discovery of a new star observed by Professors Wolf and Reinmuth, of Heidelberg. The new star is of the 13th magnitude and is situated in a spiral nebula at an estimated distance of 10,000,000 light years from the earth. (A "light year" is the term employed by astronomers to denote the distance travelled by light in the space of a year; the speed at which light travels is about 186,000 *miles per second*!)

The new star is calculated to be 10,000,000 times brighter than the Sun, exceeding in brightness all the previous new stars except the Nova Andromedæ of 1885.

Coke Reclaiming Plant

An interesting plant for reclaiming coke from locomotive ashes is being constructed by the Boston and Maine Railroad Co., Mass., and it is anticipated that the railroad will be able to obtain all the fuel required for station heating, amounting to approximately 30,000 tons a year.

This new plant will recover from the locomotive waste, now dumped in the ash heaps, the unburnt coke present to the extent of 33 to 48 per cent., and it is anticipated that about 30 per cent. will be recovered. The new process is an adaptation of the one used in the hard coal fields for separating impurities, and is based on the comparative specific gravity principles, and the utilisation of the water flotation method by which the coke is segregated and the cinder residue precipitated.

It has been found that a considerable quantity of combustible coke is taken from fuel boxes in cleaning locomotives after each journey, and this unburnt material will contribute a large part of the new product.

King Alfred's Capital

Winchester is one of England's most ancient historical places. The first King of Wessex was buried where its Cathedral now stands and it was the capital of Britain in King Alfred's day. Here he wrote the Anglo-Saxon Chronicle and here died and was buried.

William the Conqueror built a palace here, and here the famous Doomsday Book was compiled. No cathedral hunter would ever dream of missing the eleventh century pile at Winchester.

In the castle, the ruins of which may yet be seen, the first Parliament met in 1265, and if you believe the seven-hundred-year-old legend, here you may see King Arthur's Round Table, around which his Knights used to sit.

Over a Hundred Years Ago!

"On Wednesday se'nnight a fine vessel called the St. George, capable of carrying 1,000 tons, and the largest that was ever built in Chester, was launched from the building yard of Mr. Wilson, near Crane, Chester."—"LIVERPOOL MERCURY," 8th Dec., 1826.

They Must have been Meccano "Boys"!

"On Friday evening last the Society of College Youths rang the bells of St. Paul's, Hammersmith, a true and complete peal of 5,040 grandsire trebles, composed of 98 bobs and two singles, in the space of two hours and 59 minutes. Among these youths was Mr. Hallett, parish clerk, and W. Paris, aged each 77."—"THE TIMES," 8th Dec., 1826.

There Were No Watercarts then!

"We understand that some of the most respectable tradesmen of the town are exerting themselves to get the High-street well watered every day during the summer months. We shall be very glad to see so desirable an acquisition carried into effect; and hope that if the Commissioners of the Street and Paving Act can further so desirable an object, they will not withhold their aid."—"HANTS ADVERTISER," 17th April, 1826.

He Was Wrong!

"A mechanic of Corsham, Wilts., is said to have discovered perpetual motion, and to have written a letter to the King informing him of the circumstance. It is represented to be a wheel set in motion by the help of magnets, and it had been going several days when the letter was sent."—"THE TIMES," 9th Nov., 1826.

Liquid Air Plant Explosion

A serious explosion at a liquid air plant at Boulogne-sur-Seine occurred during the evaporation of a large quantity of liquid air in order to obtain small quantities of xenon and krypton. Experts believe the disaster to be due to the presence of some impurity, probably acetylene, which gas is frequently found in the atmosphere due to the large amount of calcium carbide that is used.

As much as 1,000 cubic metres per hour are treated at liquid air plants. It is estimated that if acetylene is present in the atmosphere to the extent of one part in a million, then in one month there would be produced over two pounds of liquid acetylene. This gas when mixed with liquid oxygen forms a very explosive mixture.

Another impurity that might have been the cause of the accident is ozone, this gas would accumulate in a similar way to acetylene.

Fishes that Change their Colour

It is not generally known that fishes are able to adapt their colour to that of their background, so that it is difficult to see them even in the clearest water except when they are very near the surface. A trout, for instance, that lives in moorland streams, is usually dark brown in colour, matching the general peaty-coloured surroundings, but when he is transferred to clear water flowing over rocks and gravel, he changes in a very short time into a much brighter fish, with a dark green back and silvery undersides.

Perhaps the most surprising cases of colour adaptation are to be found among the flat-fish that live on the sand or mud at the bottom of the sea. Even a black background spotted with white is not altogether beyond their powers of imitation! It is a little mystifying to find that this imitative power is connected in some manner with eyesight. Although both the eyes of such a fish as the plaice or halibut are on the upper side of the head, so that the fish cannot make a close study of its background, yet severing the optical nerve or laying the fish with its eyes downward will prevent the colour change!

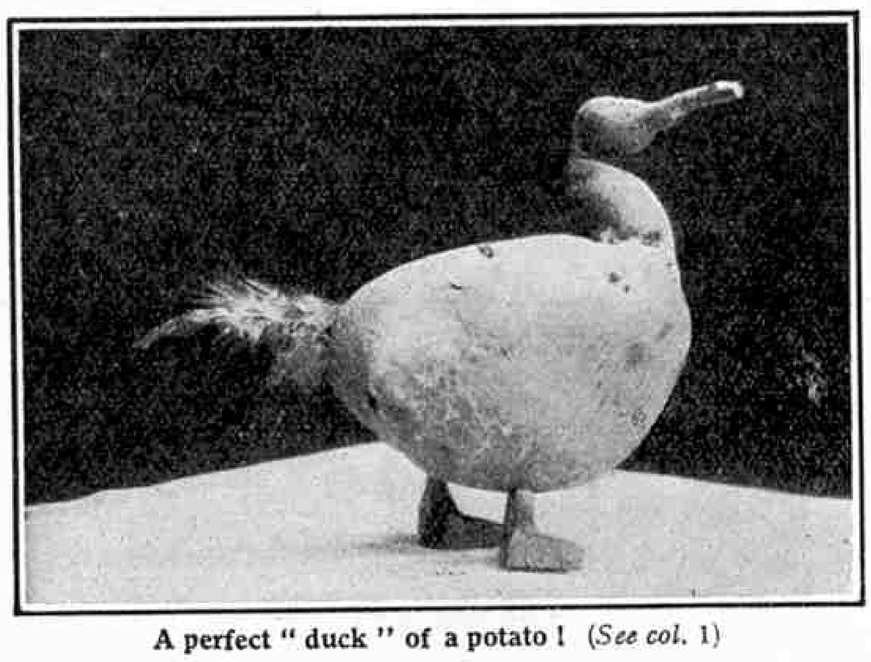
Clouds as Film Screen

An invention by means of which a picture may be thrown on the clouds is announced by a leading firm of optical-glass makers in Germany. They have perfected what is believed to be the first apparatus of its kind, and have carried out at Jena experiments in projecting pictures on the clouds. The success of the tests was remarkable, the pictures on the clouds coming out with great clearness.

Freaks of Nature

A short time ago the Editor of the "*Southern Railway Magazine*" published a photograph of a most unusual freak of nature, and by his kind permission we are able to reproduce this. As most students of nature know, it is a not uncommon thing to come across a case of "fasciated stem"—that is, one on which minor stems have grown out of the parent stem. The flower under notice, however, has "gone one better" even than this, having seeded and from the seed pod thrown out no less than eight stems crowned with perfect blossoms. There are thus eight perfect flowers from the parent flower—a French Marigold.

The announcement of this "freak" brought another interesting photograph, which is reproduced here also. This shows an "Arran Chief," a "perfect duck" of a potato, grown in the Isle of Wight. With the exception of the embellishments abaft and below, the potato here portrayed is exactly as taken from the ground.



A perfect "duck" of a potato! (*See col.* 1)

To those readers who are conversant with the eccentricities of Nature, the cause of the peculiar formation is obvious, but to those who are not quite so well versed in matters horticultural, it should be explained that this particular tuber has "grown out." Growing out is a trouble frequently experienced in a wet and dry season, and is due to the following cause: Under normal conditions the potato has made good progress; a prolonged period of dry weather ensues and growth is arrested. The warm dry spell of weather is followed by generous rains, and the potato, which has rested in Mother Earth, warmed, perhaps by weeks of powerful sun, is wakened into fresh activity; but, strange to say, instead of adding to its bulk by equally distributed expansion, it appears to find a weak spot in its outer raiment, and forthwith proceeds to grow knobs. These knobs frequently develop into entirely separate tubers, which, in turn, proceed to throw out yet another sucker or shoot, terminating in still another separate tuber, and so *ad infinitum*. It will be observed from the illustration that the first shoot has been severed at the termination of the "bird's" bill, enhancing the realistic effect.

The Thief of the World

Have you ever *seen* the thief of the world—the stoat, I mean, not the fox—actually at his mischievous work?

Listen, then, to a farm labourer friend of mine, in Worcestershire, who has.

In our rickyard (he says) was an old hovel, in a corner, and a stoat lived in there, well 'dug in.' We could never catch him. In the middle of the rickyard was a large fowl hut on wheels.

One day, at dinner-time, I stood looking out of the barn door, and I heard a soft noise in the hen-roost. In a moment, an egg fell out of the entrance-hole, down on to the ground, which was soft with straw litter.

At once the stoat sprang down after it, reared up on hind legs and ran merrily off, bowling the egg before him with his fore-paws. He ran at a good speed, trundling the egg, and looked so smart and funny.

Having no gun, I could not shoot him, so I shouted. He ran away and I rescued the egg. He must have lifted it out of the egg-box inside the hut, carried it to the hole and dropped it to the ground.



Another Freak of Nature—multiple marigold flowers from a seed pod

This same listener—what a lot he must have seen, since he started work at eleven years old, for half-a-crown a week, thirty-three years ago!—witnessed, going out to the farm one morning, that incident which I regretfully said some time ago I have never had the luck to see—a mother rabbit, in defence of its young one, knock a stoat flying.

Yet when there are no young to defend, how helpless the rabbit seems against its enemies!—"*Radio Times.*"

"Strads" that go to America

"If only the men with money would turn their attention to the art treasures, and, in particular, to the old Cremona violins which are taken to America by the score every year, they would not regret it, even from the financial point of view." So says Mr. John P. Sheridan, a well-known Liverpool violinist, who owns a Stradivarius of the Golden Period, as well as one of the world's finest Josef Guarnerius de Gesu instruments.

In spite of repeated and very substantial offers from Americans, Mr. Sheridan refuses to part with these valuable instruments. "I do not think it right that England, once so famous a home of art treasures, should part with all her lovely instruments to the Americans, who come over each year, scour the country, and then make an open boast that they possess practically every Cremona instrument that Europe has to sell them.

"It is to be regretted that more people do not use our own modern violins," he added. "Some of the more serious-minded makers of to-day are turning out some really fine instruments.

"There are not, and there never will be, enough Cremona instruments to go round, and it has been said on good authority that in 1940 a good Stradivarius will fetch £40,000."—"*Liverpool Echo.*"

Who Invented Postcards?

According to the late Mr. H. Snowden Ward, the plain, or ordinary G.P.O. postcard was invented on 26th January 1869, by Dr. E. Hermann, of Vienna, but it was not used in this country until October 1870. The use of picture cards was practically impossible in Britain until 1894, because no private cards were permitted until that year. A few pictorial advertisements very near postcard size had been used by Cassells and other firms, but they can scarcely be regarded as being real postcards, as they had to be sent at book-post rate, and were not allowed to carry a letter-like communication without being surcharged.

Messrs. Raphael Tuck and Sons began the picture-postcard business in 1899, but five years earlier picture-postcards were made by several firms, notably Messrs. Bloom and Degen, London; Stewart and Co., Edinburgh; and the British Photographic Publishing Co., Leicester. Sir Adolph Tuck probably did more than anyone else to popularise the picture card, of which he was undoubtedly the pioneer, although the statement—often made—that he was the real "inventor" of it, is not correct.

The World's Smallest Books

Several of the smallest books in existence—the Bijou and London Almanac ranging from 1789 to 1839—were sold recently at Sotheby's, the famous auctioneers in London. Some of them are so small that they are accompanied by a magnifying glass to enable their contents to be read. One is an almanac for 1838 and measures only three-quarters of an inch by five-eighths, and is about an eighth of an inch in thickness.

The Bijou Almanac was published annually from 1835 to 1853 and in 1841 was advertised as "the first book presented to the then Princess Royal of England," Queen Victoria's daughter. The tiny volume for 1838 contained portraits of William IV., Queen Victoria, Mozart, and Sir Walter Scott.

Other tiny books that have been published include "*The Mill*" (five-eighths by three-quarters of an inch), and the "*Midget New Testament,*" published in Glasgow. In 1674 there was published in Holland the "*Court of Flowers,*" which was one-fourth the size of an English penny stamp.

It is interesting to learn that the British Museum not only has copies of the smallest books, but also possesses the largest, which stands 5 ft. 10 in. in height and is 3 ft. 2 in. across. A beautiful set of miniature books was made for the Queen's Dolls' House exhibited at Wembley.

War on the Primrose

German doctors have opened a campaign against the primrose. They demand that this innocent looking, but pernicious, flower henceforth shall be banned, boycotted, and *verboten*. "Down with the Primrose!" is the new slogan that is being taken up in all seriousness by the leading Berlin medical journals.

One of Berlin's most prominent skin specialists declares that two-thirds of all the cases of facial eczema are traceable to the poison distributed by this insinuatingly popular plant. Contact with the petals of the bloom has a special danger to the face and hands, says the professor.

5,000 Tractors in 60 Days

A Wonderful Feat of War-time Production

THE light tractor as employed for farming operations of all kinds and for light haulage purposes is now so familiar an object that we are apt to lose sight of the fact that it is a very recent introduction.

The war with its inevitable result of acute shortage of labour and horses brought the tractor within a few months into a position that otherwise would probably have taken years to reach. The story of the "Fordson" tractor, for example, as told by Mr. Henry Ford in his remarkably interesting book: "*My Life and Work*," is a striking example of rapid development under the pressure of war-time conditions.

Tractors in War-time Emergency

Mr. Ford describes how in 1917, at about the time the United States came into the war, the British authorities, looking well ahead, realised with great anxiety that if the torpedoing of ships by German submarines continued at its then rate, the available shipping—already greatly depleted—would soon become insufficient to bring the American troops across the Atlantic, to carry the necessary munitions for these and other Allied troops, to carry the necessary food for the various fighting forces and at the same time convey enough food for the home population of England. The position was very serious and the British Government naturally looked round for some means of increasing the amount of foodstuffs raised in the country.



A Fordson Tractor as used for road haulage

Substitute for Draught Horses

One of the most pressing problems was that of finding a substitute for draught horses, of which there was an acute shortage. The English-made tractors in existence at that time were almost all steam driven and in the great majority of cases were too heavy for all-round agricultural purposes. It was impossible to begin to produce suitable tractors on a scale sufficiently large to be of any practical value, as the whole of the factories capable of manufacturing such machines were already working to their utmost capacity on the all-essential munitions.

High-speed Production

Tractors built in the United States had been assembled at the Ford works at Manchester for demonstration purposes and the Board of Agriculture recommended the Royal Agricultural Society to examine and test these machines and report upon their suitability. Two tractors were put through a variety of tests and the results were considered satisfactory. Finally the Ford officials in charge of the Manchester plant offered to make and deliver 5,000 tractors at an agreed price and to commence shipping them from the United States within sixty days, and a contract was immediately signed.

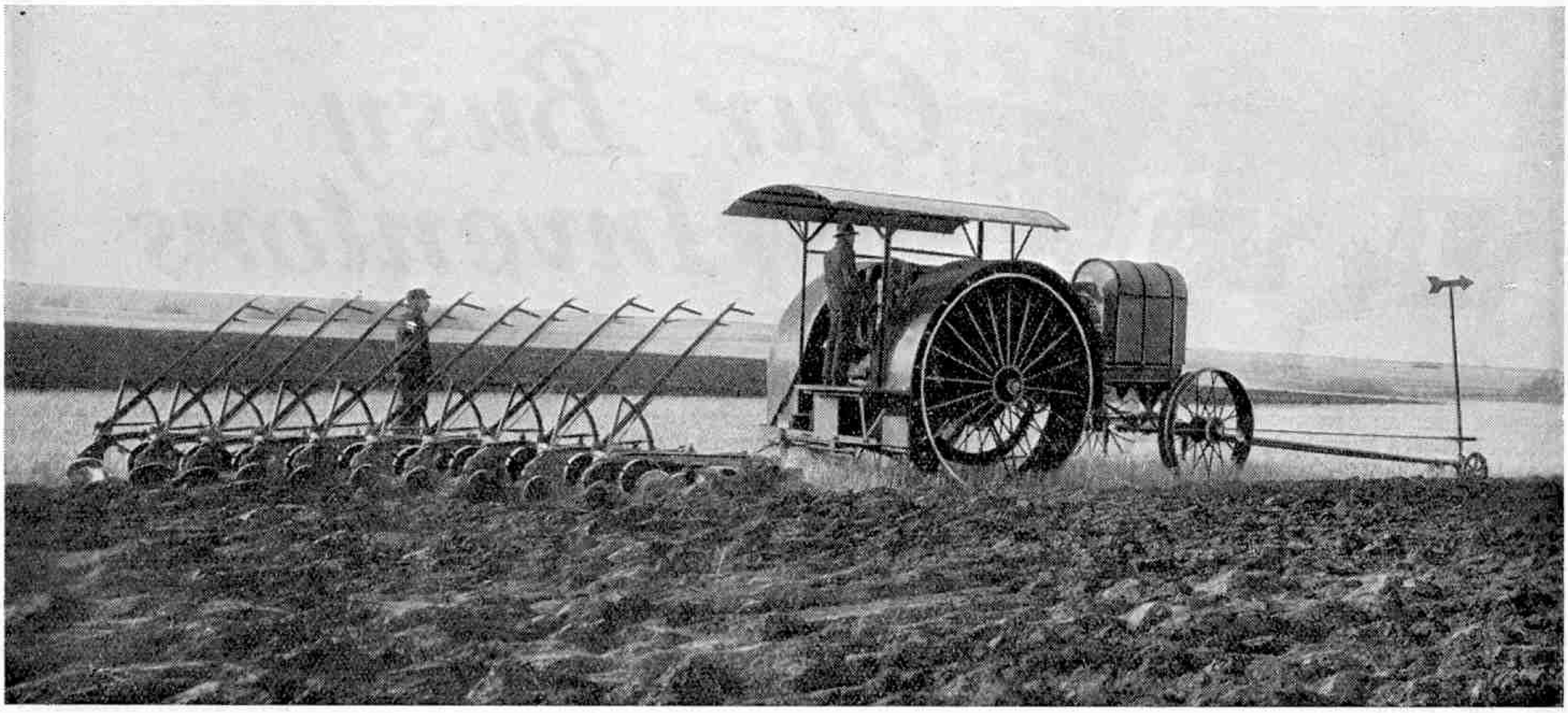
At that time the Ford Tractor Works in the United States were not ready for production, as it had not been intended to commence output for another year. In order to meet this emergency a special plant was erected and equipped at lightning speed, and in less than sixty days from the signing of the contract the first tractors were at the docks at New York in the hands of the British authorities. The entire shipment of 5,000 tractors was put through within three months.

Mr. Ford points out how this emergency production resulted in the Fordson tractor being actually at work in large numbers in England before it was really known at all in the United States where it was designed and built.

Power for the Farmer

Mr. Ford began life on his father's farm in Michigan and he tells us that his earliest ambition was to provide farmers with an adequate source of power to haul their plough and other implements. He believes that within comparatively few years: "a farm depending solely on horse and hand power will be as much of a curiosity as a factory run by a treadmill."

Perhaps he is a little too optimistic in this view, but there is no doubt at all that, for the larger farms at any rate, the tractor possesses very great advantages over horses and one feels that another of Mr. Ford's



The Tractor in Agriculture : Hauling Multiple Plough in Canada

prophecies is in a fair way to be fulfilled : " We shall have as great a development in farming during the next twenty years as we have had in manufacturing during the last twenty."

Tractor's Advantage Over Horses

For agricultural purposes one of the great points in favour of the tractor as compared with horses is its superior speed. The tractor does not get tired, it works steadily along hour after hour on any kind of land, heavy or light. It used to be argued that the light tractor, as opposed to the old heavyweight machine, was not capable of pulling a plough through very heavy clay soil, and that it could not plough to a sufficient depth. Both these arguments have been refuted and whatever drawbacks the tractor may have they do not lie in these directions.

Of course, the usefulness of the tractor is not by any means confined to ploughing. It can be used successfully for cultivating, drilling or rolling and as a source of power for harvesting operations it is unsurpassed. It is also always available for any kind of haulage operations, either on the farm itself or on the road in the way of bringing material from the railway station to the farm.

The present-day tractor has reached such a pitch of mechanical efficiency that it may be employed for an almost infinite variety of purposes quite apart from agriculture. Its great advantage lies in its mobility. Where the work cannot be brought to the tractor the tractor goes to the work. Consequently we find tractors at work in all sorts of unexpected places, engaged in driving stone-crushing plant, mortar mills, tar macadam and concrete mixers, pumps, air compressors for rock boring and drilling and other machines too numerous to mention.

The tractor also finds a very valuable sphere of employment in haulage work for which big and heavy road locomotives are unsuitable, particularly in working over bad ground where the heavier machine would sink and come to a standstill. An interesting development during the past year or two has been the employment of tractors for grass cutting and other operations on golf courses, and there appears to be unlimited scope in this direction.

In the Stocks—(*continued from page* 530)

was heard uttering such an expression as " Plague take you," he was promptly arrested, fined and placed in the stocks to meditate upon the error of his ways. Apparently in those days it was wise to think before speaking !

There are many references to stocks in the literature of the period, among which one of the most interesting is the following from Shakespeare's "*King Lear*," published in 1607 :—

The Duke of Cornwall discovers Kent quarrelling with Oswald, a steward of the King's daughter, and angrily declares (*Act* 2 : *Scene* 2) :—

D. of C. " Fetch forth the stocks !
You stubborn ancient knave,
you reverend braggart,
We'll teach you — "

Kent : " Sir, I am too old to learn ;
Call not your stocks for me,
I serve the King
On whose employment I was
sent to you."

D. of C. " Fetch forth the stocks ! As I
have life and honour
There shall he sit till noon."

Regan : " Till noon ! Till night, my
lord ; and all night too."

The unhappy Kent is forthwith thrust into the stocks and left there. He is still a prisoner when the King, in the company of Gentlemen and the Fool, arrives (*Act* 2 : *Scene* 4) :—

Kent : " Hail to thee, noble master ! "

King Lear : " Ha ? Mak'st thou this shame
thy hobby ? "

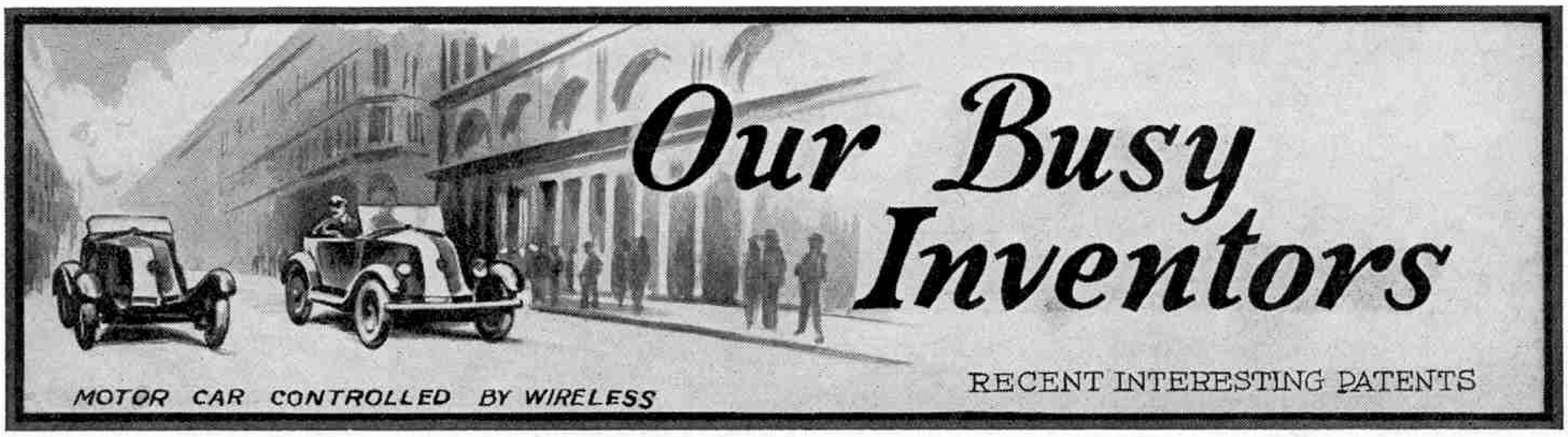
Kent : " No, my lord."

Fool : " Ha, ha ! he wears cruel
garters. Horses are tied by
the heads, dogs and bears by
the neck, monkeys by the
loins, and men by the legs.
When a man's over-lusty at
legs, then he wears wooden
nether-stocks."

Gradually stocks fell into disfavour as a means of punishment. The last stocks in London were removed in 1826 from St. Clemence Dane, in the Strand, but they persisted until later in certain parts of the country. They were used, for instance, in Colchester in 1858, at Tavistock in 1863, at Rugby in 1865 ; while at Newbury in 1872 or thereabouts certain individuals were escorted to the local stocks and imprisoned therein as a " reward " for misbehaviour in church !

To-day such stocks as still remain are lonely relics of a bygone mode of punishment and are unpatronised except by curious sightseers like the two gentlemen in our illustration.

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Enclosed Motorcycle Engine

Visitors to the Tourist Trophy races in the Isle of Man this month may see a novel motorcycle that is the invention of a Liverpool man, Mr. A. Tinkler. The inventor obtained third place in the sidecar event in the T.T. races in 1924 and he intends to use his new motorcycle in this year's senior race.

The really novel feature of the cycle is that the engine and transmission are enclosed, the only moving parts visible being the wheels. The valves are operated by an overhead cam shaft. The engine is a 500 c.c. single cylinder, water cooled, with chains totally enclosed, and running in oil. The engine has given good results on the bench, but still awaits a road test.

The improvements in the transmission, such as the provision of oil baths for the chains, are certain to promote increased efficiency, while the cover prevents damage from grit and dust thrown up from the road.

* * * *

Clock Wound by the Wind

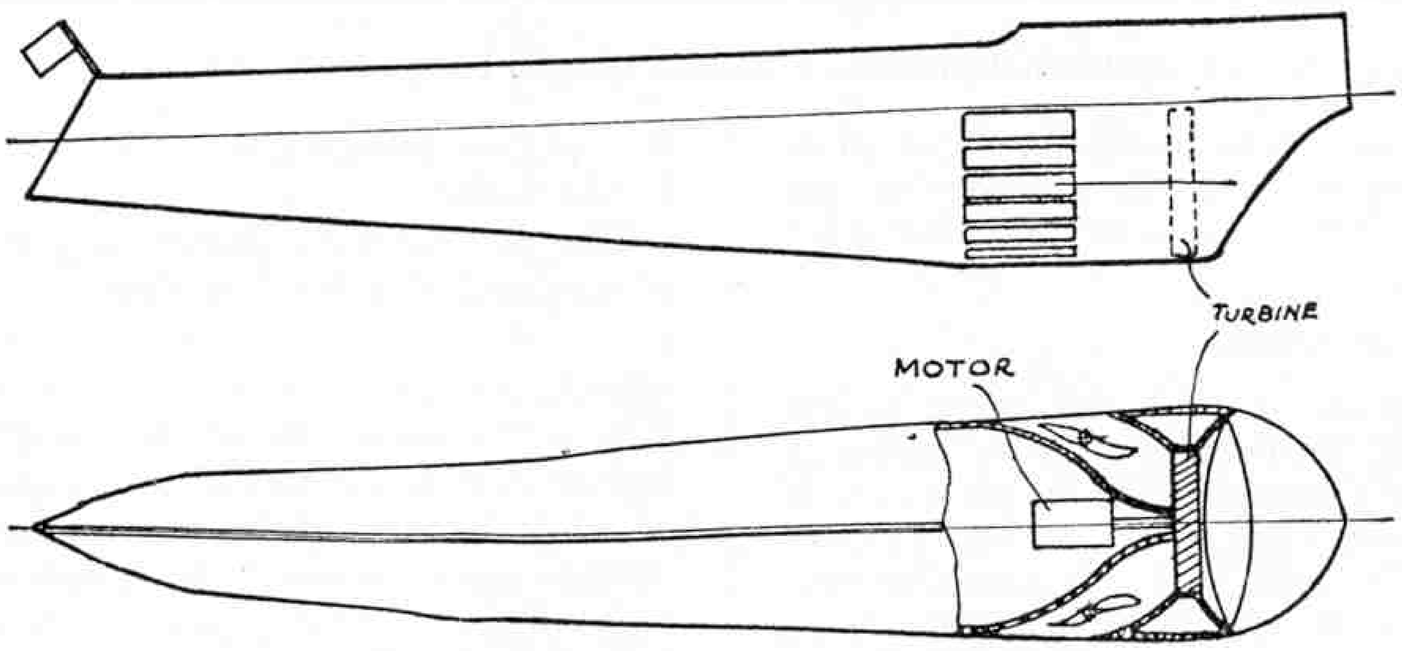
Almost perpetual motion, but not quite, is the claim of the American inventor of a remarkable clock. It is a gravity-driven time-keeper depending on wind power for the renewal of its motive force.

The drive is obtained by the fall of a steel ball that drops into a cup on the main shaft of the clockwork and turns this by its own weight. Above and below the main works are spiral tracks upon which a number of the steel balls run. Each of these drives the clock through approximately a quarter of a revolution, at the end of which period it falls out, while a new one is released mechanically from above to take up the driving duty. Sufficient balls are stored on the spiral tracks to last for five days.

The only external power required is that necessary to hoist the balls to their positions above the clock. For this purpose a small elevator runs upwards from the bottom of the lower spiral track, which automatically transports the balls one at a time. This is driven by a windmill with funnel-shaped vanes mounted above the clock. Any passing air current sets this in operation and as the supply of balls will last five days it will seldom be necessary to adopt any other means for keeping the clock in action.

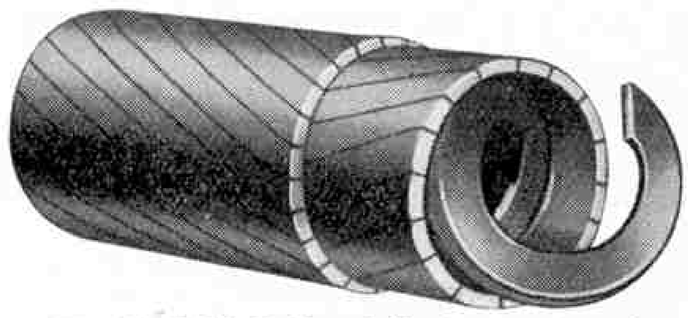
Cinematograph Film on Copper

An interesting cinematograph invention has appeared in Germany. Instead of using a transparent celluloid film and projecting the light from the film on to the screen, the new idea makes use of a film of thin copper. This, of course, is not transparent, and the picture is projected on to the screen by light reflected from the film.



The "*Forelle*," a novel Boat described on the next page

The most important point about the new method is that the flatness in the picture is abolished. The pictures are photographed in four exposures, from four points diagonally opposite each other, and the four pictures thus taken are combined into one master film. The finished picture as projected from the master film then presents a true perspective view of the scene photographed. It is also possible to produce multi-coloured effects in a simple manner.



The "A.E.G." Hollow Cable (see next page)

Safety Device for Gas

A simple automatic gas valve has been patented by a Liverpool inventor. The purpose of the "Riscavoid," as it is called, is, as the name suggests, to guard against the risk of poisoning by escaping gas.

This valve can be adapted quite easily to any gas fitting. In its normal position no gas can pass through it as the valve is kept automatically closed until a release button underneath is pressed upward. Having been released in this way with the ordinary tap opened, the valve then remains open until the tap is closed or until the pressure falls, as for instance, when the slot meter is not in use. In these circumstances the valve closes, and then once more the gas is cut off until the release button is pressed.

It will be realised that this valve gives a complete guard against gas escapes, as in all cases it must be deliberately opened before any gas can pass, while it comes into action automatically when needed.

* * *

Lock that Makes Time Record

It is often a matter of importance to know when and by whom a door was locked, as for example in the case of small lock-up branches of large multiple stores. An American inventor has now made this possible, the lock itself being made to give the record.

Usually six keys are provided for a lock of the new type, each key having an initial at the end. When inserted into the lock the end presses against a travelling tape driven by an accurate clock so that the time is registered and at the same time an impression of the initial at the end of the key is obtained. Thus irregularities and late coming are easily detected by this lock.

* * * *

Electric Power Without a Dynamo

A method of producing electricity that has been known for many years is to heat the junction of two metals, when a current will flow through a wire connecting them externally. This method so far has not been able to compete with the dynamo, but now two Americans claim to have developed it into a commercial possibility.

The difficulties previously were partly mechanical and partly economic. The current produced was less than could be obtained by other methods for the same expenditure of energy, and the cost of the metals used was a heavy item. The inventors claim to have discovered an alloy of cheap and abundant metals that is specially suitable for the purpose. The thermo-couples, as the current-producing units are called, are heated by oil, gas or coal burned beneath a cylinder containing them.

It is stated that a 40-room house has been lighted with a plant of this type that cost only £16 or so to construct.

Improved High Tension Electric Cable

The safe and economic transmission of electricity at high voltages is attended with many practical difficulties and attempts have been made by electrical experts in many countries to effect improvements in the methods in use. One of the most promising suggestions appears to be one patented by the " A.E.G.," the well-known German electrical firm, the engineers of which have produced a hollow cable of satisfactory construction.

For small voltages ordinary copper wires are quite satisfactory, but if they are used with high voltages leakage takes place. With the very high voltages now used for long-distance power transmission the leakage is made evident by the glow that is often visible round the wires at night, particularly where they are in contact with their supports. The obvious method of preventing this is to use conductors of large diameter so as to reduce the voltage per unit area of surface. Unfortunately the increase necessary in the diameter of copper conductors means a very large increase in cost and also in difficulty of handling.

One solution of the problem is to use hollow conductors of large external diameter, as it is the surface layer of a conductor that is concerned in the transmission of high tension alternating current, a fact familiar to all wireless experimenters. A hollow cable of ordinary construction would be quite unsatisfactory as regards strength, however, and the central feature of the invention patented by the A.E.G. is the design adopted to give a reasonably simple and yet strong and easily handled cable. This is a spiral shaped metal band wound edge-ways, as shown on the previous page. This method of winding gives a spiral that is almost rigid when supported by two layers of hard-drawn copper strip wound in opposite directions. The only new feature in the machinery used in the manufacture of this type of cable is a special nut that is used for guiding the strip during the spiral winding process. Means must also be provided to prevent the spirals from falling over on their flat sides.

The A.E.G. have used this new form of cable with great success in important installations in the brown coal districts near Cologne. This low-grade coal is very largely used for producing electric current, which is transmitted at high tension by overhead cables to considerable distances, for which purpose the new cable is eminently suitable.

* * * *

An Ingenious Printing Invention

A new printing material has been introduced by a German inventor. This is a hard clay-like substance, called " Depesi," which is mounted on wood so that the surface is at the right height for printing.

This material is very suitable for amateur work as the large Wood and Block letters can easily be cut out with a sharp knife or chisel and file after they have been traced on the hard surface. If a mistake is made it can be rectified by filling in with a mixture of the powdered material and gum. When dry this is smoothed down with sandpaper. Clean cut edges are readily obtainable with this very durable new material.

Water Tap that Cannot Leak

After 14 years' work a consulting engineer in London has succeeded in producing a tap that cannot leak. It can be easily taken to pieces for cleaning purposes and any defective part replaced in a moment without any necessity to call in a plumber.

The inventor, Mr. Richard Howell, has always been impressed by the enormous amount of water wasted through the inefficiency of the old type of water tap. The washer is the great weakness, as it perishes too easily and the fitting of a new one is too costly and troublesome. The wastefulness of a leaky tap may be gauged by the fact that as much as 40,000 gallons of water may be lost annually through one tap.

The new tap is washerless, and is guaranteed to remain splashless and dripless for ten years at least, during which time it will not require repair or replacement. In a trial one of the new taps has been mechanically turned off and on for more than a quarter of a million times and still does not leak.

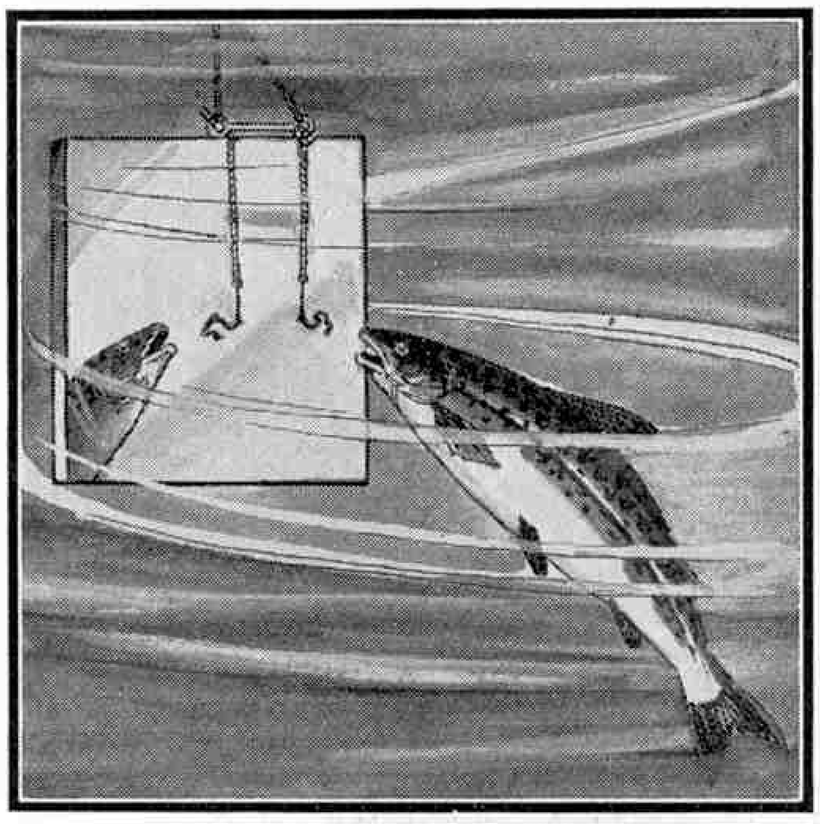
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Silk from the Dustbin

The disposal of garbage has long been a problem to municipal authorities, but it may soon be made into a profitable business yielding gun-cotton, artificial silk, tar, charcoal and acetic acid, by means of a process invented by a Berlin engineer, Herr Kurt Gerson.

Garbage often includes cellulose-containing materials, such as wood, old cloth, etc., and by the new method this is separated and sifted. It is first subjected to a special treatment, after which it can be turned either into gun-cotton or artificial silk. The remaining refuse, potato peelings and other organic matter is made to give tar, charcoal, and acetic acid by distillation.

Curious Ideas of Inventors of the Past



(3) Deceiving the Fishes

A patent, taken out in 1894, consisted of a mirror that was intended to act as a lure for fishes. The idea was that " the fish, when approaching the bait, will see the reflection of himself in the mirror and will be made bolder by the supposed companionship, and more eager to take bait before his competitor seizes it "

Novelty in Ship Construction

A boat constructed on entirely new lines has been produced by Mr. A. Boerner, a German inventor, who has derived his inspiration from the action of fast swimming fish. Mr. Boerner had long been puzzled by the great speed with which a trout swims against the current in a river, and from the study of this motion and that of the biggest fast swimming fish, the shark, he has arrived at some remarkable conclusions.

It is commonly believed that a fish swims by means of its fins, but Mr. Boerner holds otherwise. He noticed that the shark possessed more gills than slower fishes, the great blue shark having no fewer than ten. He further noticed that the shark had many thorn-like prominences on the skin that certainly were not needed for protection. Finally he arrived at the conclusion that fishes do not swallow water merely for breathing, but also for swimming, so that the gills are doubly important.

According to this theory the water swallowed is expelled backward from the gills with increased velocity and is sent gliding over the surface of the body of the fish. In this manner a medium is inserted between the body of the fish moving forward and the resistance set up by the water. Further, the expelled water forms eddies that catch on the scales of the fish and assist its movement in a forward direction. The fins are used only for the preservation of balance, and the tail for starting and steering.

Having arrived at this explanation, Mr. Boerner constructed an experimental model of a boat in accordance with his new theory. Instead of placing the screw at the stern, as in the ordinary boat, he placed it in the forward section of the bow where his boat has a funnel-shaped opening below the water line. On each side of the boat, in positions corresponding to those of the gill-slits of the fish, were openings designed to fulfil a similar purpose, the water being driven by the screw through these openings. The sides of the boat behind the slits were roughened in imitation of the roughening of the skin of the shark. The boat was 30 ft. in length and was provided with an engine of 6 h.p. only. Its unique appearance and the origin of its design led the inventor to call it the " *Forelle,*" this being German for trout.

Trials made on the Elbe near Dresden seemed to verify the inventor's theories. Resistance to the movement of the ship seemed to be entirely absent, as was shown by the fact that the boat made hardly any bow-wave. A surprising speed was reached, but in spite of this only a small backwash was noticeable. Trials are now to be made with larger vessels constructed on the same plan in the expectation that the Boerner effect, as it is called, will be found to be applicable to all river and sea-going craft. If this should prove to be the case it should be possible to increase the speed of ships by more than 100 per cent. without any increase in power, a saving of energy of about 70 per cent. being thus effected.

Steering can be effected quite easily with the Boerner ship by varying the flow of water through the artificial gill-slits. The boat turns towards the side on which the flow is reduced.

Fine Model of 40-Gun Ship

Recently Completed by "*Arabic's*" Third Officer



HAVING worked two years, in his hours off duty, in shaping and rigging a model of a 40-gun frigate of the year 1700, Sidney B. Morfee, third officer of the White Star liner "*Arabic*," now has the satisfaction not only of seeing his task drawing to a successful close, but also of knowing that his little ship is worth at least £200, for he has just been offered this sum, which offer he refused, however.

The model, which is 2 ft. 6 in. in length, is the latest of several made by Mr. Morfee in recent years. It was preceded by a model of the "*Mayflower*," the Pilgrim ship, made while he was in the "*Olympic*."

Mr. Morfee's models are notable for their fidelity to detail. Every feature of the original ship is presented, as nearly to scale as is possible on such a small reproduction. The original of his 40-gun frigate was the "*St. George*," one of the most elaborately decorated vessels of her time in the British navy, with much carving and gilding about her stern, and with gilded wreaths about her upper tier of gun ports. The designs in the carvings were symbolical of the union of England and Scotland, with roses and thistles intertwined, and lions and unicorns fraternizing amidst cherubs and other symbols of love and felicity.

All this ornamentation has been reproduced by Mr. Morfee, in carving of minute perfection. Guns and gun carriages, rails, stern lanterns, fiddle head, anchors, capstan and fighting tops are perfect in every detail. Gilding has been put on wherever shown in the original, and the ship's rigging and blocks are reproduced with an accuracy of which only a sailor is capable.

In creating his miniature ship, Mr. Morfee followed exactly a contemporary model of the "*St. George*," a piece of great value, owned by the Metropolitan Museum of New York, making many visits to the museum to study its details, and securing photographs of it from which to work.

The lines of the hull, and the rigging and sail plans were obtained from works on naval architecture that give them in exact measurements, from the original builder's plan.

The materials used in the model include white pine for the hull, various hard woods for the rails and carvings, brass and other metals for various fittings, and linen thread of different sizes for the rigging.

We are indebted to the "*Ocean Ferry*" for the above particulars and for the accompanying illustration.

OUR MAIL BAG



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

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

S. A. Marsh (Greenock).—We greatly appreciate your enthusiasm for Meccano and the "*M.M.*" Your suggestion regarding the covers for the Magazine is interesting and practical and will have careful consideration, although we cannot promise to make the change. Why not enter some of your models in our competitions?

J. Haggan (Belfast).—"I received your answering letter alright and I think it was just splendid of you to answer it in the way you did. Honestly, dear sir, I bubble over with glee every time I think of such an organisation as the Meccano Guild." We hope, J.H., that you will continue to "bubble" for many years! As to our reply to your letter, we answer carefully every letter that comes along and we endeavour to enter into the spirit of our correspondents in each case.

K. Cradduck (Manchester).—Very many of our correspondents agree with you that it seems a very long time waiting for the next "*M.M.*" Unfortunately it takes a considerable amount of time to prepare each issue and we are afraid that the interval cannot be shortened at present. We are glad that you enjoyed your visit to our factory, and we shall hope to see you again on some future occasion.

E. Judd (Winnipeg, Canada).—"Now I have discovered the "*Meccano Magazine*" you will be annoyed by one of my epistles every once in a while." You are quite wrong, E.J., for on the other hand we shall always be glad to receive cheery letters like yours. Day by day we receive further proof of the good work accomplished by the Guild in bringing together, either personally or by correspondence, boys all over the world who have the common interest of the Meccano hobby.

H. G. Cole (Dorking).—We must compliment you upon your skill as a typist. We are most emphatically of opinion that typewriting is easier to read than handwriting. Almost every day we receive one or two letters that are almost indecipherable. Sometimes we have to hold a sort of committee meeting of the staff to worry out some of the words, and you would smile if you heard the many different suggestions put forward! The trouble is bad enough when the letters are in English and you may imagine what it is like in letters from foreign boys.

L. Martin (Barrow-in-Furness).—"Before my brother obtained a Meccano he was very impatient when doing things, but since he got his set he has calmed down, so that is one good thing Meccano has done for him!" As a matter of fact Meccano cures quite a lot of diseases of this kind!

W. Ashworth (Hoddlesden).—We receive many letters like yours from enthusiastic model builders expressing appreciation of the value of "*Standard Mechanisms*," and like you many of our correspondents wonder how they ever built good models without it. The great value of this manual is that it provides a real solid foundation upon which any type of model may be built on sound engineering lines. One flourishing Meccano Club devotes certain evenings specially to the study of sections of this Manual, and the results have been splendid.

B. J. Slade (Minehead).—There is a danger that the Magazine staff may begin to suffer slightly from "swelled head" if they read many letters like yours. In regard to your remark: "I bet you have a time of it getting it ready every month," we hasten to assure you, B.J.S., that you win your bet! We do "have a time of it," but so long as the many thousands of our readers are satisfied with the result we feel well repaid.

J. Watson (Birmingham).—We are sorry that there has been a little misunderstanding regarding your order for Meccano parts. With certain exceptions, all Meccano parts are now coloured and these coloured parts will always be supplied unless the order distinctly specifies nickelled parts. We are glad to note that you have now obtained exactly what you wanted and that, as you put it, you are once more "smiling from ear to ear."

A. Hill (Cottesloe, W. Australia).—We are always glad to receive your letters and we are not a bit dismayed when two arrive within a couple of days of one another! Your cutting regarding the proposed railway from Freemantle to Esperance is quite interesting and if the scheme materialises we shall be glad if you will send us further details. The profession of pharmaceutical chemist ought to suit you admirably but we beg of you to be a little more cautious in your experiments otherwise, as far as we can judge, you are likely to blow yourself up one of these days!

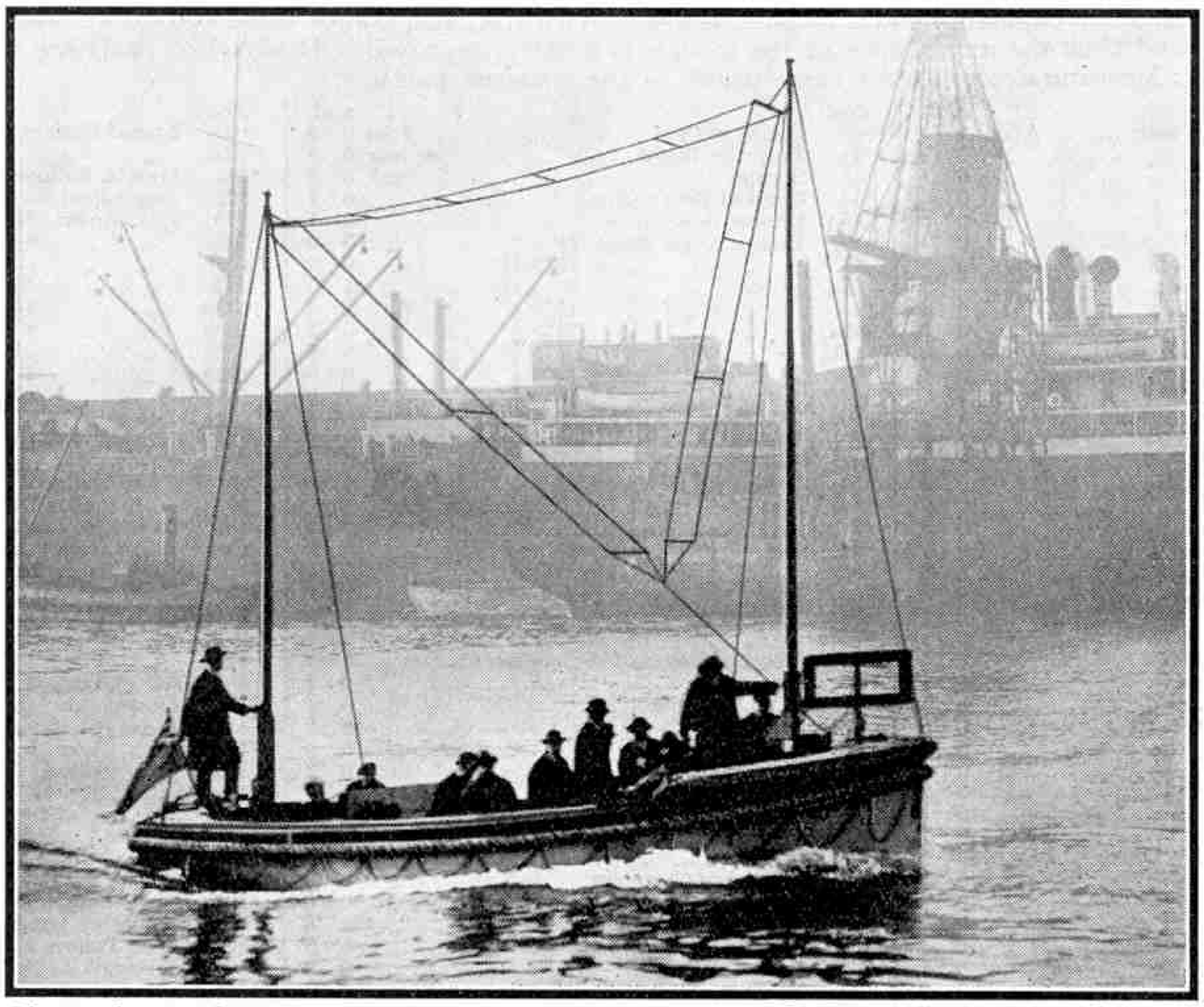
New Motor Lifeboats

Fitted with Wireless and Direction Finders

By J. Robertson

AMONG the more recent developments in wireless communication has been the fitting of a complete transmitting and receiving installation to the motor lifeboats now carried by all large liners. These motor lifeboats are about 30 ft. in length and are strongly built of steel and propelled by a powerful petrol motor. Their principal work consists in the towing of other lifeboats and therefore they are fitted with a strong hook and tow rope.

The larger liners carry two such boats, one on the starboard side and the other on the port side. Thus, whenever it is required to lower the lifeboats in bad weather, at least one of the motor boats will be on the lee side of the ship. In such a case, when all the available boats have been launched they are gathered together and attached by a tow rope to the motor boat.



Photograph courtesy] [*Marconi's Wireless Telegraph Co. Ltd.*

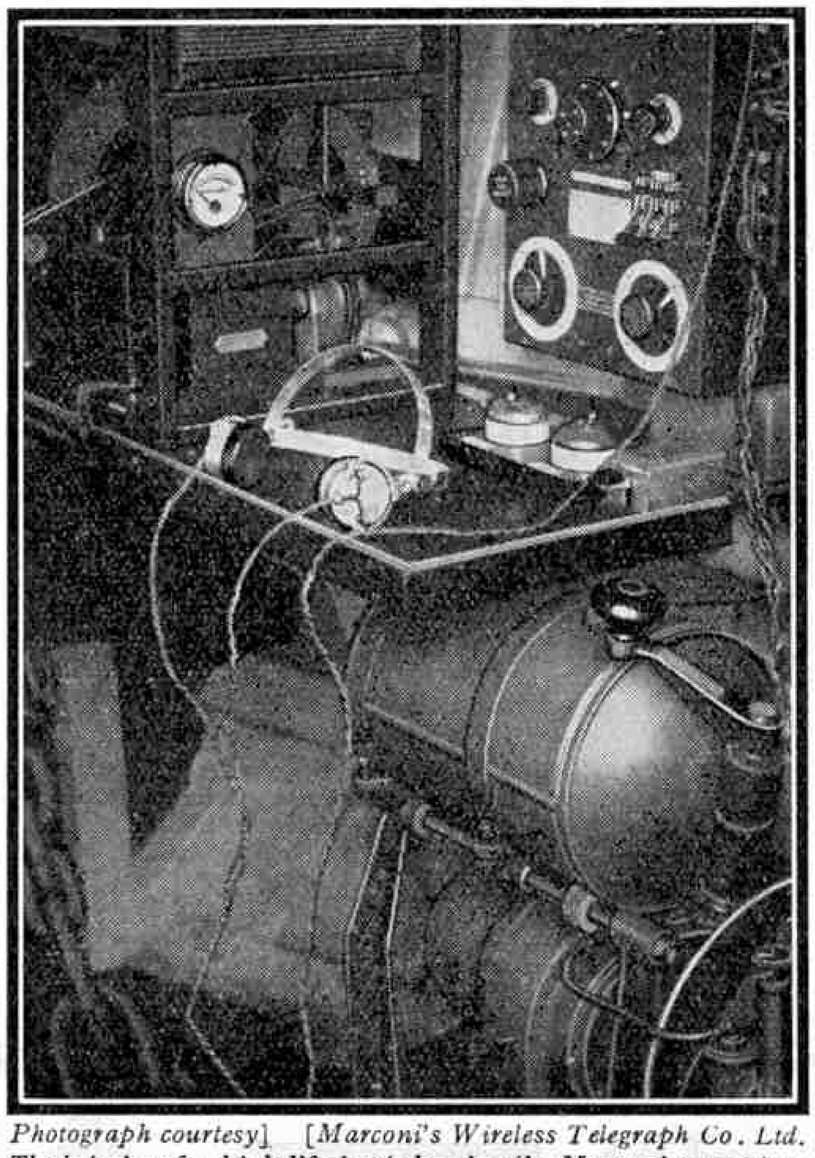
A ship's motor life-boat fitted with Marconi apparatus. In the bow of the boat is shown a rectangular frame used in connection with the direction-finder

Motor lifeboats are fitted with a ¼ k.w. transmitter using a quenched spark. The power is supplied in some cases from an accumulator battery having a capacity of 25 volts, 80 ampere hours, which drives a suitable motor generator. In other cases a small petrol engine is used to drive the generator.

When accumulators are used these are generally of the nickel-alkali type, as such cells will stand more rough usage than the ordinary type. In either case the alternating current supplied by the generator is passed through a step-up transformer, which raises it to the necessary voltage.

The receiver is of comparatively simple design. It consists of a single-valve set complete with batteries capable of working for a considerable period, together with a crystal detector for use when the batteries become exhausted. The tuning is simple and is confined to a wavelength of about 600 metres, this being the standard wavelength for distress working.

The apparatus is secured in a tiny cabin in the bows of the boat, sufficient space being provided for a small seat for the operator. The down lead is brought into the cabin by an insulated lead-in and thus the apparatus is safe from damp and always ready for use in a few moments.



Photograph courtesy] [*Marconi's Wireless Telegraph Co. Ltd.*

The interior of a ship's life-boat showing the Marconi apparatus. On the left is the ¼ k.w. quenched spark transmitter, and on the right the six-valve direction-finding receiver. The petrol-driven generator is shown underneath

The greatest difficulty that presented itself to the designers was the limited height and length of the aerial system. This problem was solved by using a long down lead stretching from the after end of the aerial down to the cabin roof forward, instead of the usual direct down lead from the forward end of the aerial. In this manner the effective length was increased considerably.

The aerial generally fitted is of the ladder type, that is, it consists of two wires placed a short distance apart and held in position by separators placed at intervals of a few feet, the aerial thus having the appearance of a rope ladder. An aerial of this type has the advantage of being very easily rolled up and of occupying very little space when not in use.

All wireless installations are under the control of the Postmaster General and the requirements for a motor lifeboat are that the apparatus shall be capable of working for a period of not less than eight hours continuously, so that by careful manipulation and use at fixed periods it is possible to continue working for even several days.

In addition to the usual transmitting and receiving apparatus is a direction-finding receiver complete with frame aerial and using six valves. As high-frequency amplification is employed, each separate stage being screened with copper to prevent oscillation, the set is capable of taking very accurate bearings on a station over 100 miles distant.

Direction-finding apparatus will be of the greatest possible value to motor lifeboats in cases of emergency. For instance, if the boats became separated in fog, each could plot its exact position on the chart and by exchanging this information a course could be set that would bring the boats together again. Further, the lifeboats could exchange information regarding their respective positions with a vessel coming to their rescue, thus enabling the distance separating them to be measured and the time calculated that must elapse before the vessel reaches them. In this manner the dreadful uncertainty of rescue would be removed.

Motor lifeboats, of course, carry the usual compass and charts, together with tools, ropes, food and water.



MECCANO
ACCESSORY PARTS

The full range of Meccano Accessory Parts is listed below. With the exception of those starred all steel parts are now brightly enamelled in colours, and thus the appearance of the models is greatly improved. If nickelled parts are preferred they may still be obtained from your Meccano dealer at the same prices as the coloured parts.

No.		s.	d.
1.	Perforated Strips, 12½" long ... ... ½ doz.	1	0
1a.	" " 9½" " ... ... "	0	9
1b.	" " 7½" " ... ... "	0	8
2.	" " 5½" " ... ... "	0	6
2a.	" " 4½" " ... ... "	0	5
3.	" " 3½" " ... ... "	0	4
4.	" " 3" " ... ... "	0	3
5.	" " 2½" " ... ... "	0	3
6.	" " 2" " ... ... "	0	3
6a.	" " 1½" " ... ... "	0	3
7.	Angle Girders, 24½" long ... ... each	0	8
7a.	" " 18½" " ... ... "	0	6
8.	" " 12½" " ... ... ½ doz.	1	9
8a.	" " 9½" " ... ... "	1	3
8b.	" " 7½" " ... ... "	1	2
9.	" " 5½" " ... ... "	1	0
9a.	" " 4½" " ... ... "	0	10
9b.	" " 3½" " ... ... "	0	8
9c.	" " 3" " ... ... "	0	8
9d.	" " 2½" " ... ... "	0	7
9e.	" " 2" " ... ... "	0	6
9f.	" " 1½" " ... ... "	0	6
*10.	Flat Brackets ... ... "	0	2
*11.	Double Brackets ... ... each	0	1
*12.	Angle Brackets, ½"×½" ... ... doz.	0	6
*12a.	" " 1"×1" ... ... each	0	1
*12b.	" " 1"×½" ... ... "	0	1
13.	Axie Rods, 11½" long ... ... "	0	3
13a.	" " 8" " ... ... "	0	3
14.	" " 6½" " ... ... "	0	2
15.	" " 5" " ... ... "	0	2
15a.	" " 4½" " ... ... "	0	1
16.	" " 3½" " ... ... "	0	1
16a.	" " 2½" " ... ... "	0	1
16b.	" " 3" " ... ... "	0	1
17.	" " 2" " ... ... "	0	1
18a.	" " 1½" " ... ... "	0	1
18b.	" " 1" " ... ... "	0	1
19.	Crank Handles, Large ... ... "	0	3
19s.	" " Small ... ... "	0	3
19a.	Wheels, 3" diam., with set screws "	0	8
20.	Flanged Wheels ... ... "	0	6
	Pulley Wheels.		
19b.	3" dia. with centre boss and set screw "	0	8
19c.	6" " " " " " "	2	6
20a.	2" " " " " " "	0	6
21.	1½" " " " " " "	0	6
22.	1" " " " " " "	0	4
23a.	½" " " " " " "	0	4
22a.	1" " without " " " "	0	2
23.	½" " " " " " "	0	2
24.	Bush Wheels ... ... "	0	6
25.	Pinion Wheels, ¾" diam. ... ... "	0	6
26.	" " ½" " ... ... "	0	4
	Gear Wheels.		
27.	50 teeth to gear with ¾" pinion ... "	0	9
27a.	57 " " " ½" " ... "	0	9
27b.	133 " " " ½" " (3½" dia.) "	1	6
28.	Contrate Wheels, 1½" diam. ... ... "	0	9
29.	" " ¾" " ... ... "	0	6
30.	Bevel Gears ... ... "	0	10
31.	Gear Wheels, 1", 38 teeth ... ... "	1	0
32.	Worm Wheels ... ... "	0	6
34.	Spanners ... ... "	0	2
34b.	Box Spanners ... ... "	0	3
35.	Spring Clips ... ... per box (doz.)	0	3
36.	Screw Drivers ... ... each	0	3
36a.	" " Extra Long ... ... "	0	6
37.	Nuts and Bolts, 7/32" ... per box (doz.)	0	6
37a.	Nuts ... ... " "	0	3
37b.	Bolts, 7/32" ... ... " "	0	3
38.	Washers ... ... "	0	1

No.		s.	d.
40.	Hanks of Cord ... ... 2 for	0	3
41.	Propeller Blades ... ... per pair	0	4
43.	Springs ... ... each	0	2
*44.	Cranked Bent Strips ... ... "	0	1
45.	Double Bent Strips ... ... "	0	1
46.	Double Angle Strips, 2½"×1" ... ½ doz.	0	6
47.	" " " 2½"×1½" ... "	0	9
47a.	" " " 3" ×1½" ... "	1	0
48.	" " " 1½"×½" ... "	0	4
48a.	" " " 2½"×½" ... "	0	5
48b.	" " " 3½"×½" ... "	0	6
48c.	" " " 4½"×½" ... "	0	9
48d.	" " " 5½"×½" ... "	0	9
50.	Eye Pieces ... ... each	0	2
52.	Perforated Flanged Plates, 5½"×2½" "	0	5
52a.	Flat Plates, 5½"×3½" ... ... "	0	5
53.	Perforated Flanged Plates, 3½"×2½" "	0	3
53a.	Flat Plates, 4½"×2½" ... ... "	0	3
54.	Perforated Flanged Sector Plates "	0	3
55.	Perforated Strips, slotted, 5½" long "	0	2
55a.	" " " 2" " "	0	1
56.	Instruction Manuals, Complete ... "	2	6
56a.	" " No. 0-3 ... "	1	0
56b.	" " No. 0 ... "	0	4
56c.	Meccano Standard Mechanisms Manual "	1	0
57.	Hooks ... ... "	0	1
57a.	" (scientific) ... ... "	0	1
57b.	" Loaded ... ... "	0	5
58.	Spring Cord ... ... per length	0	9
59.	Collars with Set Screws ... ... each	0	2
61.	Windmill Sails ... ... "	0	2
62.	Cranks ... ... "	0	3
62a.	Threaded Cranks ... ... "	0	4
63.	Couplings ... ... "	0	6
63a.	Octagonal Couplings ... ... "	0	8
63b.	Strip Couplings ... ... "	0	8
63c.	Threaded Couplings ... ... "	0	6
64.	Threaded Bosses ... ... "	0	2
65.	Centre Forks ... ... "	0	2
66.	Weights, 50 grammes ... ... "	1	0
67.	" 25 " ... ... "	1	0
68.	Woodscrews, ½" ... ... doz.	0	3
69.	Set Screws ... ... "	0	4
69a.	Grub Screws, 5/32" ... ... "	0	4
69b.	" " 7/32" ... ... "	0	6
70.	Flat Plates, 5½"×2½" ... ... each	0	3
72.	" " 2½"×2½" ... ... "	0	2
76.	Triangular Plates, 2½" ... ... "	0	2
77.	" " 1" ... ... "	0	1
78.	Screwed Rods, 11½" ... ... "	0	6
79.	" " 8" ... ... "	0	5
79a.	" " 6" ... ... "	0	4
80.	" " 5" ... ... "	0	3
80a.	" " 3½" ... ... "	0	3
80b.	" " 4½" ... ... "	0	3
81.	" " 2" ... ... "	0	2
82.	" " 1" ... ... "	0	1
89.	Curved Strips, 5½" ... ... "	0	2
90.	" " 2½" large radius ... "	0	1
90a.	" " 2½" small radius ... "	0	1
94.	Sprocket Chain ... ... per 40" length	0	6
*95.	Sprocket Wheels, 2" diam. ... ... each	0	5
*95a.	" " 1½" " ... ... "	0	4
*95b.	" " 3" " ... ... "	0	6
*96.	" " 1" " ... ... "	0	3
*96a.	" " ¾" " ... ... "	0	3
97.	Braced Girders, 3½" long ... ... ½ doz.	0	9
97a.	" " 3½" " ... ... "	0	8
98.	" " 2½" " ... ... "	0	6
99.	" " 12½" " ... ... "	1	9
99a.	" " 9½" " ... ... "	1	6
99b.	" " 7½" " ... ... "	1	3

No.		s.	d.
100.	Braced Girders, 5½" long ... ... ½ doz.	1	0
100a.	" " 4½" " ... ... "	0	10
*101.	Healds, for looms ... ... doz.	0	9
102.	Single Bent Strips ... ... each	0	1
103.	Flat Girders, 5½" long ... ... ½ doz.	1	0
103a.	" " 9½" " ... ... "	1	6
103b.	" " 12½" " ... ... "	2	0
103c.	" " 4½" " ... ... "	0	9
103d.	" " 3½" " ... ... "	0	7
103e.	" " 3" " ... ... "	0	6
103f.	" " 2½" " ... ... "	0	5
103g.	" " 2" " ... ... "	0	4
103h.	" " 1½" " ... ... "	0	3
103k.	" " 7½" " ... ... "	1	3
*104.	Shuttles, for looms ... ... each	4	0
105.	Reed Hooks, for looms... ... ... "	0	4
106.	Wood Rollers ... ... "	1	3
106a.	Sand Rollers ... ... "	1	6
107.	Tables for Designing Machines ... "	1	0
108.	Architraves ... ... "	0	2
109.	Face Plates, 2½" diam. ... ... "	0	4
*110.	Rack Strips, 3½" ... ... "	0	2
111.	Bolts, ¾" ... ... "	0	1
111a.	" ½" ... ... 2 for	0	1
111c.	" ¾" ... ... doz.	0	4
113.	Girder Frames ... ... each	0	2
*114.	Hinges ... ... per pair	0	4
115.	Threaded Pins ... ... each	0	2
*116.	Fork Pieces ... ... "	0	3
117.	Steel Balls, ⅜" diam. ... ... doz.	0	6
118.	Hub Discs, 5½" diam. ... ... each	1	3
119.	Channel Segments (8 to circle, 11½" diam.) ... ... "	0	4
120.	Buffers ... ... "	0	2
120a.	Spring Buffers ... ... per pair	0	8
*121.	Train Couplings ... ... each	0	2
122.	Miniature Loaded Sacks ... ... "	0	2
123.	Cone Pulleys ... ... "	1	3
*124.	Reversed Angle Brackets, 1" ... ½ doz.	0	10
*125.	" " " ½" ... ... "	0	6
126.	Trunnions ... ... each	0	3
126a.	Flat Trunnions ... ... "	0	2
127.	Simple Bell Cranks ... ... "	0	3
128.	Boss Bell Cranks ... ... "	0	4
*129.	Rack Segments, 3" diam. ... ... "	0	6
*130.	Triple Throw Eccentrics ... ... "	1	3
131.	Dredger Buckets ... ... "	0	2
132.	Flywheels, 2¾" diam. ... ... "	2	3
133.	Corner Brackets ... ... "	0	3
*134.	Crank Shafts, 1" stroke ... ... "	0	3
135.	Theodolite Protractors ... ... "	0	3
136.	Handrail Supports ... ... "	0	3
137.	Wheel Flanges ... ... "	0	4
138.	Ship's Funnels ... ... "	0	4
139.	Flanged Brackets (right) ... ... "	0	2
139a.	" " (left) ... ... "	0	2
140.	Universal Couplings ... ... "	0	9
141.	Wire Lines (for suspending clock weights) ... ... "	0	9
142a.	Dunlop Tyre to fit 2" diam. rim ... "	0	4
142b.	" " " 3" " ... "	0	6
143.	Circular Girders, 5½" diam. ... ... "	1	0
144.	Dog Clutches ... ... "	0	6
145.	Circular Strips, 7" diam. over all "	1	0
146.	" Plates, 6" " ... ... "	1	3
*147.	Pawls, with pivot bolts and nuts "	0	3
*147a.	Pawls ... ... "	0	2
*147b.	Pivot Bolt with nuts ... ... "	0	2
148.	Ratchet Wheels ... ... "	0	9
149.	Collecting Shoes, for Electric Locos "	1	6

*These parts are available with nickel finish only, as mentioned above.

Ask your dealer for a copy of the complete illustrated list of Meccano Accessory parts and keep it by you for reference. If you have any difficulty in obtaining a copy we shall be pleased to send one direct, post free, on request.

MECCANO LIMITED
BINNS ROAD
LIVERPOOL



Results of the Suggestions Voting Competition

In December last we announced in connection with the "Suggestions Section" a novel voting competition. The object of this competition was to discover the most popular suggestions published in the "*M.M.*" during the twelve months ending December, 1926, and each competitor was asked to write down, in order of merit, the four suggestions that he considered to be the best. A large number of readers responded to our request for votes and we believe that the result of the competition forms a very fair test of the popularity of the various contributions published in the "Suggestions Section" during the year. It should be pointed out, however, that a few of the readers who voted may not have been in possession of a copy of each of the twelve issues of the "*M.M.*" concerned, and therefore some of the suggestions that appeared earlier in the year may have deserved a larger number of votes than they actually received.

The competition was divided into "Home" and "Overseas" Sections, and every vote received was carefully recorded. The four best suggestions, as indicated by the votes received in the Home Section, proved to be as follows :—

First : No. 66, Miniature Electric Washing Machine, by Carl W. Beese (published December, 1926).
Second : No. 58, Stephenson's Link Motion, by J. S. Watson (published August, 1926).
Third : No. 63, Electric Fan (published November, 1926).
Fourth : No. 52, Automatic Gear Change, by H. F. Barnard (published August, 1926).

Home Section Results

No reader succeeded in placing all the four suggestions in their correct order of merit, and we decided therefore to select the prize-winners by awarding four points for each suggestion that was placed in its correct position, three points for each suggestion that was only one place out of the proper order, two points for each suggestion that was two places out, and so on. E. H. Palmer, of 23, Clarence Road, Wisbech, named all four suggestions, but he transposed Nos. 1 and 2. Nevertheless his score of 14 points out of a possible 16 tops the list and he therefore receives First Prize, which consists of a cheque for £1-1s. Two competitors who tied for Second Prize, each scoring 12 points, will receive 5/6 each. They are Aubrey Hinds, of Newport, Mon., and H. C. A. Smith, Sutton, Surrey.

In addition, the following readers will each receive a complimentary copy of the Meccano Standard Mechanisms Manual. The figures in brackets show the individual scores.

K. Milne, Rednal, Birmingham (11) ; A. Preston, Syston, Leicester (11) ; A. Kelcey, London, S.W.6 (11) ; H. Legerton, Norwich (10) ; B. Thompson, Horsham (10) ; R. Dixon, London, N.17 (10) ; H. Poose, Weymouth (10) ; Irvine Leonard, Birmingham (10) ; W. Grieve. Edinburgh (10) ; S. W. Summerill, Barnstaple (9) ; Eric Wakelin, Norbury (9) ; Graeme Bryson, Liverpool (9) ; Philip V. Youle, Heanor, Notts. (9) ; E. Freeman, Birmingham (9).

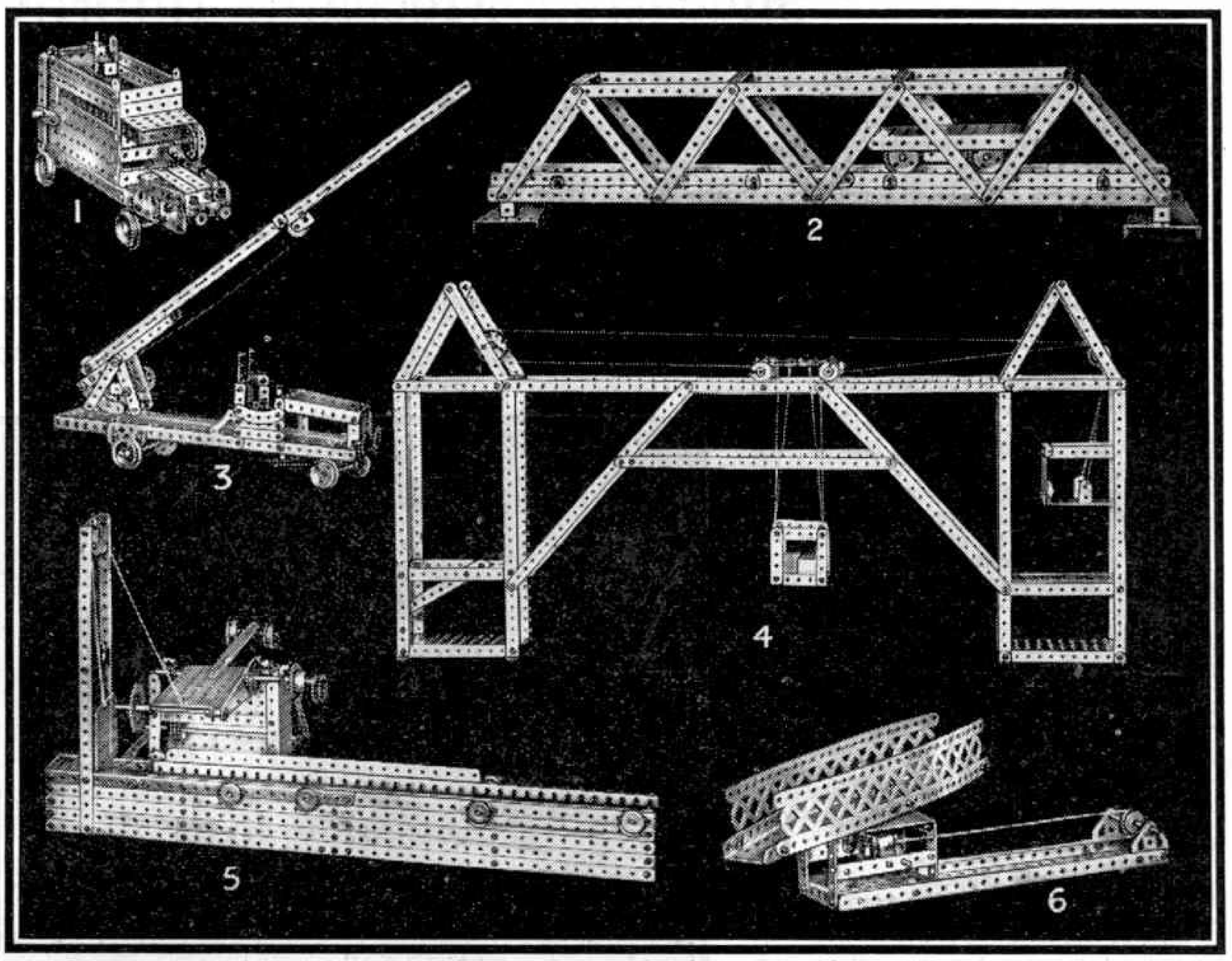
C. W. Beese, the contributor of Suggestion No. 66, will receive as a special award a cheque for 10/6, and the contributors of Suggestions Nos. 58, 63, and 52 will each receive a Certificate of Merit and a copy of the Meccano Standard Mechanisms Manual.

We may mention here that the following suggestions proved very popular with our

(*Continued on page* 558)

An Interesting Norwegian Meccano Contest

Mr. Ingwald Nielsen, whose establishment in Torvgaten, Oslo, is famous as the Meccano distributing centre of Norway, has sent us a few particulars of a very successful model-building competition that he recently organised for the benefit of Norwegian Meccano boys. He received a very large number of excellent models in connection with the contest and a good deal of interest and enthusiasm was aroused locally by an impressive window exhibition of the prize-winning entries. "Many of the models were built by quite young boys," writes Mr. Nielsen, "yet they contain new movements and mechanical arrangements of which even experienced engineers might well be proud." This remark is borne out well by the photographs.



Six interesting Models selected from the Norwegian Model-building Competition

The competition was divided into three Sections, according to the ages of the competitors. The accompanying illustration shows a few of the models submitted. No. 1 is an excellent little model of a motor van entered in Section B (for boys between the ages of 10 and 14 years) and No. 2 represents a viaduct equipped with railway track and a trolley car. This latter model tied with a hammerhead crane for Third Prize in Section C (for boys of 14 and over). No. 3 is the splendid motor fire escape with which Willy Halvorsen secured First Prize in Section B ; the method by which the ladder in this model is extended with the aid of Sprocket Chains is particularly good. The transporter shown at No. 4 shared honours with another equally interesting model for third place in the same Section. No. 5 is an ingenious reproduction of a wood saw, with which Ragnar Holm Lie, aged 14, gained First Prize in Section C, and No. 6 shows the model swing bridge that placed Thomas Berg at the top of Section A (boys under 10).

Knut Berg secured Second Prize in Section A with a neat model of a tram car, and Claus Carl Helvig obtained a similar award in Section B with a miniature racing car. Two competitors tied for Second Prize in Section C ; these were Wilhelm Foss, who also submitted a tram car, and Magne Odnaes, who built a fine stiff-leg derrick.

Among the other photographs received we noticed a number of interesting motor vehicles, two or three aeroplanes, and a bicycle. We were particularly interested also in a good representation of an electric loco, another model of a transporter, and a lighthouse.

We know from experience that Mr. Nielsen was faced with no easy task in judging the entries and we congratulate him on the way in which he has distributed the awards. It is obvious that a great deal of time and patient study were expended in the process, but judging from the enthusiasm and skill displayed in the work received from scores of our young Norwegian friends, the task must have been extremely pleasant and well worth while.

"Meccano Standard Mechanisms"

There is a large number of Meccano movements that may be applied to more than one model—in most cases without any alteration, but in some few instances with only slight alterations to the original movement. The entire collection of these movements may be obtained in the form of a new Manual entitled "Meccano Standard Mechanisms." No keen Meccano boy will consider his equipment complete without a copy of this Manual.

The price of "Meccano Standard Mechanisms" is 1/1½ post free (overseas, price 1/7½ post free) from any Meccano dealer or direct from Meccano Ltd.

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 Meccano Improvements

SMALLER CLOCKWORK MOTORS.—We doubt whether it would be possible to reduce the size of the Clockwork Motor without seriously impairing both its strength and efficiency, which of course, is most undesirable. However, we are considering the possibility of altering the present shape of the Motor. We note your further suggestion that the Motor parts should be obtainable separately, but we do not see that this would offer any special advantage. (*Reply to W. Tye, Ipswich, and W. Burton, Ludlow*).

A BIG MECCANO OUTFIT.—Your idea of a Meccano set built to a large scale, with ½" diameter Axle Rods, etc., is somewhat staggering! No doubt some remarkable machines could be built from such a set, but we regret that your suggestion cannot be put into practice. (*Reply to L. Davies, Stourbridge*).

NUMBERS ON PARTS.—The suggestion that all Meccano parts should be stamped with their reference numbers has been under consideration for some time, but we fear that its adoption would cause a substantial increase in manufacturing costs. (*Reply to F. Barthelmas, Well Hall, and H. Lawrence, Heath Town, Staffs.*)

Suggested New Meccano Parts

WOODEN PARTS.—We do not favour the introduction of wooden plates, etc., drilled with the Meccano equidistant holes. While such parts might improve the appearance of a few models, their use would be very limited and they would not be so realistic or workmanlike in appearance as the existing metal parts. Many Meccano boys prefer to manufacture for themselves any wooden pieces that are particularly required. (*Reply to E. G. Hobson, Stroud*).

1" ANGLE GIRDERS.—We note your suggestion regarding the introduction of a 1" Angle Girder, but such a part would serve no useful purpose that is not already covered by existing pieces. It certainly would be of use for joining Flat Girders at right-angles, but the same result can easily be obtained by the use of two Angle Brackets. (*Reply to E. W. White, London, N.1*).

LONGER CRANK HANDLES.—The Crank Handle is manufactured in two sizes at the present time, one having a 3½" shaft and the other a 5" shaft. The smaller part is included in Outfits 00, 0, 1, and 2 and one of each size is included in all Outfits from No. 3 upward. Both sizes are numbered "19" but we are making arrangements to have them shown separately in future price lists. (*Reply to G. Chayter, Seaforth*).

IMPROVED SHIP'S FUNNELS.—We are interested in your proposal that the Meccano Ship's Funnel (part No. 138) should be raked or sloped off from the base. This part is intended for many other uses in addition to its association with model vessels, however, and if it is shaped in the way that you suggest, it would lose much of its adaptability. It should be possible to obtain the required rakish effect by bolstering up one side of the existing funnel. (*Reply to F. E. C. Early, Torquay*).

DUNLOP TYRES.—The desirability of introducing 1" and 1½" diameter Dunlop Tyres is under consideration, but it is doubtful whether these would be of much use. (*Reply to P. D. White, Taunton, N. Devon, and G. Lambert, London, S.W.15*).

SLEEVE COUPLING.—We hope to introduce in the near future a new coupling similar to the one you suggest. It will be listed under the name of "Sleeve" Coupling. (*Reply to C. Whitaker, Keighley*).

DEEPER GROOVES FOR PULLEYS.—We note your suggestion for deeper-grooved Pulleys but we do not consider that any great advantage would be obtained by their introduction. If the special Meccano Cord is used we do not think any difficulty will be experienced in taking the cord twice round the Pulley when required. As previously mentioned, examples of built-up deep-grooved pulleys are shown under Standard Mechanisms Nos. 39a and 155. (*Reply to A. King, Glasgow*).

A MECCANO BOY'S MOTOR VAN



Our illustration shows A. L. Noke, Secretary of King Edward's Grammar School Meccano Club, Birchfield, Birmingham, with an excellent model of a motor van that he recently constructed from his own designs. The realistic appearance and good proportions of the model are indicated in the photograph, and the mechanical details of the chassis are equally well built.

A very effective representation of the engine is obtained by the use of three Worm Wheels secured side by side to represent cylinders and mounted in a suitable framework constructed from two Flat Trunnions and 2½" × ½" Double Angle Strips. The van is equipped with two opening doors, a let-down flap at the rear, elliptic springs, headlamps, horn, reflector-mirror, foot and hand brakes, etc. The foot brakes work on to drums mounted on each end of the rear axle, while the hand lever, which operates brakes of a similar type to Standard Mechanism No. 83, is fitted with a ratchet gear that enables it to be locked in any desired position. The complete model weighs 9½ lbs.

DOUBLE-THROW CRANKSHAFT.—Your proposed crankshaft would be adaptable to very few models. A coupling mounted at right-angles at each end of a 3½" Axle Rod should fulfil its functions quite well. (*Reply to M. English, London, S.E.3*)

NEW BRACED GIRDERS.—We shall consider the possibilities of Braced Girders made in 1½" widths. We do not think a curved variety of this part would be of much value. (*Reply to J. McManus, Derry*).

CURVED RODS.—Curved Rods might be of use as hand-rails, stay-rods, etc., but they could be used for few other practical purposes. (*Reply to A. C. Coomber, Ipswich*).

IMPROVED FLANGED WHEELS.—We do not think that many advantages would accrue from perforating the flanges of the Flanged Wheels. Such an alteration would increase the cost of these parts, and would also render them less efficient as tram or locomotive wheels, etc., for which purpose they were primarily designed. (*Reply to N. G. Bird, Sigglesthorne, Yorks.*)

1" × 1" CORNER BRACKETS.—There would be little scope for a 1" × 1" Corner Bracket. Most of its functions are covered already by the existing 1" Triangular Plate (part No. 77). (*Reply to D. H. Williams, Ipswich*).

HELICAL GEARS.—As stated previously helical gears constructed on so small a scale would not be satisfactory in operation. In practice this type of gear wheel is used to reduce "backlash," but its advantages when used in Meccano models would be negligible. (*Reply to F. Clough, Manchester*).

CAR BUMPERS.—A miniature bumper for attachment to model cars would be purely ornamental, and would be of use in very few other models. Such an accessory can be reproduced very easily with the existing parts. (*Reply to R. Fysh, Moose Jaw, Canada*).

WIDER BRACED GIRDERS.—We receive numerous suggestions to the effect that the width of the Braced Girders should be increased from the present 2" to 2½". We are unable to see that such an alteration would constitute any particular improvement, however, and in many models it would prove somewhat cumbrous. (*Reply to D. Armitage, West Bridgeford, Notts.*)

LONGER PINION WHEELS.—We are considering the introduction of elongated Pinions for use in drive-changing gear, etc. We shall make an announcement on this subject in the near future. (*Reply to G. Cunliff, Johannesburg, S.A.*)

SHORTER COUPLINGS.—The present Coupling is constructed according to the Meccano standard, and any alteration in its size would affect adversely its interchangeability. (*Reply to R. Dobbie, Christchurch, N.Z.*)

LONGER PERFORATED STRIPS.—18½" and 24½" Strips would serve few really useful purposes. Such lengths may be obtained quite easily by joining two or three of the existing Strips. (*Reply to W. Allen, Winnipeg*).

RATCHET SPANNER.—We regret that we cannot alter our decision regarding the introduction of a Ratchet Spanner. Such a part would prove altogether too expensive. (*Reply to H. F. Barnard, Merstham, Surrey*).

THREADED BOSS.—The Threaded Boss is already fitted with both longitudinal and transverse borings. Does not this cover your proposed improvement? (*Reply to E. Rawlings, Westmount, Quebec*).

8" PERFORATED STRIP.—This part seldom is required; moreover, it can be substituted without trouble by two Strips of the existing sizes overlapped and bolted together. (*Reply to R. Loveland, Handcross, Sussex*).

LONGER AXLE RODS.—The present maximum length of the Axle Rods, i.e. 11½", appears to satisfy most demands, but we will keep your suggestion in mind. (*Reply to H. Hosegood, South Norwood, S.E.*)

Suggested Hornby Train Improvements

ELECTRICAL REVERSE FOR LOCOMOTIVES.—We note your proposal that electric engines should be fitted with permanent magnet motors so that they may be reversed from the track. While this is highly desirable, we would point out that permanent magnet motors are not as efficient in operation as those fitted with wound field coils, and they cannot be operated from alternating current. At present we consider that it is advisable to use the wound-field type, employing a mechanical reverse gear. (*Reply to B. Herbert, Sunderland, and C. B. Mawdsley, Southport*).

ELECTRIC COLLECTING SHOE DEVICE.—We note your suggestion that Hornby electric locomotives should be fitted with a device by means of which the collecting shoe may be raised clear of the live rail. We agree that this would be of value when it is desired to run two engines from the same circuit, for it would allow one to remain stationary whilst the other is in motion. Further experiments will be made in connection with your idea. (*Reply to S. Gregson, Leicester*).

SLIP COACHES.—The question of introducing slip-coach working in the Hornby system has been under consideration for some time past. Experiments are being carried out and we hope to be able to make an announcement on the subject in the near future. (*Reply to G. Jones, London, S.E.25; K. W. Turner, Southwold; L. Black, London, N.4; B. Cook, Richmonsworth; T. N. Kenealy, London, S.W.5, and many others*).

WELL WAGONS.—The existing trolley wagon is very similar to your proposed well wagon, and we are unable to see any advantage that would result from the introduction of a new accessory complete with a miniature casting to represent a typical load. It is a simple matter to devise suitable loads for these wagons from any scrap material. (*Reply to O. Geomans, Redditch*).

VACUUM BRAKE CONNECTIONS. — As pointed out in a previous issue of the "*M.M.*," the addition of vacuum brake connections to Hornby rolling stock would be purely ornamental, and would tend to increase the cost of the accessories to a large extent. We are unable therefore to consider their introduction at present. (*Reply to G. Trobridge, Bellevue East, Johannesburg*).

PLATELAYERS' TROLLEY.—We think there would be little demand for this accessory. When required an excellent substitute might be constructed from Meccano parts. (*Reply to L. H. Porter, Stoke-on-Trent, and others*).

RAIL MOTOR TRAIN.—This model would no doubt be of considerable interest to many readers, but we do not consider that it would prove as popular as the ordinary type of locomotive. (*Reply to E. Crilley, Kenilworth*).

"TUBE" RAILWAYS.—There is little demand for the introduction of a train set modelled on the London "Tube" railways. As pointed out in the "*M.M.*" for August 1926, it is practically impossible to obtain the proper surroundings for a miniature underground railway. It is for this reason that our all-electric train set was copied from the electrified portion of the Metropolitan Railway, a large section of which runs continuously above ground. (*Reply to M. H. Holloway, Minchinhampton, Glos.*)

DETACHABLE LAMPS.—We have noted your suggestions on this point and are keeping the matter in mind. As we have previously remarked, however, there are several difficulties obstructing the introduction of small accessories of this type. (*Reply to R. Blackstonne, Wallington, R. Plumb, Ruislip, and E. Riches, Hemel Hempstead*).

SPRING BUFFERS.—The addition of spring buffers would merely serve to increase the price of Hornby rolling stock, and therefore we do not think their introduction is worth while. (*Reply to C. Yates, Brinscall, Lancs., and P. Barkham, Redhill*).

BRAKE FOR CONTROL LOCOMOTIVES.—We are experimenting with a view to the possibility of fitting a hand brake lever to Hornby Control locomotives. Meanwhile if it is required to brake the locomotive without using the special Control Rail, the reverse lever should be placed in a central position. This should be done gently so that no damage results to the gears. (*Reply to R. Plunkett, London, N.19, and P. Summers, Newent, Glos.*)

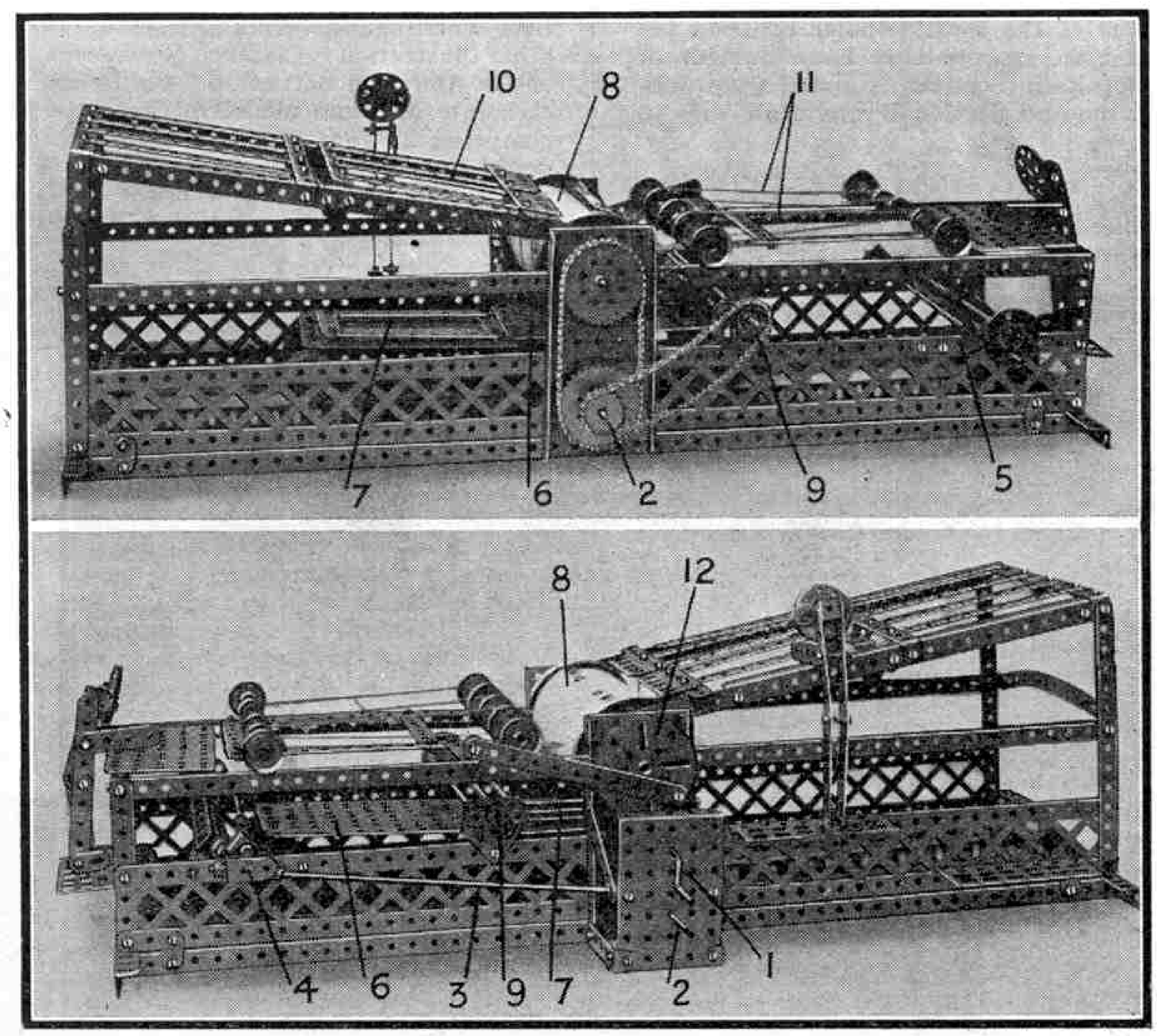
EIGHT-WHEELED VEHICLES. — Very many suggestions have been received regarding eight-wheeled passenger and goods rolling stock, including petrol wagons, coal trucks, milk vans, etc., and we are giving careful consideration to the question of their introduction. We hope to make an announcement in the near future. (*Reply to D. J. Taylor, S. Ashfield, N.S.W.; P. Harrison and D. Lambert, Southbourne; J. E. Phelps, Johannesburg; W. R. Tomkins, London, S.W.16; J. C. Thorne, Maidstone; D. Miller, Birkenhead; K. Nelson, Montreal; and many others*).

COUPLED WHEELS IN No. 1 LOCOMOTIVES.—Following our announcements in recent issues we have experimented with the possibility of coupling the wheels in the No. 1 Hornby engines, thus converting them to the true 0–4–0 wheel arrangement, and we hope to adopt this improvement shortly. A further announcement will appear in an early issue of the "*M.M.*" (*Reply to Eric Crilley, Kenilworth; H. S. Napier, Buncrana, Co. Donegal; W. B. Hutchison Jr., Cambuslang, Glasgow; J. H. Capell, Weston-super-Mare; Douglas Short, London, N.W.7; S. G. Sanders, Rossendale; M. Rowlett and C. Wood, Gillingham; and many others*).

"COWCATCHERS" FOR LOCOMOTIVES.—Your suggestion re fitting cowcatchers to Hornby locomotives is very interesting, but as pointed out in a previous issue we fear that they would scarcely be suitable for the existing engines, excepting, perhaps, the "Blue" Train Locomotive. Those Hornby enthusiasts who particularly require this fitting should be able to construct a substitute without much trouble. (*Reply to V. Eckersall, Manchester*).

DOUBLE TRACK VIADUCT.—The possibility of introducing a Viaduct fitted with parallel tracks will receive further attention at a later date. (*Reply to P. Harrison and D. Lambert, Southbourne: and H. S. Napier, Bancrana, Co. Donegal*).

PRINTING PRESS BUILT WITH OUTFIT No. 5



The small son and daughter of Mr. F. Shrubsole, of Ashford (Kent), are fortunate in having a father who takes such a keen and helpful interest in their hobby. Most Meccano boys sooner or later "get round Dad" to help them build something "extra special," and the fine printing machine shown above is the result of an appeal of this kind put forward by our two young Ashford readers. The two views are of opposite sides of the machine. The model is built from a No. 5 Meccano Outfit and one extra ½" Pinion.

The operation of the principal working parts of the machine is as follows. The Crank Handle 1 carries a 57-teeth Gear Wheel that engages with a similar wheel on an 11½" Rod 2. The latter carries an Eccentric, which gives a throw of 1" and has its arm pivotally attached to an 11½" Rod 3. The other end of this Rod is connected to the ink roller 4, which moves down the Curved Strip 5 to the ink duct and on its return just touches the ink slab 6. The Rod 2 carries at its centre a Worm driving a ½" Pinion on a short vertical Rod, to the top of which is secured a Crank that is connected pivotally by a 5½" Strip to the underside of the bed. The forme is represented by a framework of Strips supported on Washers and secured to the 5½" × 3½" Flat Plate 7. The ink slab 6 is bolted to the end of this plate 7 and the whole unit, representing the bed, is mounted on Flanged Wheels that run on girders in the base of the model. The bed moves to and fro as the handle 1 is turned.

The other end of the Rod 2 carries two Sprocket Wheels, as shown in the upper illustration. The larger of these wheels drives a similar wheel secured to the shaft of the cylinder 8, whilst the smaller drives the centre roller of the three inking rollers 9. A stout piece of cardboard is wrapped round the cylinder to represent the "blanket." Three cords, or "tapes," are tied to a cord stretched from side to side under the feed board 10 and passed round the under-side of the cylinder, their other ends being secured to a transverse Rod on the other side of the cylinder. These serve to guide the sheets of paper while printing. The printed sheets are picked up on the travelling bands 11 and conveyed down to the end of the machine where, it will be noted, a "pressman" stands ready to receive them! The bands 11 are carried in a frame that is moved to and fro as the sheets are printed by means of the Face Plate and connecting rod 12 (see lower illustration). A second pressman is stationed at the feed board, and there is no doubt that this individual will see that the Meccano printing press produces some very fine work!

RAIL CONNECTING PLATES.—We note your suggestion concerning a locking plate for insertion between rails. The new Hornby rails are manufactured with specially shaped sleepers and locking plates (or Connecting Plates) similar to the one you suggest. These plates hold the rails securely together and result in a very rigid layout. (*Reply to P. Vigors, Fernhill Heath, Worcester*).

No. 1 TANK PASSENGER SETS.—We shall consider the possibility of introducing a No. 1 Tank Passenger Set. (*Reply to B. Jenkins, Cardiff*).

THREE-WAY POINTS.—We note that you support the suggestions regarding a three-way point. We shall keep your ideas before us. (*Reply to D. Blake, Wallington, and W. Gunn, Gourock, Scotland*)

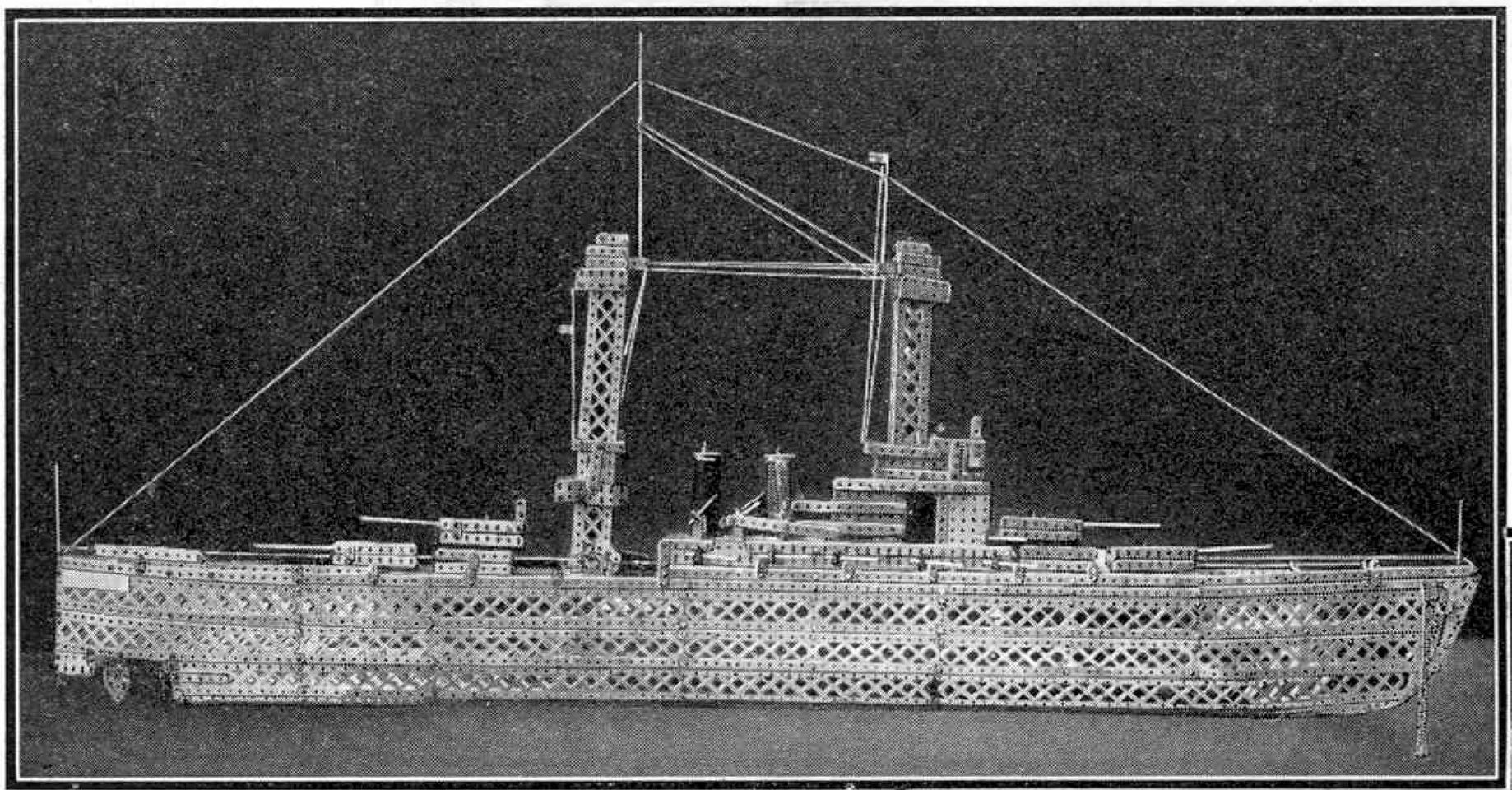
Results of
Meccano Model-Building Contests

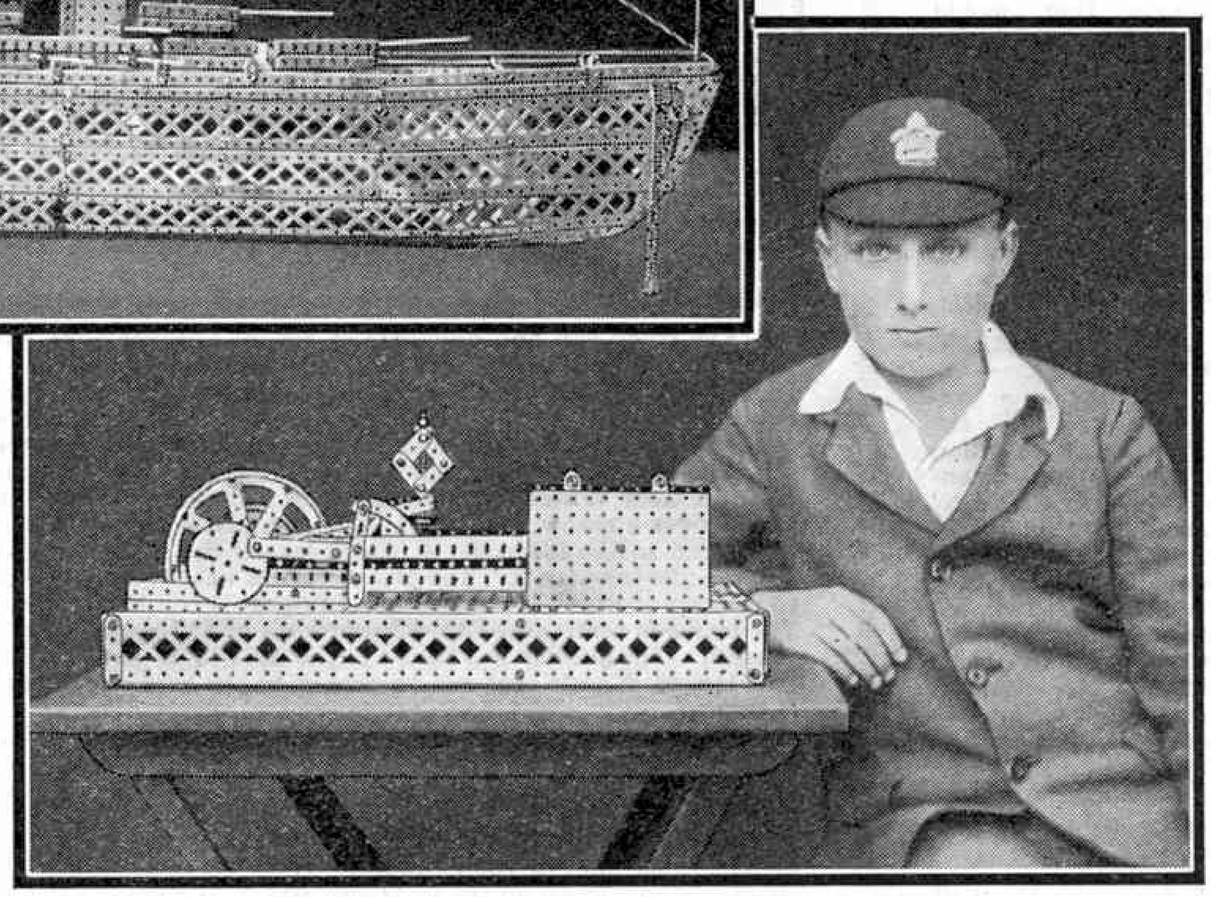
By Frank Hornby

November Competition, Overseas Section

THE following are the results in Section D (for overseas readers) of the special Model-building Competition that was first announced in the November 1926 "*M.M.*" As previously stated, this proved to be one of the most popular contests yet published in these pages and an exceptionally large number of entries was received. The results in Sections A and C were published in last month's Magazine and Section B was dealt with in the April issue.

FIRST PRIZE (cheque to value £3-3s.) : Mario Cavallini, Via dei Cestari 42, Rome. Second Prize (cheque to value £2-2s.) : G. N. Keightley, 21, Crimea Street St. Kilda East, Melbourne. Third Prize (cheque to value £1-1s.) : Clarence Robinson, "Westfield," Clarksville, Via Milton, Otago, N.Z.





Above : Model of the U.S. battleship "California," by Clarence Robinson (Awarded Third Prize). Right : G. N. Keightley with his model Horizontal Engine (Second Prize)

SIX PRIZES, each of Meccano products to the value of half-a-guinea: Frank H. Ogier, Penshurst, Sydney, N.S.W. ; Stanley Brazendale, Barren Plain, Via Bothwell, Tasmania ; Ernest Summers, Westboro', Ontario ; Eddy Boon, Den Wolder, Holland ; Fred C. Emms, Penshurst, Sydney, N.S.W. ; Edward Balfour, Westmount, Quebec.

SPECIAL COMMENDATION (Certificates of Merit) : J. A. Cook, Pleystowe, Mackay, Queensland ; W. L. Holcroft, East London, S. Africa ; Lester Beldan, Toronto ; Walter A. Cooper, Elwood, Victoria ; Leonard Fisher, Bertrams, Johannesburg ; H. Divola, Glebe, N.S.W. ; R. O. Jukes, S. Canterbury, N.Z. ; Frank Van Bulck, Paris (XI.) ; C. Irvine-Smith, Berea, Johannesburg ; William van Santen, Terborg, Holland ; Billy Swift, Westmount, Quebec ; M. and S. Falkof, Bellevue, Johannesburg ; D. R. Heeramaneck, New Gamdevi, Bombay ; William Ebbitt, Montreal ; Jack Sharpley, Hastings, N.Z. ; Frank Thorp, Montreal.

Lord Kelvin's Tide Predicter

Meccano has long been recognised as a valuable medium with which to construct and demonstrate intricate scientific apparatus, and Mario Cavallini's model (awarded First Prize) forms an interesting example of this more serious side of Meccano model-building. It is a reproduction of the Tide Predicter of Lord Kelvin and was built for the Royal University of Rome. As most of our readers will know, this famous invention of Kelvin's consists of a series of pulleys controlled so as to represent the action of the forces that operate tidal oscillation. The model is too intricate to describe in the space that I have at my disposal this month, but I may be able to reproduce it at some future time.

The lower photograph on this page shows G. N. Keightley with the model horizontal single-cylinder engine with which he secured Second Prize. The engine is equipped with an ingenious representation of Corliss valve gear, the operation of which is controlled by a centrifugal governor as in actual practice. The subject of our other illustration is Clarence Robinson's Third Prize-winning model of the American battleship "*California.*" This is one of the most elaborate Meccano models of warships that I have yet seen. It comprises 28 guns, four of which are anti-aircraft, and the entire vessel measures nearly six feet in length. The lattice-girder mast construction peculiar to American ships of war is reproduced in a realistic manner by means of Braced Girders.

A Keen Tasmanian Meccano Boy

Stanley Brazendale sent in a remarkably clever model of a sewing machine constructed entirely from a No. 2 Outfit. Stanley is ten years of age and was born in the Tasmanian Bush. There is no school within ten miles of where he lives and his nearest neighbour is 2½ miles distant. Consequently he has no "club night" to look forward to each week and no school-fellows with whom he can discuss Meccano problems ; nevertheless his model-building skill places him on a level with the keenest members of the great Meccano family.

Another model of a horizontal engine—this time of the compound type—secured a prize for Frank Ogier. This model is driven by a Clockwork Motor and is equipped at each end of the crankshaft with a flywheel consisting of a Hub Disc bolted to a Bush Wheel. Ernest Summers' entry is in the form of a dentist's chair liberally equipped with all the "instruments of torture" that form the stock-in-trade of the modern dentist. Ernest tells us that he has had excellent opportunities recently of becoming familiar with all the details of the prototype of his model!

"New Meccano" Competition

It will be recalled that this competition was organised with a view to testing our readers' skill in producing artistic effects and obtaining greater realism in their models with the aid of the new Meccano coloured parts. The results of the competition show that our readers fully appreciate the possibilities of the new parts, and some of the models submitted present a most pleasing appearance. Many excellent models were received in Section "B" and the standard of merit was so high that the judges found it impossible to select with any degree of certainty the first three prize-winners. It was decided, therefore, to amalgamate the principal cash prizes and to divide the amount so obtained equally amongst six readers, whose names will be found below.

The following are the prize-winners in the "Home" Sections (A, B, and C). Section D (for overseas readers) closes at the end of this month and the results will be published as soon thereafter as possible.

Section A (for competitors over 16 years of age).

FIRST PRIZE (cheque to value £3-3s.): O. Roberts, Cricklewood, London, N.W. SECOND PRIZE (cheque to value £2-2s.): P. W. Nevinson, Southsea, Hants. THIRD PRIZE (cheque to value £1-1s.): J. Small, Clubmoor, Liverpool.

SIX PRIZES, each of Meccano products to value 10/6: B. Rawlinson, Ipswich; Joseph Major, Erdington; C. G. Collins, London, S.E.11; Malcolm Brown, Brighton; Charles Wilcox, Bristol; David Newland, Hull.

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

SIX PRIZES (each consisting of cheque for £1-1s.): K. Randall, Holloway, London, N.; C. Cotton, Nottingham; P. Everingham, Eastbourne; J. Redfern, Manchester; J. B. Chapman, Cleethorpes; Graeme Bryson, Calderstones, Liverpool.

SIX PRIZES (each of Meccano products to value 10/6): Herbert Proctor, Hyde, Cheshire; V. Wherry, Bourne, Lincs.; Stanley Gross, Calne, Wilts.; Rodney S. Weaver, Prestwich, Manchester; Albert Ellithorne, Hammersmith, London, W.6; Sydney Eaton, Leicester.

SPECIAL COMMENDATION (Certificates of Merit): C. Hulme, Marple, Cheshire; Reginald C. Randall, St. Albans; Eric Wakelin, Norbury, Surrey; John Hady, Ilford; William J. Lane, Treharris, South Wales; George A. Sawyer, Sheffield; George Meiklejohn, Burntisland; Jack Fraser, Renton, Dumbartonshire; Percy Higgon, Hallen Henbury, near Bristol.

Section C (competitors under 12 years of age).

FIRST PRIZE (Meccano products to value £2-2s.): Trevor Urben, Millbrook Road, Southampton. SECOND PRIZE (Meccano products to value £1-1s.): Denis Ware, Gore Road, Burnham, Bucks. THIRD PRIZE (Meccano products to value 10/6): Cyril Matthews, Ladyhouse Lane, Berry Brow, Huddersfield).

SIX PRIZES, each of Meccano products to the value of 7/6: C. Johnson, Tunbridge Wells; H. Douglas Hosegood, South Norwood, London; David A. Tanfield, Newcastle-on-Tyne; Denis Lock, Bath; David B. Hall, Rochdale; Charles Stuart, Paisley.

SPECIAL COMMENDATION (Certificates of Merit): N. L. Akerman, Bedworth, near Nuneaton; K. Gillanders, Wealdstone; Arthur W. Gadd, Uckfield; R. J. Booker, Rustington; A. S. J. Lightfoot, Newton Abbot; James G. Smith, Rothesay, Bute.

Section A

The majority of the entries in this Section consist of cranes, motor vehicles, bridges, and other familiar structures, but the coloured parts are employed in each model in a striking and original manner. The first prize-winning model, by O. Roberts, represents an armoured train. This is of very elaborate construction and is designed to run on Gauge 1 rails.

P. Nevinson's entry is in the form of a single-deck six-wheeled motor omnibus, in which a very fine effect is obtained by the use of the new 3" Dunlop tyres, while J. Small secured Third Prize with an excellent model of a tramp steamer. Good use is made in the latter model of the red plates, which help to throw up the brass fittings to great advantage. In short, this model should prove a delight to the eyes of any mariner!

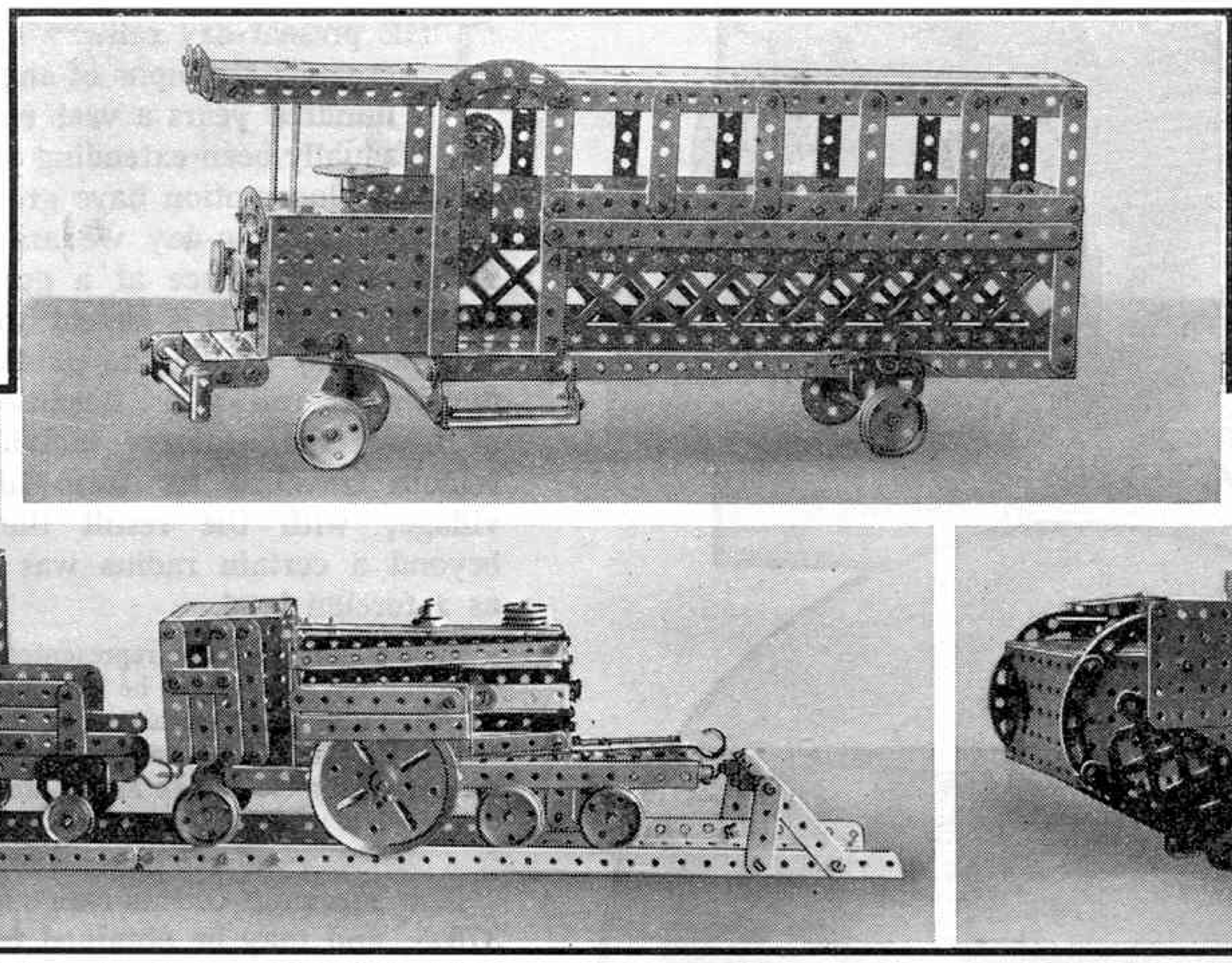
Section B

As I have mentioned already six entries in this section received equal awards. One of these was a fine representation of a "Scammell" removal van, by J. B. Chapman. The vehicle is six-wheeled, the front of the van portion being pivoted on the rear of the motor chassis, and the bodywork consists principally of Flat Plates. A fine finish is given to the model by an excellent combination of the coloured parts.

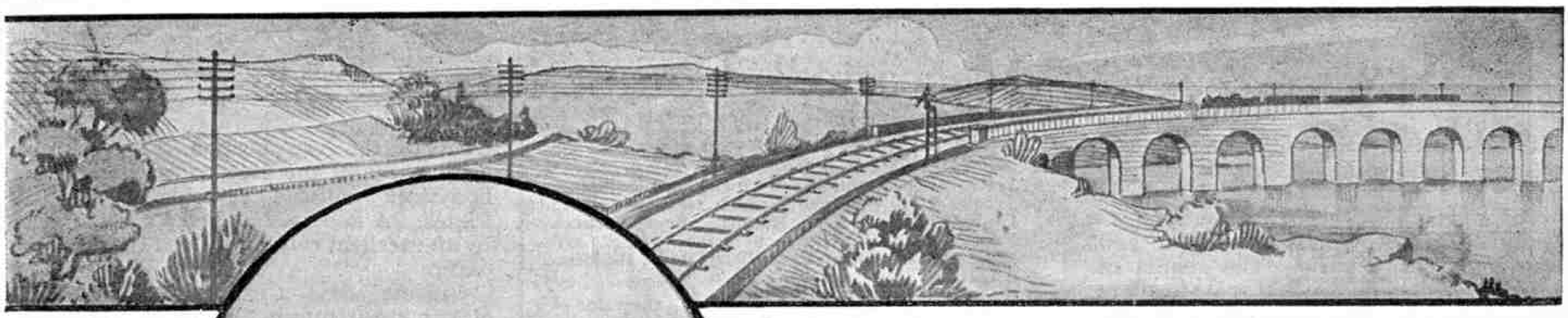
Graeme Bryson submitted a model of an Automatic Weighing Machine. This is similar in principle to Model No. 607 in the Complete Instructions Manual, but a penny-in-the-slot mechanism is added that allows nobody to use the machine without first paying one penny. I have suspicions that this model was designed with one eye on the Meccano savings box!

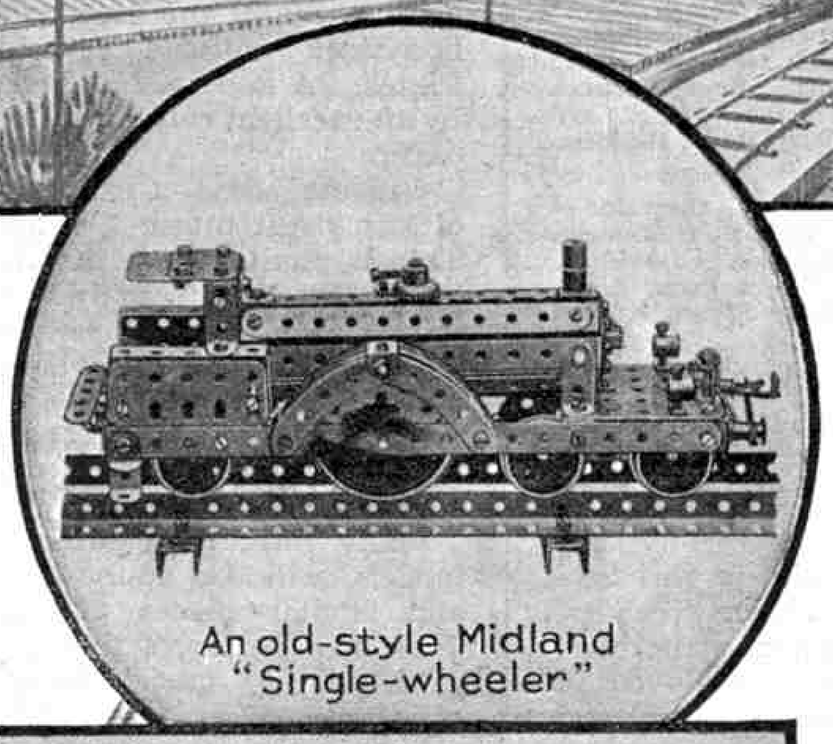
Many interesting subjects for Meccano models will be found in fair grounds and similar places of amusement, and John Redfern owes the inspiration of his prize-winning model to a visit to one of these places. The model is in the form of a circular stand of somewhat similar appearance to the familiar "houp-la" stalls, but it is equipped with a large revolving arm that is rotated by means of two propellers. As far as I can gather the prizes are awarded to the lucky people who "back" the numbers opposite which the revolving arm finally stops. The model is most effective in operation and presents a striking appearance, the roof being constructed entirely from red Flat Plates, while green Braced Girders encircle the stand at top and bottom. The two pairs of Meccano Propeller Blades are driven from a 4-volt Electric Motor placed in the centre of the apparatus, below the pivot of the revolving arm, and the latter is rotated entirely by the tractive effort exerted by the propellers.

C. Cotton's model is in the form of an armoured car, complete with two machine guns. This vehicle is very neat in appearance and well built, an excellent finish being obtained by the use of the coloured parts and the new Meccano Dunlop Tyres fitted to the four 2" road wheels. A simple but very efficient steering gear is also included.

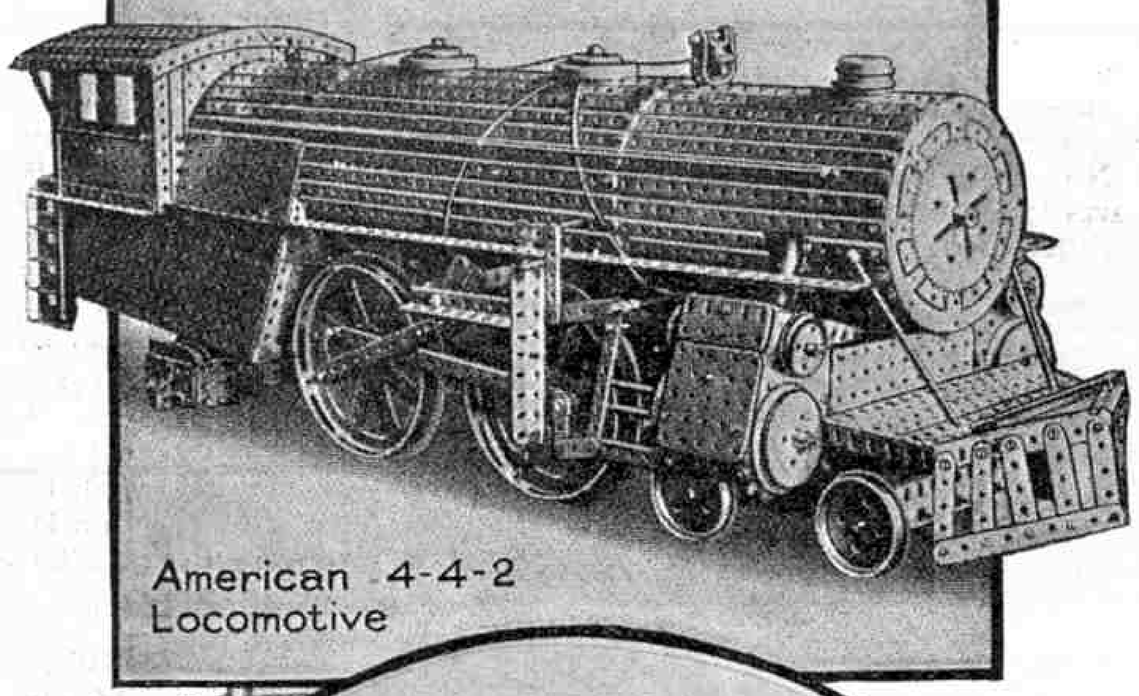


The first three prize-winning models in Section C (for boys under 12 years of age). Top: Motor Bus, by C. Mathews (Third Prize). Left: Locomotive and Tender, by T. Urben (First Prize). Right: Military Tank, by D. Ware (Second Prize)

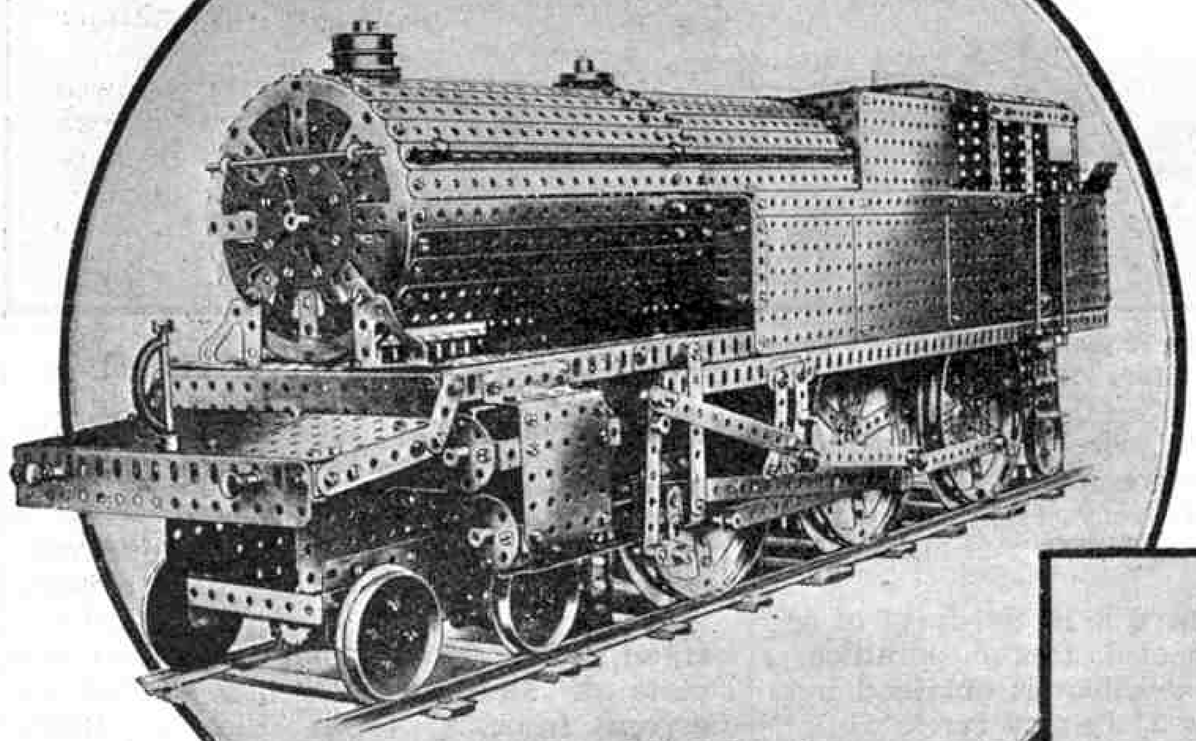




An old-style Midland "Single-wheeler"



American 4-4-2 Locomotive



A typical Meccano Tank Loco.

THE NEW MECCANO

EXAMPLES OF MODEL CONSTRUCTION:

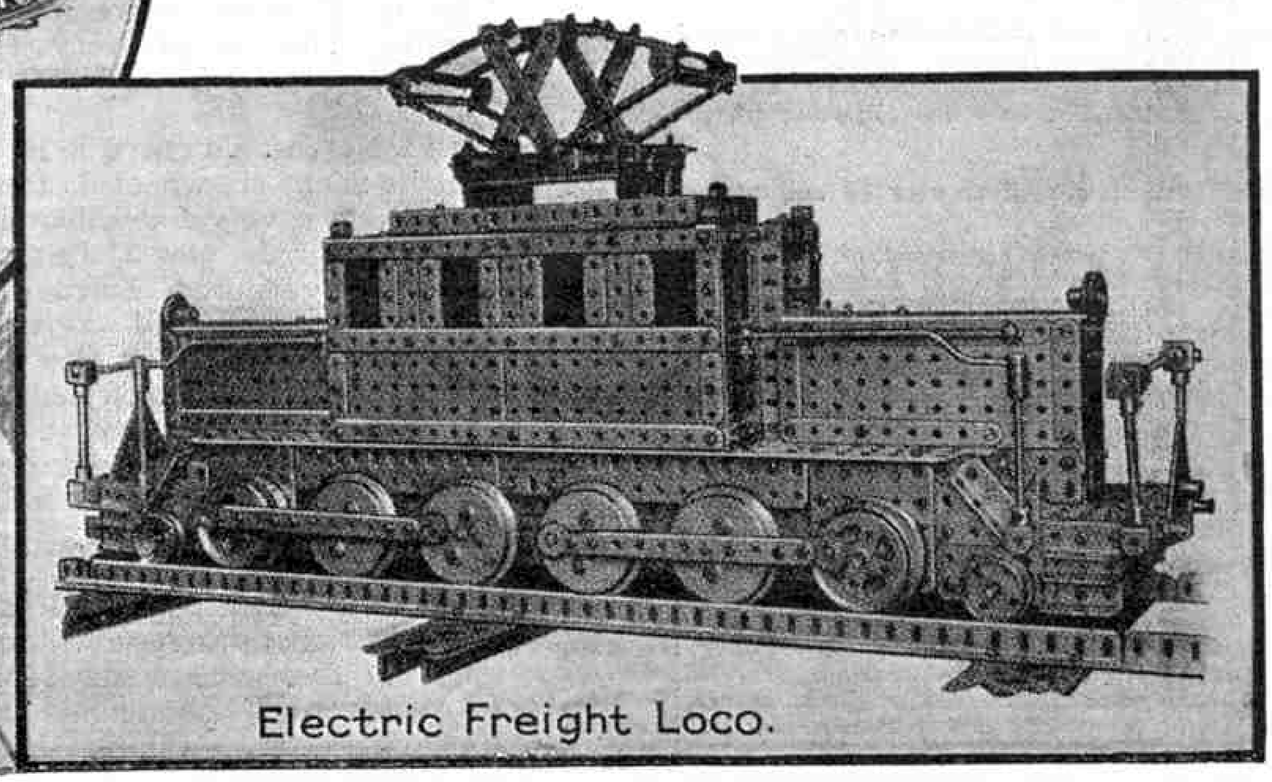
3.–Transport by Rail

THE present-day railway system is one of the greatest triumphs of engineering. For one hundred years a vast network of steel rails has gradually been extending all over the country. Means of locomotion have grown more and more efficient, until to-day we are able to travel for almost any distance at a great speed and with every comfort. It is almost impossible to imagine the everyday life of the public before the introduction of railways. Because of the difficulties of travel the ordinary individual a century ago seldom travelled far from his native town or village, with the result that the countryside beyond a certain radius was as remote to him as a foreign land.

Railway Transport is represented by a number of fine Meccano models, as will be seen from the examples shown on this page. Locos made with New Meccano parts are not only realistic in appearance but they may be driven by the Electric or Clockwork Motors and employed in building up complete working model railways.

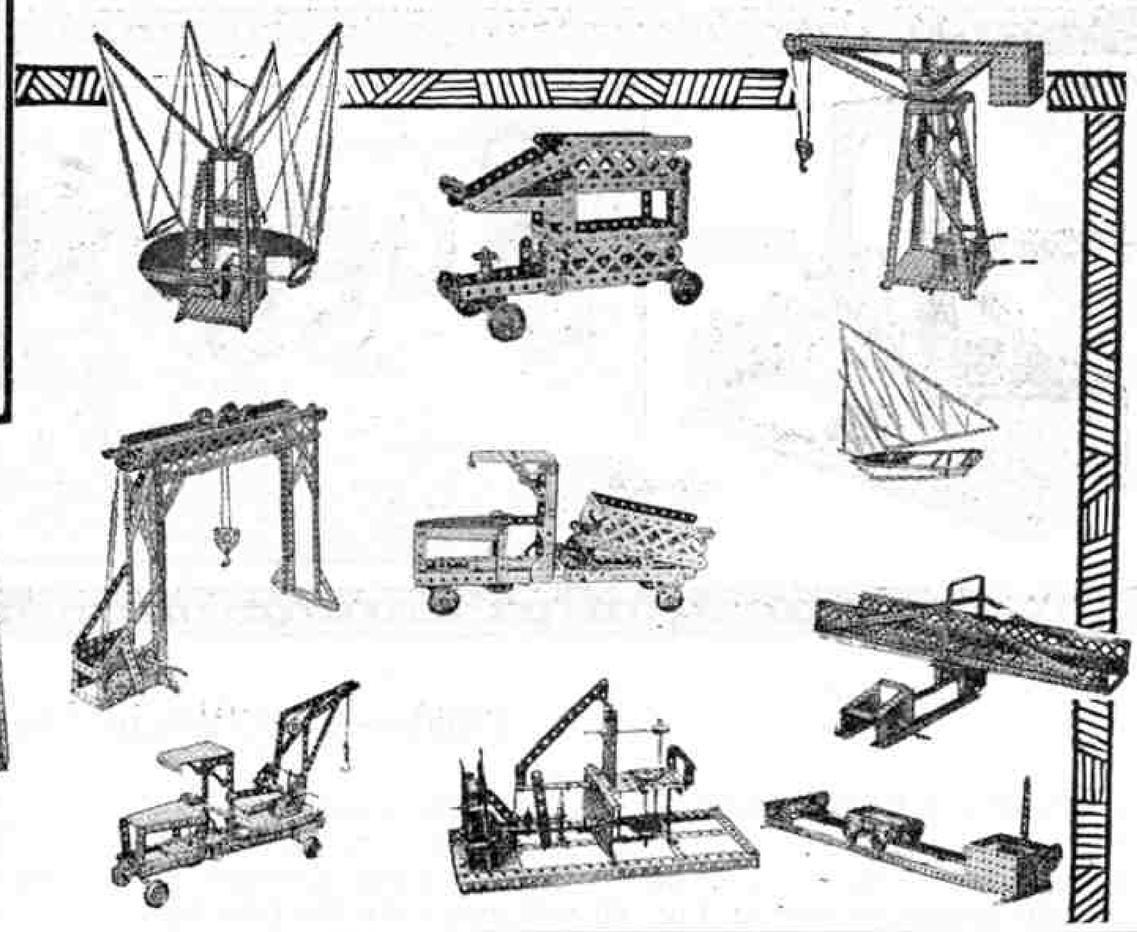
New Meccano Outfits range in price from 3/6 to 370/–, and may be obtained from all leading toy stores. Ask to see them.

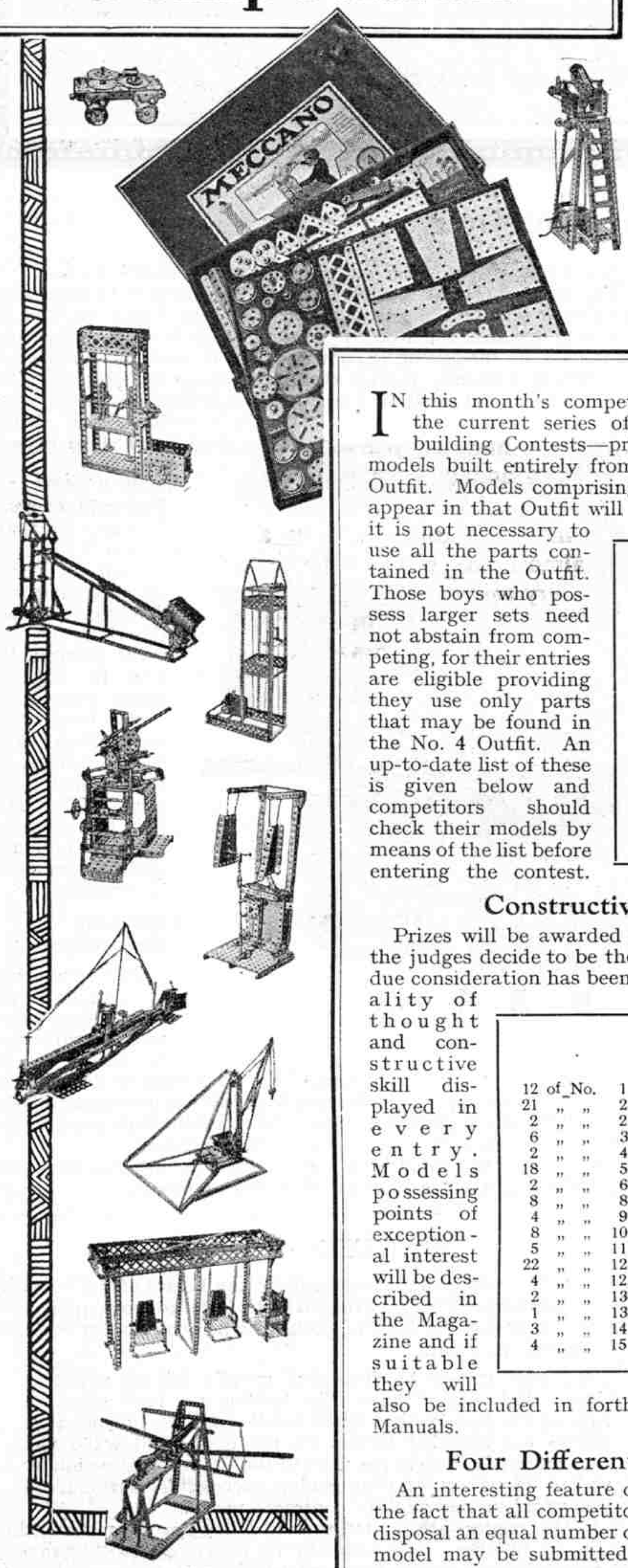
MECCANO LTD., Binns Rd., LIVERPOOL



Electric Freight Loco.

A New "No. 4 Outfit" Model-Building Competition





IN this month's competition—the fifth of the current series of "Outfit" Model-building Contests—prizes are offered for models built entirely from a No. 4 Meccano Outfit. Models comprising parts that do not appear in that Outfit will be disqualified, but it is not necessary to use all the parts contained in the Outfit. Those boys who possess larger sets need not abstain from competing, for their entries are eligible providing they use only parts that may be found in the No. 4 Outfit. An up-to-date list of these is given below and competitors should check their models by means of the list before entering the contest.

LIST OF PRIZES

Prizes will be awarded for the best entries FROM EACH SECTION as follows:—

FIRST PRIZE: Meccano products to the value of £3-3s.

SECOND PRIZE: Meccano products to the value of £2-2s.

THIRD PRIZE: Meccano products to the value of £1-1s.

SIX PRIZES, each consisting of Meccano products to the value of 10/6.

Constructive Skill

Prizes will be awarded for the models that the judges decide to be the best received, after due consideration has been given to the originality of thought and constructive skill displayed in every entry. Models possessing points of exceptional interest will be described in the Magazine and if suitable they will also be included in forthcoming Instruction Manuals.

Four Different Sections

An interesting feature of the contest lies in the fact that all competitors will have at their disposal an equal number of parts. Any type of model may be submitted provided that it is the competitor's own unaided work, both in design and construction.

Entries will be divided into the following sections: Section A, for competitors over 16 years of age. Section B, for competitors under 16 and over 12 years of age. Section C, for competitors under 12 years of age. Section D, for competitors residing outside Great Britain.

Closing Date for Sections A, B, and C: 30th July. Section D: 31st October, 1927.

Important Instructions

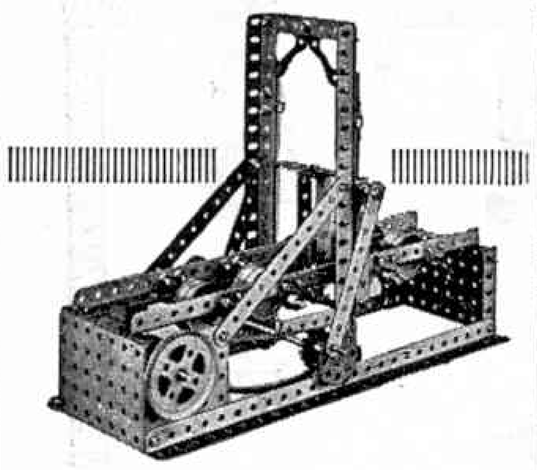
Readers should send in clear photographs or good drawings of their models together with any explanations that may be necessary.

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 (No. 4) and the Section in which the model is entered. Envelopes should be addressed "No. 4" Competition, Meccano Ltd., Binns Road, Liverpool.

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 Ltd.

Contents of Outfit No. 4

12	of	No.	1	5	of	No.	15A	2	of	No.	34	3	of	No.	54	6	of No. 100
21	„	„	2	5	„	„	16	18	„	„	35	1	„	„	56	2	„ „ 103F
2	„	„	2A	5	„	„	17	1	„	„	36	1	„	„	57	2	„ „ 108
6	„	„	3	4	„	„	18A	124	„	„	37	10	„	„	59	1	„ „ 109
2	„	„	4	2	„	„	19	6	„	„	37A	4	„	„	61	3	„ „ 111
18	„	„	5	1	„	„	19B	24	„	„	38	2	„	„	62	6	„ „ 111C
2	„	„	6A	8	„	„	20	4	„	„	40	6	„	„	63	2	„ „ 115
8	„	„	8	1	„	„	21	1	„	„	43	1	„	„	65	1	„ „ 116
4	„	„	9	4	„	„	22	1	„	„	44	2	„	„	77	4	„ „ 125
8	„	„	10	3	„	„	22A	3	„	„	45	1	„	„	80A	4	„ „ 126A
5	„	„	11	3	„	„	23	2	„	„	46	4	„	„	90	2	„ „ 130
22	„	„	12	2	„	„	24	2	„	„	48	4	„	„	90A	1	„ „ 134
4	„	„	12A	2	„	„	26	10	„	„	48A	3	„	„	94	1	„ „ 147A
2	„	„	13	1	„	„	27A	6	„	„	48B	1	„	„	95	1	„ „ 147B
1	„	„	13A	1	„	„	28	2	„	„	48D	2	„	„	96	1	„ „ 148
3	„	„	14	2	„	„	29	2	„	„	52	1	„	„	98		
4	„	„	15	1	„	„	32	5	„	„	53	4	„	„	99		



Suggestions Section

Edited by "Spanner"

(86)—Automatic Reversing Gear

A REVERSING GEAR that at regular intervals will automatically change the direction of rotation of a driven rod should prove of great value in a very large number of models. The device shown in Fig. 86 will not only do this but in addition it provides a means whereby the frequency at which the reversing movement is effected may be varied to almost any extent. Thus a model in which it is incorporated will operate in a certain direction for a period ranging from, say, 20 seconds to three or four minutes or longer, and will then reverse and work in the opposite direction for a similar period. Another advantage of the gear lies in the fact that the movable components are held in engagement by means of a spring until the moment of actual changing.

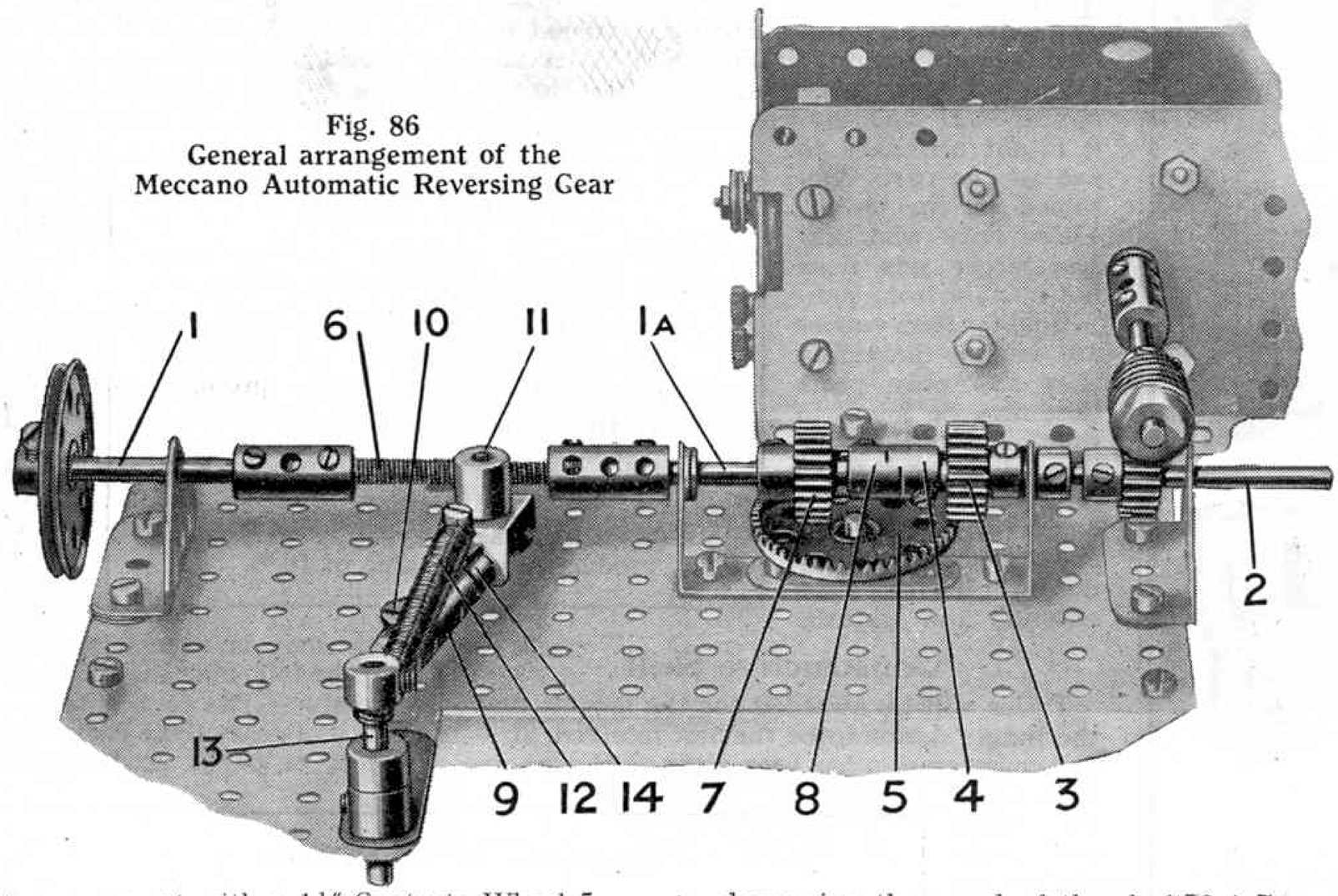


Fig. 86
General arrangement of the Meccano Automatic Reversing Gear

The power from the Motor may be led through any convenient gearing to the driven shaft 1 via the intermediate shaft 2. This shaft 2 carries a ¾″ Pinion 3 and a section of a Dog Clutch 4. The Pinion is in constant engagement with a 1½″ Contrate Wheel 5.

A short Threaded Rod 6 is inserted in the centre of the driven shaft and is secured between Couplings mounted on the short Rods 1 and 1a. The whole driven unit 1, 6, 1a is slidable in its bearings and carries a ¾″ Pinion 7 and a Dog Clutch section 8 corresponding to 4. These are so arranged that when the clutch segments 8 and 4 are in engagement the Pinion 7 is out of mesh with the Contrate Wheel 5. In this position the shafts 1 and 2 rotate as one unit and the Contrate Wheel revolves idly. In the second position of the driven shaft the clutch is disengaged and the Pinion 7 engages the Contrate Wheel 5, with the result that Rod 1 is driven in a direction opposite to that of Rod 2, the drive now being transmitted by way of the Contrate 5. It may be noted that the principle of this reverse gear is similar to Suggestion No. 47 (see "*M.M.*" for July 1926). The total longitudinal movement of the driven unit in its bearings should be about ½″.

How the Automatic Mechanism Works

The automatic reverse motion is effected as follows: A coupling 9 is free to turn about the Pivot Bolt 10 secured to the base of the model and carries a 2″ Rod that is free to slide in a Double Bracket pivotally attached to a Threaded Boss 11 mounted on the Rod 6. A Spring 12 is connected to a point 13, 2½″ from the bolt 10, and its other end is attached to a ⅜″ Bolt that serves in place of a set-screw to secure the Collar 14 on the 2″ Rod. The Collar 14 is placed from the end of the Coupling 9.

The motor must be started in a certain direction so that when the clutch segments 8 and 4 are engaged the Threaded Boss 11 advances towards the Rod 1. The clutch is held in engagement meanwhile by the Spring 12, but the Boss 11, moving slowly along the Rod 6, presently carries the Spring over the bolt 10. The Spring now tends to pull the Threaded Boss in the opposite direction and the driven unit slides over to the reverse position, wherein the Pinion 7 is engaged by the Contrate Wheel 5. But the motion of the driven shaft is now reversed; hence the Boss 11 returns towards the Rod 1a until it again passes the centre point, when the driven shaft is pulled back to its original position. The Dog Clutch is then re-engaged and the cycle of operations is repeated.

Adjusting the Change-over

The frequency at which the change-over movement occurs may be varied by (a) decreasing the speed of the shaft 2 in proportion to that of the Motor or (b) increasing the longitudinal sliding movement of the driven shaft and thereby increasing the length of time required for the Threaded Boss 11 to reach the central position.

Little difficulty should be experienced in incorporating the mechanism in a large number of Meccano models.

WANTED—An Idea!

We reprint, with acknowledgments to the Editor of the "*Sunday Times*," an extract from a correspondent's letter to that paper. We believe it contains the kind of problem with which most Meccano boys delight to wrestle.

> "I read myself to sleep, and usually fall off with the electric light on. I have tried holding the book over the edge of the bed, so that when it falls from my unconscious fingers the resulting thump on the floor shall wake me. Unfortunately, I have got used to the thump, and no longer wake. Have any of your readers successfully surmounted this problem that nightly confronts me?"

"*M.M.*" readers are invited to send along any suggestions they may have to offer. Ideas should be addressed to "Spanner" and those showing particular merit will be suitably rewarded and published in the "Suggestions Section."

(87)—The Magic Box

A New "Mystery Model" Contest

We are taking the opportunity afforded by an amusing model submitted by Clifford Stairmand, of Darlington, to announce another "mystery model" competition. The two similar contests previously published, namely the "Cum Bak" and the "Mysterious Reversing Gear" (first announced in the "*M.M.*" for May and October, 1926, respectively) proved extremely popular and we have no doubt that our readers will welcome this opportunity to exercise their skill in elucidating another fascinating Meccano problem.

On this occasion the puzzle centres about the Magic Box illustrated in Fig. 87. In the properties of this device readers will find a marked resemblance to the Magic Sector Plates shown under Model No. 252 in the Instructions Manual, but there is an added attraction. The box has two cords, A and B; the top cord should be held in one hand and the bottom cord in the other so that both cords are vertically in line. By applying a slight pull the box is held stationary, but if the pull is increased, the box climbs up the cord A. If the strain on the cords is decreased the box descends to its original position.

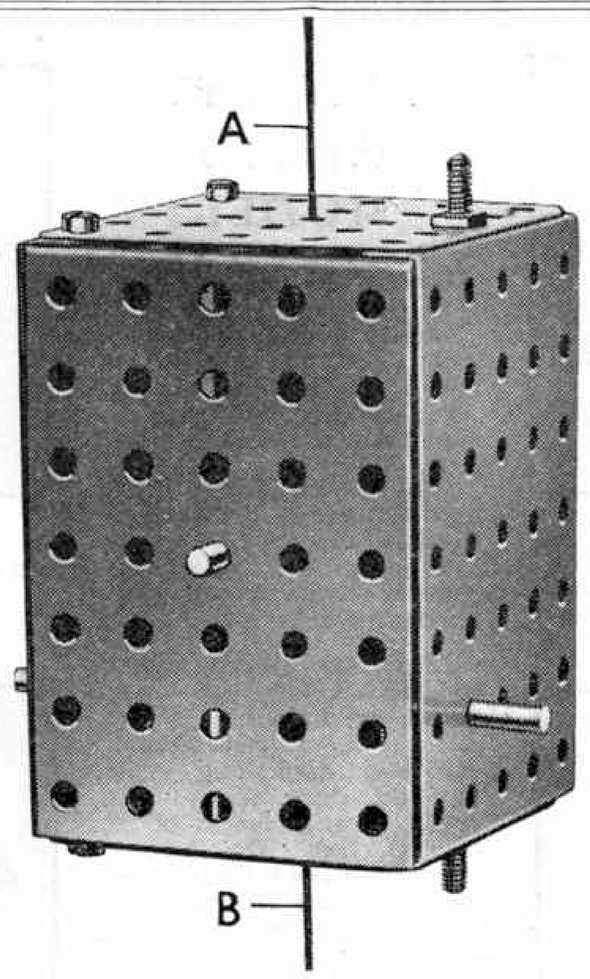


Fig. 87

Competitors are asked to explain the mechanism by which these results are obtained. The sides of the box consist of four $3\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plates, and two $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates form the top and bottom. One of the Flanged Plates is held in place by a $4\frac{1}{2}''$ Threaded Rod with a nut at each end; this plate, of course, is not added until the rest of the box is completed. The operating mechanism is very simple and only standard Meccano parts are used.

Prizes Offered for Solutions

Entries in the Competition will be divided into Section A, for readers residing in the British Isles, and Section B, for readers residing overseas. A prize consisting of a selection of Meccano or Hornby goods, to be chosen by the winner, to the value of 10/6 will be presented for the best entry in each section, and other readers whose entries are considered to be particularly good will receive special Meccano Certificates of Merit and complimentary copies of the Meccano Standard Mechanisms Manual.

If no competitor succeeds in reproducing the operating mechanism exactly as fitted to the original model the prize will be awarded to the competitor whose entry approaches nearest to the correct solution or shows how the required results may be obtained in the simplest manner.

Competitors should send in clear photographs or drawings of their solutions together with any explanations that may be necessary, although the latter should be as brief as possible. Actual models should not be sent. The name, address, and age of the competitor and name of the competition ("Magic Box Competition") must appear on the back of each photograph or sheet of paper used. Competitor's ages will be taken into consideration when judging the entries. Envelopes should be marked "Magic Box."

Closing date for Section A, 30th July. Section B, 31st October, 1927.

Address Wanted

Will NEVILLE O'NEILL, late of New North Road, Auckland, New Zealand, please send his present address, as there is a prize awaiting him.

(88)—A Useful Photographic Accessory

(I. Dodd, Rock Ferry)

Those of our readers who are interested in photography will find the apparatus shown in Fig. 88 extremely useful. Its object is to impart a slight but regular rocking motion to the developing dish or hypo bath while developing negatives or fixing prints, thus ensuring that the contents of the dish are continuously in motion and obviating the necessity of constantly moving the dish with the hand.

Our contributor suggested that the rocking frame supporting the dish should be operated by means of a pendulum, but it was found that the momentum so imparted was quickly dissipated owing to the levelling action of the liquid in the dish. With a little extra trouble a very effective and pleasing model may be obtained by using a Meccano Clockwork Motor as the driving power, as indicated in the illustration. We have added a fan-wheel to reduce the speed of the Motor, and with the gearing shown the model will be found to run for fully ten minutes from one winding. The fan-wheel method of governing the speed of the Motor was recommended under "Queries and Replies" in the December, 1925, Suggestions Section, and we would again remind our readers of the excellent results that can be obtained from its use. The speed of the fan is restricted within certain limits owing to the atmospheric resistance on the blades, hence the Motor is compelled to revolve at a correspondingly slow speed. The power absorbed in driving the fan is very small.

The following particulars should make the construction and operation of the model quite clear. The sides of the Clockwork Motor are extended by two $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates, which serve as bearings for the shafting. (A Washer should be placed on each bolt between the Plates and the Motor, to ensure that the former are in correct alignment). The driving shaft of the Motor carries at one end a $3\frac{1}{2}''$ Gear Wheel 1 that engages with a $\frac{1}{2}''$ Pinion on the shaft of the fan-wheel 2. The latter comprises four blades shaped from a sheet of stout cardboard, each about 3" long and 2" wide at the outer end. The blades are slotted to fit over a Bush Wheel secured to the shaft and are bolted to two Angle Brackets, one on each side of the Bush Wheel. Each pair of Angle Brackets is secured to the Bush Wheel at right-angles to the next pair.

The model is driven from a $\frac{1}{2}''$ Pinion secured to the other end of the Motor shaft, and engaging the 57-teeth Gear Wheel 3 mounted on a 2" Axle Rod that also carries a Face Plate 4. The connecting Rod 5, consisting of two $5\frac{1}{2}''$ Strips overlapped nine holes, is attached pivotally at one end to the Face Plate 4 by means of bolt and nuts (see Standard Mechanism No. 262) and at the other end in a similar manner to a crank 6 formed from a $2\frac{1}{2}''$ Strip bolted to a Bush Wheel that, in turn, is secured to the $11\frac{1}{2}''$ Rod 7. Eleven $2\frac{1}{2}''$ Strips 8 bolted to the other side of the Bush Wheel form a counterbalance for the weight of the crank 6 and connecting Rod 5. The Rod 7 carries another Bush Wheel 9 that is connected by cords 10 to the frame 11, on which the hypo dish may be placed. When the model is in motion the frame 11, owing to the action of the crank and connecting Rod 5, is rocked smoothly and slowly about the 8" Rod 12 journalled in the base.

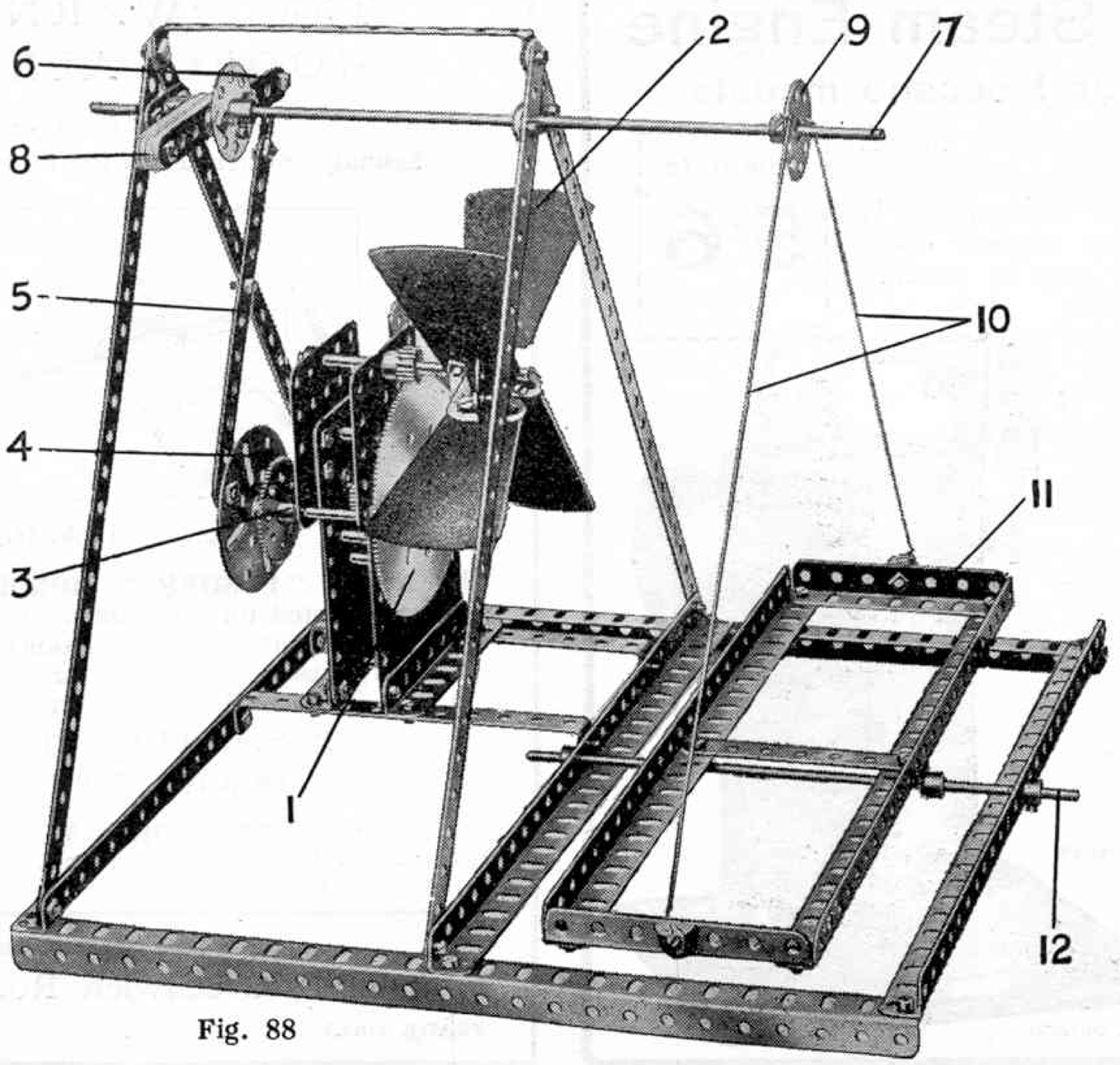
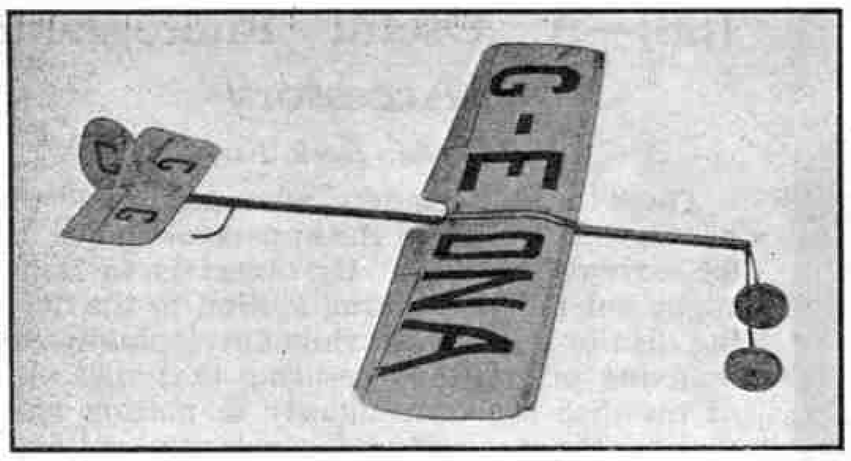


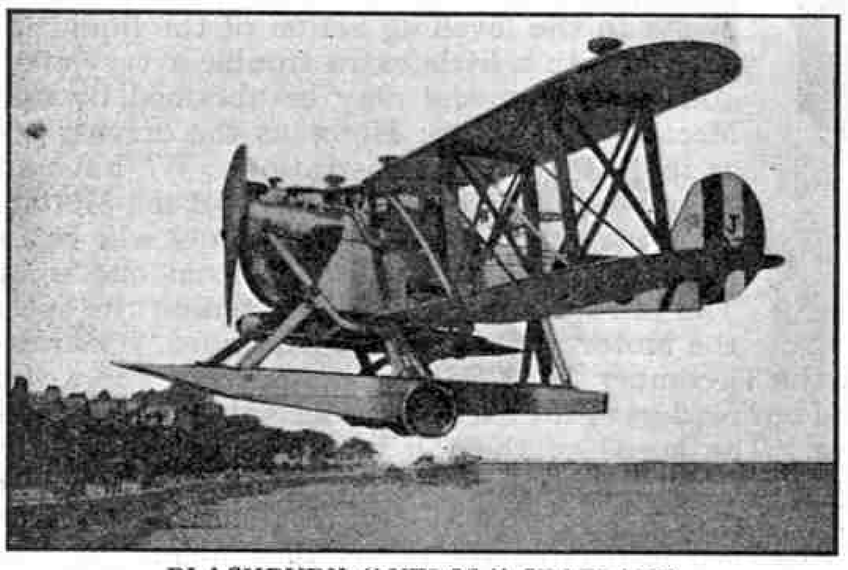
Fig. 88



MODEL GLIDER " G-EDNA "

These models will soar to a height of 30 ft.

G-EDNA 24" Model, set of parts ... ... **2/6** Post 6d.
G-EDNB 18" ,, ,, ... **1/9** ,, 6d.
G-EDNC 12" ,, ,, ... **1/-** ,, 4d.



BLACKBURN " VELOS " SEAPLANE

A 24" model with elastic motor inside the fuselage, four aluminium disc wheels, two floats and finished torpedo.
Set of parts and instructions ... **3/6** Post Paid.

APPLEBY'S PATENT MODEL AEROPLANES

These models are wonderfully realistic, having all the parts and fittings of the originals faithfully reproduced in miniature.

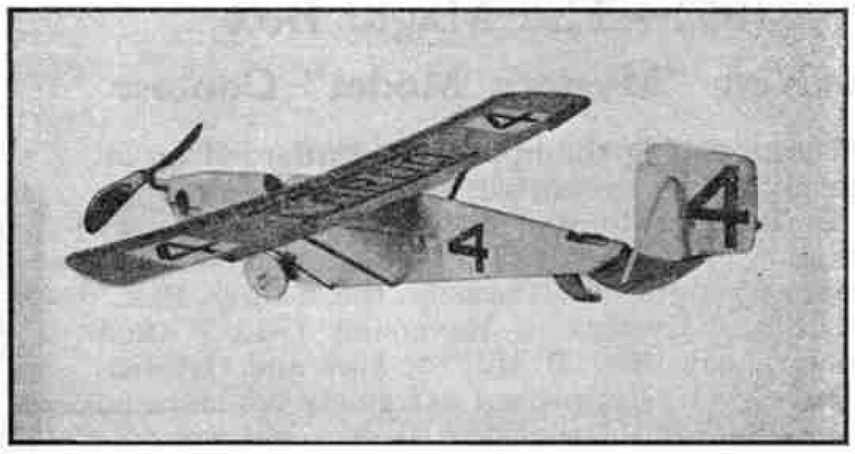
The illustrations are actual photographs of the finished models, and the sets which you buy will make up exactly similar without any further parts being required.

The model Gliders (types G-EBNA/B/C) are our latest productions. They have a new type of double surfaced mainplane, aluminium disc wheels and will soar to a height of 20 or 30 feet. The largest model G-EBNA if launched in an upward direction will climb to a great height, flatten out and then gracefully glide down to the ground in either a straight or circular course.

ORDERS OVER 3/- Post Paid.

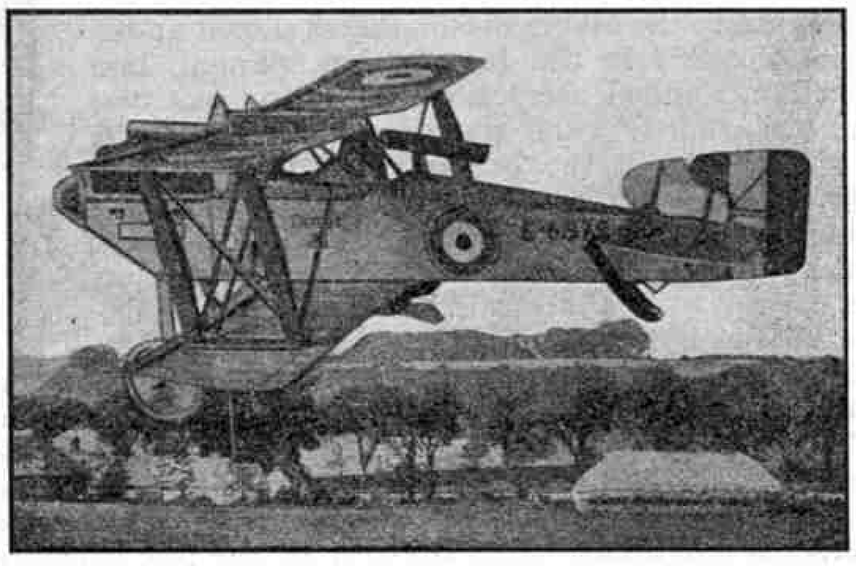
Colonial customers should remit 9d. per model extra to cover extra postage.

SEND YOUR ORDER NOW



WEE BEE I. No. 4

An excellent model, with elastic motor, aluminium wheels. Span 21". Will fly 50 yds. and loop the loop.
Set of Parts and instructions **1/6**. Post 4d.



MILITARY BIPLANE, TYPE E-6879

A model Glider complete in all detail. Will perform almost any evolution of the original.
Set of Parts and Instructions 1/-. Post 4d.

William E. Appleby (N/C) & Co.,

(Dept. K) 217, 219, JESMOND ROAD, NEWCASTLE-ON-TYNE

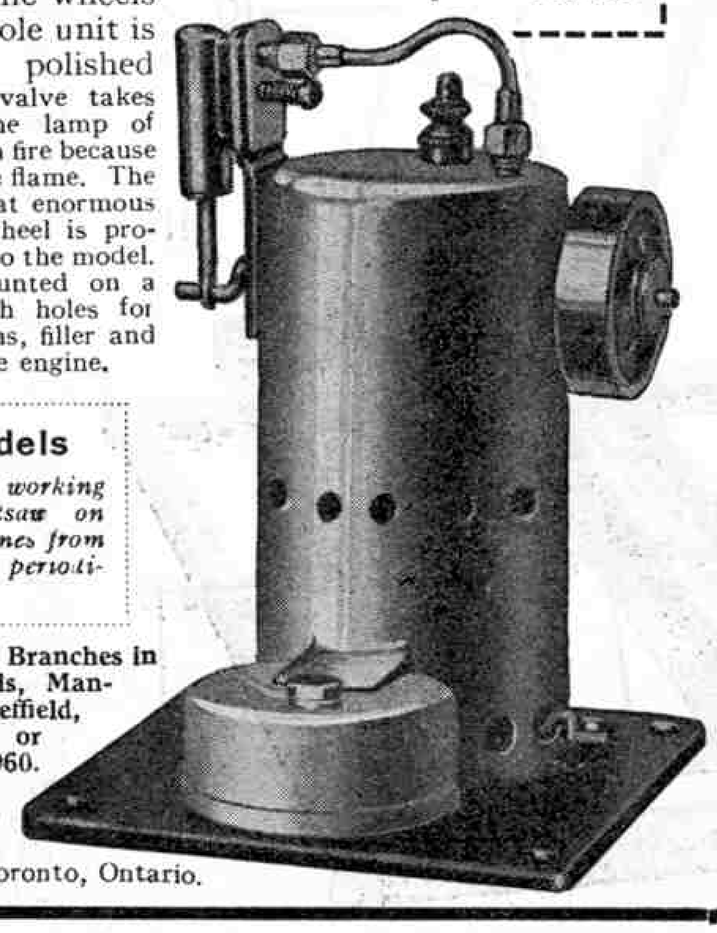
HOBBIES

"Demon" Steam Engine

will drive your Meccano models

Don't have your Meccano Models standing idle for lack of driving power. Make them like the real thing by adding a " Demon " Steam Engine. Couple it up to your crane, or loom or windmill, and see it " make the wheels go round." The whole unit is strongly made of polished brass and the safety valve takes away all danger. The lamp of methylated cannot get on fire because the spirit is not near the flame. The brass flywheel revolves at enormous speed and a grooved wheel is provided for a driving belt to the model. The whole unit is mounted on a metal base drilled with holes for fitting. Full instructions, filler and lamp are packed with the engine.

Complete 5'6 Post 6d.



Working Models

You can build working models with a fretsaw on correct engineering lines from the designs published periodically in Hobbies.

Obtainable from Hobbies Branches in London, Glasgow, Leeds, Manchester, Birmingham, Sheffield, Southampton, Brighton, or direct from Department 960.

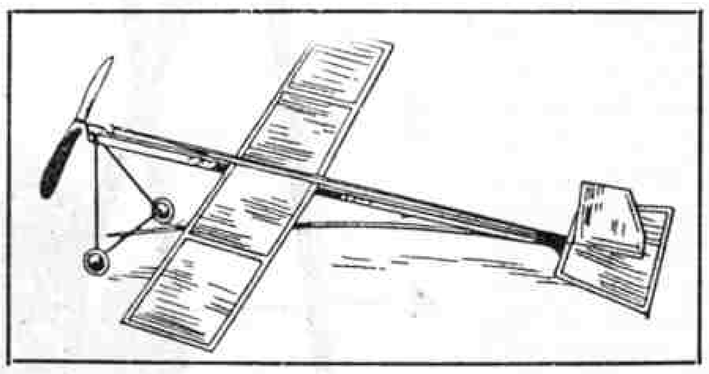
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The No. 0 " PUSHER " MONOPLANE selling at 5/6, can be adjusted for all manner of flights, i.e., Elevator can be flattened out for long distance flying, or adjusted for sharp rising, or again for turning left or right.
This Machine is practically unbreakable.

Prices : PUSHER TYPE 5/6 to 14/6

TRACTOR TYPE 4/6 to 21 -

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can be obtained from any London Store, or Messrs. Hamley Bros. Ltd. or Branches, and from all the leading Stores throughout the world.

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TRADE ONLY. LEAFLETS FREE.

Animal Railway Workers and Travellers—(*Continued fr m pag* 509)

finding puss, but his efforts were unavailing. At the first important stop, more than an hour later, the guard informed a train examiner about the "mews," and careful investigation revealed the refreshment-room cat perched precariously on top of the electric-lighting dynamo under the van floor. This experience effectually cured her ladyship of the desire to travel!

As a rule animals do not enjoy railway travelling, and we are all familiar with the pathetic sight of small calves and other quadrupeds consigned by passenger train—the former looking very worried in their enclosed sacks. Sometimes guards and porters are called upon to face stiff problems connected with the transit of such animals. One or two railwaymen failed to see the funny side once when two "billy-goats," with labels on their collars, had to change trains at a junction. To beguile the time these nimble-footed fellows chewed the labels off each other's collars, and the only clue to their destination thus being lost, all that could be done was to make the beasts as comfortable as possible in the parcels office and await the frantic wire that was bound to come asking for "any trace of two goats?"

The loading and unloading of horses and cattle is often attended with plenty of excitement and no little danger, but the men soon become adepts in the art of handling fractious or timid beasts. Sometimes, however, there is a thrill.

A Pedigree Bull's Adventure

The writer recalls a valuable pedigree bull, destined for stock purposes in the Argentine, that was being unloaded from a horse-box at the port of embarkation, and in less time than it takes to tell had nimbly skipped on to the permanent way after breaking its halter, and disappeared into the mouth of the tunnel! Frantically the signalman set his signals back to danger, and telephoned to the next box. The tunnel was curved and over half a mile in length, but in a very few minutes the answer came back that the bull had just left the tunnel mouth and was "going strong" along the down line! From this point onward the line was equipped with live rails for electric trains, but the frightened beast succeeded in steering clear of the danger and, becoming exhausted, was easily secured clear of the track and all ended well.

On one occasion a package of ants' eggs was delayed in transit by rail and, being placed near a warehouse stove, hatched out, the ants doing much damage to parcels and causing endless annoyance and subsequent correspondence.

Many stories could be told of railway working being affected by wild nature, and it is not long since a Great Western "flyer" was summarily stopped miles from anywhere, to the mystification of the engine crew. On alighting they found that a rook had flown against the vacuum brake air-pipe on the front of the loco and, by displacing the stopper, had admitted air to the pipe and thus applied the brakes throughout the train.

On another line, one moonlight night, the signalman at a lonely moorland cabin was amazed to see what he thought was a human form on the front of an express loco dashing past. He telephoned to the next box, the train was stopped, and a magnificent white owl was discovered dead and impaled on the smokebox door handle of the loco. The wings had been kept outstretched by the draught of the train and in the moonlight it is not surprising that the lonely signalman got a shock!

Small Creatures that Cause Trouble

Even fishes sometimes take a hand in adding to the tribulations of the railway staff. One driver whose loco was giving serious trouble was entirely at a loss to trace its source. The ultimate solution was found in a displaced grid connected with the inlet for water into some water-troughs over which the train had travelled, filling its tender at high speed. Invading minnows from the stream whence the water was drawn had choked up the injector pipes that fed the boiler.



Courtesy] [*Southern Railway*

Unbolting the mass of control rods in the old signal box at Cannon Street Station during recent reconstruction

An observer has expressed the opinion that these small fishes are very sensitive to sound, as he has seen numbers of them trespassing in a water-trough between the rails and, on the approach of a train, dashing to the far end of the trough until the last carriage was well beyond their domain.

More than once dislocation of traffic owing to the failure of signalling arrangements has been traced to a beetle or fly getting into the delicate electrical apparatus and causing a short circuit. In tropical countries, of course, insects provide a still greater menace, and after the passing of a swarm of locusts so many slippery bodies have remained on the track that trains have been unable to start. In addition, the ravages of the tropical ant on sleepers, signals, and wooden fittings of every description call for special methods of construction and constant strict inspection.

Often in the springtime our feathered friends select some unusual nesting-place, and the writer knows of a kind-hearted country station-master whose great pride was a thriving family of whitethroats, their home having been established in a niche behind the axle-box of a goods wagon. This official was able to "wangle" the retention of that particular wagon in his siding until the young whitethroats got on the wing.

The Story of Coal—(*continued from page* 491)

does not mean, however, that the gasholder extends downwards to an unfathomable depth. The lack of a solid base is explained by the fact that the familiar steel shell with its domed roof floats in a huge tank of water, being kept in a vertical position by attached rollers or small wheels that run on columns placed at intervals around the holder. Generally the basic or water tank is accommodated below ground level.

The gasholder is built up in a number of movable sections or "lifts," each slightly smaller than the one below, so that when the holder is completely empty, which rarely happens, the various lifts telescope one into the other, the whole resting upon an inner stone curb round the base of the water tank. The gas pipe enters beneath the stonework and ascends inside the structure until above the level of the water.

As the holder fills with gas, the sections open out after the fashion of a short telescope on end. The lower edge of each section is turned upward on the outside and forms a channel that is filled with water, thus preventing any escape of gas from the holder. The upper edge of the section next below is turned down on the inner side and hooks freely with the bottom edge of the section above. Only the intermediate sections, of course, are turned at both top and bottom edge. The water tank is more than large enough to accommodate the gas holder, so that there is always a ring of water outside the submerged edge of the holder that effectually prevents any gas from escaping by way of the gasholder base.

The largest gasholder ever built has six lifts, and a maximum capacity of twelve million cubic feet of gas. As a rule, however, the capacity of gas holders is limited to the equivalent of 24 hours' maximum production of gas by that particular works.

The latest development in gasholder construction is the "tankless" gasholder, which briefly consists of a huge cylinder open at the top and closed at the bottom, and a circular disc rising and falling within the cylinder according to the quantity of gas to be stored, the circumferential sliding joint being made by a seal of tar, continuously pumped over it.

From the gasholders the gas is distributed through miles of underground gas mains to houses, shops and works.

Competition Results

OVERSEAS RESULTS

20th Drawing Contest

First Prizes: Section A, J. B. SHAW (Victoria, B.C.); Section B, E. J. SMITH (Sydney). Second Prizes: Section A, S. H. KING (Cawnpore, U.P. India); Section B, P. J. COX (Adelaide, S. Aus.)

2nd Stamp Contest

1st. C. W. DONGAN (Victoria, B.C.); 2nd, E. WHITAKER (Constantinople); 3rd. B. W. SPOONER (Onehunga, N.Z.)

Hidden Proverbs

1. D. BLACK (Newcastle, N.S.W.); 2. E. H. HANNY (Mowbray, Tasmania); 3. J. G. MURRAY (Wynberg, Cape Province). Consolation prizes are awarded to J. G. GRANADURAR (Trichinopoly); H. STENSON (Ontario, Can.); R. C. TAYLOR (Pretoria, S.A.)

Advertisement Competition

1. W. H. DELAY (Ceylon); 2. E. BALFOUR (Quebec, Canada); 3. N. F. MEITH (Victoria, W.A.); Consolation Prizes:—H. FRASER (Demerara, B.G.); W. J. FRAZER (Philadelphia, U.S.A.); E. HOLDER (Trinidad, B.W.I.); F. J. KOOT (Holland); K. LANGSDORF (Queensland); T. MARSH (Manitoba); F. T. THOMPSON (Westmount, P.Z., Canada); W. VAN VUURDE (Holland).

"If I Were Editor" Essay

First Prizes:—Section A: A. HYDE (Matathoe, N.Z.); Section B: N. SCOTT (Winnipeg). Second Prizes:—Section A: T. SCHEER (Holland); Section B: W. E. FAGG (Otago, N.Z.)

A New Meccano Orrery

Illustrating the Motion of the Earth and Moon

AN astronomical instrument in which interest has recently been revived is the orrery, which illustrates the motion of the planets and their moons about the Sun. An instrument of this kind seems to have been first made slightly more than 200 years ago by a man named Graham and the first well-known example of it was constructed in 1715 by John Rowley for Charles Boyle, the Earl of Orrery, from whose title its name is derived. An excellent example of the apparatus, made about 1770 by Benjamin Martin, is to be seen in the Science and Art Museum, South Kensington.

Charles Boyle was a member of the famous family founded by Richard Boyle, commonly known as the Great Earl of Cork. Richard Boyle was a great statesman whose active career in Ireland lasted from the time of the Armada in 1588 to the outbreak of civil war in the reign of Charles I. One of his sons was Robert Boyle, the famous chemist who was one of the founders of the Royal Society of London, while another was Lord Broghill, who so greatly distinguished himself as a soldier and statesman under Cromwell and Charles II. that he was made Earl of Orrery.

The Charles Boyle for whom the orrery was built combined some of the qualities of both these ancesters. He played a creditable part in public affairs in the early days of the eighteenth century and used to amuse himself during his leisure hours with mechanical toys.

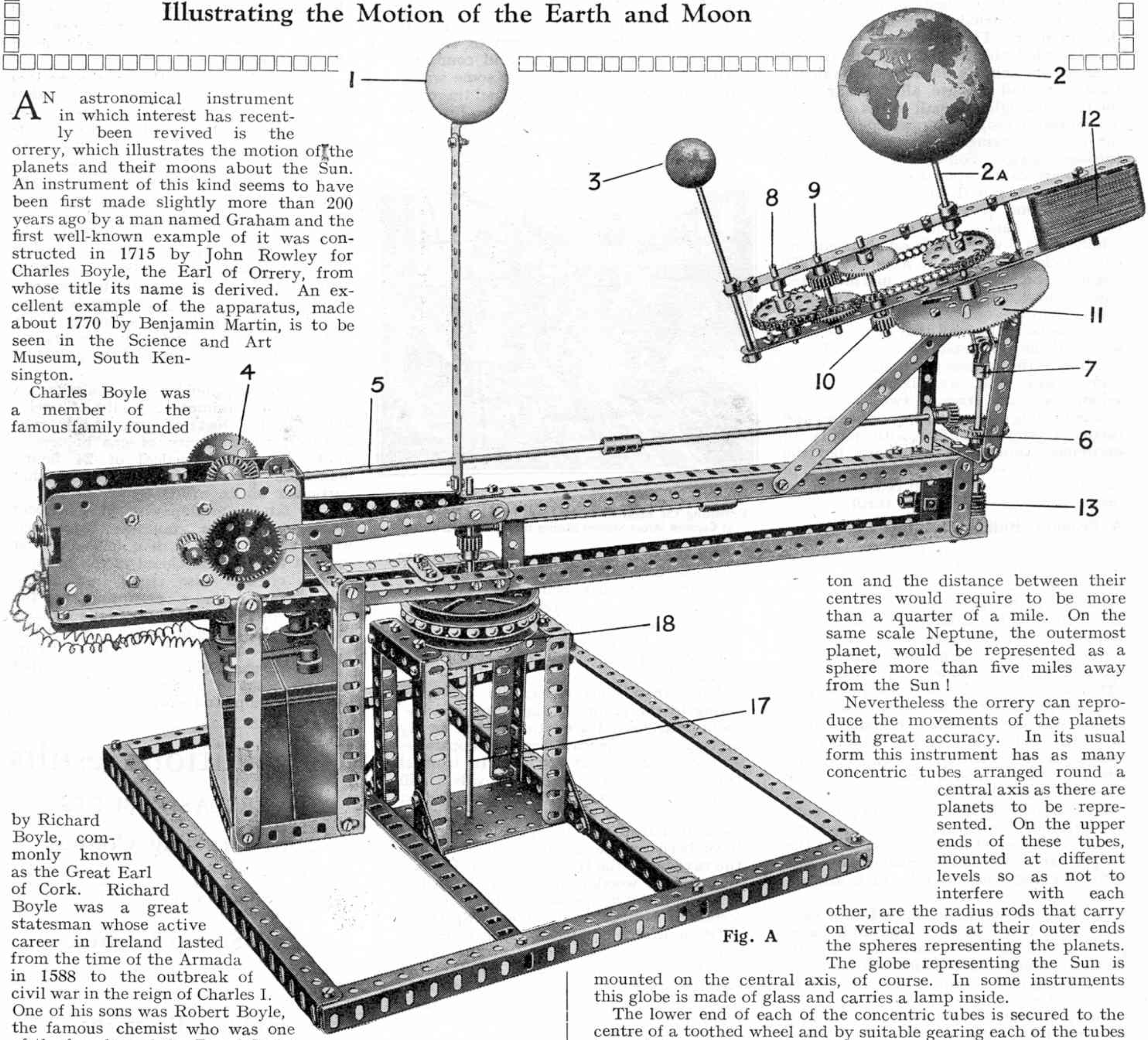


Fig. A

The Functions of an Orrery

The orrery soon proved to be much more than a mechanical toy however. It is impossible to represent the solar system mechanically with absolute accuracy, of course, the great difficulty being the correct reproduction of the sizes and distances apart of the planets. If the Earth, for instance, in such an instrument is represented by a sphere of the diameter and weight of a halfpenny, the Sun would have to be a huge globe weighing considerably more than a ton and the distance between their centres would require to be more than a quarter of a mile. On the same scale Neptune, the outermost planet, would be represented as a sphere more than five miles away from the Sun!

Nevertheless the orrery can reproduce the movements of the planets with great accuracy. In its usual form this instrument has as many concentric tubes arranged round a central axis as there are planets to be represented. On the upper ends of these tubes, mounted at different levels so as not to interfere with each other, are the radius rods that carry on vertical rods at their outer ends the spheres representing the planets. The globe representing the Sun is mounted on the central axis, of course. In some instruments this globe is made of glass and carries a lamp inside.

The lower end of each of the concentric tubes is secured to the centre of a toothed wheel and by suitable gearing each of the tubes is made to rotate round the Sun at the appropriate rate for the particular planet associated with it. Thus the tube carrying the sphere representing Jupiter is so geared that it rotates once while that carrying the sphere representative of the Earth travels round almost twelve times, thus indicating the difference between the periods in which these two planets complete their orbits.

More complications ensue when the rotations of the planets themselves and the movements of their moons are also to be represented. Even this can be done, however, and an orrery combining all these movements can be constructed without difficulty from standard Meccano parts.

The Movements of the Model

The model depicted on this page demonstrates the annual journey of the Earth and its satellite, the Moon, round the Sun, and is yet another remarkable illustration of the practical value of Meccano.

The movements to be represented are three in number. The

Earth rotates round the Sun in the same time that it takes to rotate upon its own axis 365 times, while the Moon makes 13 revolutions round the Earth in the same period. The Moon always presents the same face to the Earth, and the axis of the latter body is so inclined that there is an angle between the plane of the equator and that of the earth's orbit of 23½ degrees. The Meccano model reproduces these movements and positions with considerable accuracy.

The Sun is indicated at 1, the Earth at 2, and the Moon at 3 (Fig. A). Suitable spheres or balls to represent these bodies may be obtained quite easily, and no trouble should be found in securing them to their respective shafts. The appearance of the model will be enhanced if the globes are painted to represent the markings on the surfaces of the Earth and Moon, etc.

The Motor is mounted at the end of the revolving portion, or arm, of the model and its weight, together with that of the Meccano 8 ampere-hour Accumulator slung in a suitable frame beneath the Motor, serves to counterbalance the weight of the Earth and Moon, etc., on the other end of the arm.

The drive is led first to the Earth spindle 2a by way of two 3 : 1 reduction gears mounted on the Motor, and Bevel Wheel 4. The latter engages with a similar wheel secured to the shaft 5, which consists of two 8″ Rods secured together by a Coupling. The other end of this shaft 5 carries a ½″ Pinion gearing with a 1½″ Contrate Wheel 6 secured to a vertical Rod that is connected to the Earth spindle 2a by means of a Universal Coupling 7. This allows the Rod 2a to be placed at an angle corresponding to the "tilt" of the Earth's axis.

How the Moon is Operated

The motion of the spindle 2a is conveyed to a short Rod 8 by means of a length of Sprocket Chain and two 1½″ Sprocket Wheels, and a ¾″ Pinion secured to this Rod 8 drives a 50-teeth Gear Wheel secured to another 2″ Rod carrying the ¾″ Pinion 9. The latter, in turn, engages with another 50-teeth Gear Wheel secured to the shaft of the ½″ Pinion 10, which engages with the teeth of a 3½″ Gear Wheel 11. The Gear Wheel 11 is secured by Strips to the arm so that it cannot rotate, the Earth spindle being free to move within its boss, of course.

The gear train 8, 9, 10 is carried in an arm that pivots about the Rod 2a and since the Pinion 10, when in motion, must travel round the teeth of the immovable wheel 11, this arm together with the Moon 3 secured to its outer end, is caused to turn slowly round the Earth 2. The gear ratio is such that one complete revolution of the arm carrying the Moon takes place once in 28 revolutions of the Earth sphere 2. And since one revolution of the latter must indicate the passage of a single 24-hour day each complete circuit described by the sphere 2 corresponds to the 28-day lunar month.

The phenomenon of night, or the transit from daylight to darkness that takes place over the greater portion of the earth's surface once in every 24 hours, may easily be illustrated by adding a small electric light in place of, or in addition to, the Sun globe 1.

In order to secure smooth working, the weight of the Moon and its gear train is counterbalanced by a series of 2½″ Strips 12 mounted on the opposite end of the revolving arm.

Earth's Passage Round the Sun

Fig. B is a detail view of the model and shows the opposite side of the main revolving arm. From this illustration it will be seen that the lower portion of the Earth spindle carries a Worm 13 engaging with a ½″ Pinion 14 that is secured to a short Rod journalled in the end of the arm. This Pinion 14 gears with a similar Pinion mounted on the end of a shaft 15, consisting of two 6½″ Rods secured end to end by a Coupling, on the other end of which is a second Worm 16 engaging with the teeth of a ½″ Pinion secured to a vertical Rod 17.

This Rod 17 is gripped by the set-screw of the 3″ Pullev 18,

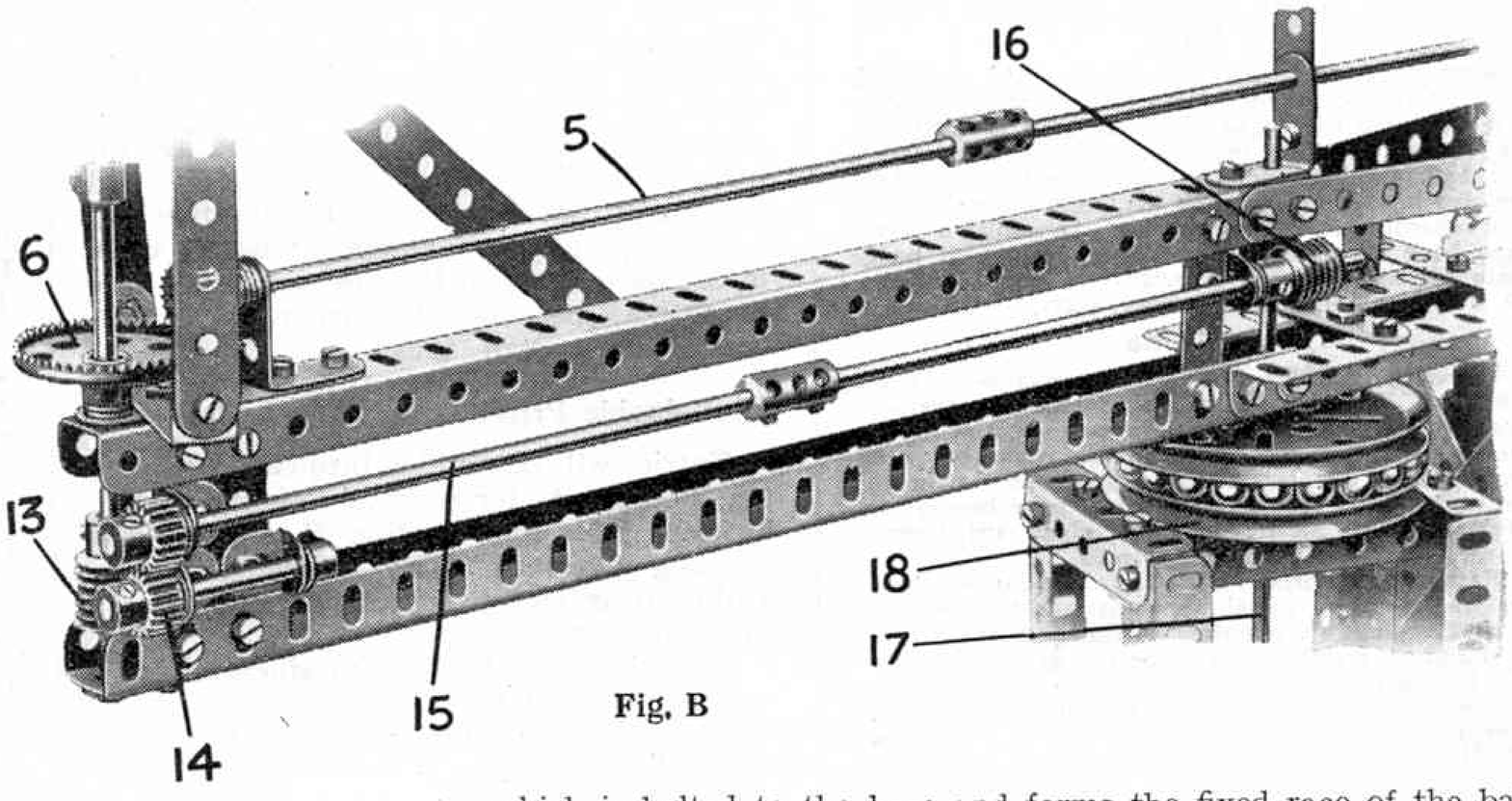


Fig. B

which is bolted to the base and forms the fixed race of the ball bearings on which the movable portion of the model rests. The construction of the ball bearing unit is identical to that described under Meccano Standard Mechanism No. 104/5, the upper 3″ Pulley of the unit being secured to the rotating superstructure. The Worm 16 is driven very slowly from the motion of the Earth spindle and because the ½″ Pinion with which it gears is quite rigid, it has the effect of turning the whole superstructure about the Rod 17. Thus the Earth 2 and Moon 3 are carried round the Sun 1.

The two separate worm gears incorporated in the drive transmission reduce the speed of rotation to such an extent that the Rod 2a must rotate 361 times before the superstructure completes one revolution. This closely approximates to the actual number required, for the Earth revolves 365 times about its own axis while journeying once round the Sun. The sum of these 365 turns, or days, makes what we term a year.

A Snapshot Competition

The many photographic enthusiasts among our readers will welcome the announcement that Gevaert Ltd., whose advertisement appears on page 568 of this issue, are organising a competition for snapshotters and are awarding valuable cash prizes each month for happy snapshots. Here is an excellent chance to make your camera pay for its season's upkeep.

The rules are very simple. Any size photograph is eligible and no entry forms are necessary. The only stipulation is that each photograph must be accompanied by a GAYVERT film carton. As many prints as desired may be entered at any time each month up to 30th September but a carton must accompany each. Full details of this competition appear in Gevaert Ltd.'s advertisement this month.

Wang's "Flexible Brain"!

The following letter was recently received by a financial house in Peking :—

"DEAR SIR,—I am Wang. It is for my personal benefit that I write for a position in your honourable Bank.

"I have a flexible brain that will adapt itself to your business and in consequence bring good efforts to your good selves. My education was impressed upon me in Peking University in which place I graduated Number One.

"I can drive a typewriter with a good noise and my English is great.

"My references are of good and should you hope to see me they will be read by you with great pleasure.

"My last job has left itself from me for the good reason that the large man has dead. It was on account of no fault of mine. So, honourable sir, what about it ? If I can be of big use to you, I will arrive on some date that you should guess.—Faithfully yours, 'WANG.'"

Important Babies at the Zoo

Among the outstanding possessions of the London Zoo is the recently-born East African buffalo. This interesting animal attracts a good deal of attention, as it is nearly 15 years since an East African buffalo was last born in the Zoo gardens.

Equally important is the baby hippopotamus and fortunately he is a much less delicate animal. In fact he is distinctly substantial for a baby and is now practically big enough to take care of himself. While younger he was the cause of a family separation. There was scarcely room enough in the small indoor tank in which these animals enjoy a bath for the two older hippopotami and there was a great risk that between them Jimmy would accidentally be crushed if he also ventured into the water. So they were separated, but soon it will be Jimmy's turn to live by himself.

Club Notes

(*Continued from page* 561)

South Africa

Simonstown M.C.—A concert recently held was a great success. The programme was well arranged and the Mayoress of Simonstown presented prizes. The hall was loaned for the occasion by Lieut.-Col. Judd, S.A. Permanent Garrison Artillery. The Mayor has promised a silver cup as a floating trophy and several ex-Flying Corps officers have volunteered to give lectures. The Girls' Section continues to grow and is now very flourishing. Club roll: 50. Leader and *Secretary*: Mr. Wm. J. Creasey, "Elsinore," Simonstown, South Africa.

Canada

Manitoba M.C.—At a recent meeting the Motor Chassis Model was explained to members, and various Standard Mechanisms also have been studied at different times. Club meetings are interesting and the members are very keen. The "*History of Meccano*" was read one evening and was greatly enjoyed. Club roll: 24. *Secretary*: Norman Scott, 664, Nassau Street, Winnipeg, Manitoba, Canada.

Italy

Siena M.C.—Members have concentrated on Model-building and at the moment a Switchback Railway is being constructed. The club has been divided into six sections for Model-building, Philately, Gymnastics, Football, Cricket and Cycling respectively. Every member is expected to wear his Guild Badge and the rule regarding this is very strict. In addition velvet caps have been introduced having the Guild badge embroidered on them. *Secretary*: Valentino Bruchi, 39, Via Ricasoli, Siena, Tuscany, Italy.

Australia

Waverley (N.S.W.) M.C.—Good progress is being made. A Draughts Championship recently organised proved very successful and other games championships are to be organised. A new club room has been secured and this is far more satisfactory than the old one. Some very good Lectures have been given. Club roll: 17. *Secretary*: V. Worstead, 101, Cowper Street, Waverley, N.S.W., Australia.

Hampton (Victoria) M.C.—The attendance is good and the members are all very enthusiastic. Hornby Train Evenings are popular. A Games Night is to be held and an Exhibition is to be incorporated with it. An interesting competition has been organised for the best model of the Sydney Harbour Bridge. Members hope to visit the offices of the "*Herald and Weekly Times*" one Saturday afternoon. Drawings Nights are popular; each boy brings drawing paper and a pencil, and drawings of locos, bridges and cranes are made. Club roll: 10. *Secretary*: F. G. Wallis, 9, Kerford Street, Hampton, Victoria, Australia.

Suggestions Competition

(*Continued from page* 545)

readers, and next to those already mentioned, received the largest number of votes:—Automatic Speed Governor (No. 29); Friction Disc Transmission (No. 46); de Havilland Differential Aileron Control (No. 51); Spring Pistol (No. 53); Free Wheel Device (No. 54); Accumulator Carrier (No. 36); etc., etc.

Overseas Section

Meccano boys all over the world apparently think very much alike, for the final order of the suggestions as decided by overseas readers' votes coincides very closely with the home readers' list, the four most popular suggestions being voted as follows:—

First: No. 67, Kinetograph, by E. H. Bradshaw (published December, 1926).
Second. No. 66, Electric Washing Machine, by C. W. Beese (published December, 1926).
Third: No. 52, Automatic Gear Change, by H. F. Barnard (published August, 1926)
Fourth: No. 63, Electric Fan (published November, 1926).

The names of the prize-winners and respective scores are as follows:—

First Prize (cheque for 10/6): Jack Steeds, 274, Kilmore Street, Christchurch, N.Z. (9); Second Prize (original amount increased and divided among the following three boys, each receiving 2/6): D. R. Edwards, Cape Town, S. Africa (8); Jack Sharpley, Hastings, Hawke's Bay, N.Z. (8); and Orlando Pappo, Alexandria, Egypt (8).

The following readers will each receive a complimentary copy of the Meccano Standard Mechanisms Manual: Frank Van Bulck, Paris, XI; Salvatore Galdes, Valletta, Malta; B. N. Ghosh, Benares City, India; H. Fox, Christchurch, N.Z.; R. Russell, Whangarei, North Auckland, N.Z.; and D. E. Sampson, Bombay.

(*Continued at foot of next column*)

Special Crane Model-Building Competition

We announced in last month's Magazine that we intended to organise a special model-building competition in connection with the article that appeared in that issue dealing with a new 62-ton steam travelling derrick crane built by a British engineering firm for the Chilian Government. Full particulars of the competition appear below and we hope that every keen Meccano boy will endeavour to carry off one of the prizes offered.

The crane was illustrated and fully described in the May issue, and competitors are asked to reproduce it as accurately as possible in Meccano. This is a good opportunity for model-builders. The crane offers a wide scope to the fortunate possessor of an elaborate Outfit while, on the other hand, it can be reproduced with great realism with the aid of quite a small set.

Competitors may use any number of parts, and any movement or detail that is not quite clear in the description of the crane may be completed according to the competitor's own ideas.

18 Valuable Prizes

Entries will be divided into two sections, i.e., Section A, for readers residing in the British Isles, and Section B, for readers residing overseas. The following prizes will be awarded for the best entries received in each Section:—

First Prize: Meccano products to the value of £3-3s.
Second Prize: Meccano products to the value of £2-2s.
Third Prize: Meccano products to the value of £1-1s.
Six Prizes, each consisting of Meccano products to the value of 10/6.

A model submitted for participation in the contest must be the competitor's own unaided work both in design and construction. The age of the competitor will be taken into consideration when judging the entries.

Readers should send in clear photographs or good drawings of their work, 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 ("Derrick Crane") and the Section in which the model is entered. Envelopes should be addressed "Derrick Crane" Competition, Meccano Ltd., Binns Road, Liverpool.

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 Ltd. Closing date for Section A, 31st August, 1927. Section B, 30th November, 1927.

E. H. Bradshaw, who contributed Suggestion No. 67, will receive a prize of 7/6, and the contributors of the other three suggestions named will each receive a special Certificate of Merit and a complimentary copy of the Standard Mechanisms Manual or Meccano parts to the same value.

Exploring the Arctic—(*continued from page* 487)

only of Franklin, Richardson, Hepburn and the interpreter—gave up all hope of being rescued. By the 6th they were on the verge of absolute exhaustion and realised that the end could not be long delayed. On the very next day, however, relief came. "Praise be unto the Lord," wrote Franklin in his diary. "we were this day rejoiced by the appearance of Indians with supplies of food."

It was entirely due to the gallant Back that the survivors of the expedition owed their lives. He had met the Indians on the 4th November and they at once hastened to the rescue. Back had endured incredible hardships—he even supported himself by eating an old pair of leather trousers, a gun cover, and some old shoes, along with the inevitable lichens.

Little remains to be told of the expedition—the worst was over, and on the 16th November the survivors were sufficiently recovered to leave Fort Enterprise. They arrived at Fort Providence on the 11th of the following month, and having rested for a few days, went on to Moose Deer Island where they spent the winter. In the following May (1822) they continued their journey and in July reached York Factory, on the shore of Hudson Bay, from whence they sailed for home reaching England in October. They had been absent three-and-a-half years, and had journeyed by land and water in the northern continent of America, a distance of over 6,300 miles.

NEXT MONTH:—
BACK'S EXPLORATIONS

Stamp Advertisements

(*See also page* 562)

FREE. 200 diff. to approval applicants, including African and Brit. Col.—W. S.C., 42, Alma Rd., Windsor.

1,000 DIFFERENT STAMPS 5/-; 500 2/- post free.—Law, 102, Jefferson Road, Sheerness.

STAMPS. My wonderful ½d. Approvals command satisfaction.—S. R. Catt, 20, Brunswick Rd., Ipswich.

STAMPS. Unmounted Collection, 1010 different, 3/6.—Gibbins, 6, Montpellier Road, Exmouth, Devon.

100 DIFFERENT STAMPS FREE.—Send for ½d. approvals.—Cox, 135, Cambridge Road, Seven Kings.

100 SUPERIOR FREE. Request cheap high-class approvals.—Porter, 20, Sydner Rd., Stoke Newington.

2,000 Assorted Foreign Stamps 1/4, Postage 4d. Clearing large stock.—37, Bostock Rd., Abingdon, Berks.

75 FREE. All different, to genuine applicants for approvals. Williams Brav Head Terr., Brav, Wicklow.

FREE. 25 British Colonials to genuine applicants for really cheap approvals.—Gosling, 93, Wherstead Road, Ipswich.

110 ALL DIFFERENT including Cayman, Dominica, Sarawak, Somali, Zanzibar, etc., 3d.—"Philatelic," 54, Claremont Road, Westcliff, Essex.

BRITISH COLONIALS ALL DIFF., 50 7d., 100 1/-, block 16 Persia 1st buyer. Collection 1,450 stamps in album, offers? 1,000 Brit. Cols., good mixture, 7/6.—17, Bayswater Av., Redland, Bristol.

300 STAMPS FOR 6d. (Abroad 1/-), including Air-post, Triangular, Old India, Nigeria, New South Wales, Gold Coast, etc. White, Engine Lane, Lye, Stourbridge.

BARGAINS ARE FOUND IN MY LITTLE BOOKS. Colonial and Foreign. Send postage and I give ten Hungary Harvesters free.—Miss Rose, 3, Bridge Road, Poplar, London, E.14.

SHANGHAI PACKET FREE

A grand packet of **25 Different Stamps** containing **Shanghai** 1893, 5c unused, a very fine stamp, **Soruth** Indian Native State, 1923, 3 pies unused, **Morocco** King George 5c unused, **Albania** 1926, 1 qind, **Japan Earthquake** 1924, **Ruanda-Urundi** surcharged on **Belgian Congo,** a fine **set of 4 French Equatorial Africa** surcharged on **Gaboon, Middle Congo, Oubangui** and **Tchad, Monaco** 1925, **Angola** 1914 unused, **New Caledonia** pictorial, **Madagascar** pictorial, **Niger Territory,** pictorial, etc., etc., free to all asking to see my famous approval sheets and enclosing **2d. for postage and packing (abroad 3d).**

S. HAMMOND, 2, Chesham Fields, BURY.

Competition Page

Which Advertisers Use These Slogans?

We do not suppose for one moment that there is one among our readers who does not understand the meaning of the word "Slogan." In its early form, a slogan was a battle cry and the word itself is derived from the Gaelic expression "sluagh-gairm," meaning an army-cry.

Originally the slogan was used by the old Highlanders of Scotland in their tribal wars. In these only a comparatively small number of men were engaged and hand to hand conflicts were the rule. Usually the fighters became isolated from one another in small groups and the battle cries were raised not only to raise the spirits of the fighters but also to indicate to "friends" where "friend" was fighting "foe." With the gradual evolution of mechanical means of warfare and the passing of the less destructive though more exciting hand to hand fights, the necessity for battle cries became less and less until to-day the word has ceased to convey its original meaning and is synonymous with another form of campaign, advertising.

Usually the advertising slogan extols in highly concentrated language some outstanding feature of the product or service advertised. It does not necessarily embody the name of the product and often the particular merit is only implied by the wording used. For example, "Worth a guinea a box!" immediately recalls the name of a certain patent medicine. And it is in that immediate association of a name with a slogan that its merit lies.

Our competition this month is designed to test our readers' powers of observation, for each of the well known slogans printed below has been advertised extensively within recent years. Prizes of Meccano products to the value of £1-1s., 15/–, 10/6 and 5/– will be awarded to the competitors who submit the most complete lists of firms owning the slogan given and the goods to which the slogan refers.

He won't be happy till he gets it.
Born 1820. Still going strong.
Masters the hair.
The flavour lasts.
—— pay carriage.
For cool smoking.
Better than a Mustard Plaster.
Won't wash clothes.
Fit —— and be satisfied.
Sip it! Drink it! Drain it!
Keep that schoolgirl complexion.
Prevents that sinking feeling.
Twixt Trent and Tweed.
If you see it in —— it is so.
They come as a boon and a blessing to men.
Won't shrink woollens.
I love to dance but oh! my feet.
If you wear wool, wear ——.
Don't trudge it, —— it.
Best Bakers Bake it.
It's the little daily dose that does it.
The greatest of all tonics.
—— washes every way, cold or hot or boiling.
See the name on every piece.
Always turn out well.
The Premier of North Wales.
Pass the ——.
The mighty atom.
It beats, as it sweeps, as it cleans.
Buy from the Pump.
The New Day Dentifrice.
Rub it in.
There is no sweeter tobacco comes from Virginia.
The machine you will eventually buy.
Builds Bonny Babies.
There can be none nicer.

In order further to test our readers' grasp of the subject, each competitor is asked to give at the head of his entry a suggested new Meccano slogan. For many years "Engineering for Boys" has stood synonymous with "Meccano" and it will have to be a first-class suggestion that improves upon it. But go ahead!

Entries must be addressed to "Slogans, Meccano Magazine, Binns Road, Liverpool," and must reach this office not later than 30th June. Overseas closing date, 30th September.

22nd Drawing Contest

The sketch "DISCOMFORTS OF PREHISTORIC AIR TRAVEL" that appeared on our April Fireside Fun pages, created considerable amusement among our readers and we anticipate that the airship of 4000 A.D. depicted on page 535 will create even more interest. But what has that to do with drawing competitions? Simply this. We have often wondered what the trend of railway practice will be in the future and we are taking this opportunity of asking readers to forecast for themselves and make a drawing of what they anticipate the locomotive of 2000 A.D. will look like.

Competitors, if they wish, may submit humorous sketches although we anticipate that the majority will prefer to stick to serious efforts. The competition will provide ample scope for imagination but we give a gentle hint. Entrants should remember that 2000 A.D. is less than 75 years away and some of the competitors at least can hope to live long enough to test the accuracy of their forecast. In the case of serious efforts special attention in judging will be paid to the general balance and cleanliness of design.

There will be two sections, A for those aged 16 and over, B for those under 16. Prizes of Meccano goods or drawing material to the value of 15/– and 7/6 respectively will be awarded to the two best entries in each section and in addition there will be a number of consolation prizes. Closing date 30th June; Overseas, 30th September.

Results

My Hornby Layout

First Prizes: Section A, W. V. GOLDING (Norfolk); Section B, J. W. LOWE (Birmingham). Second Prizes: Section A, W. H. CAMM (Grantham); Section B, G. M. BOYES (Lee, S.E.12). Consolation Prizes: H. SHAW (Rayleigh); N. H. FOWLER (Nottingham); W. S. MORGAN (Barrow-in-Furness); W. WEST (Hull).

Fifth Stamp Contest

1. H. B. PORTER (Leicester); 2. J. M. BALDRY (St. Leonards-on-Sea); 3. E. LORD (Manchester).

Sixth Stamp Contest

Readers were required in this contest to identify various scenes cut from complete stamps, each of which had been illustrated in the "*M.M.*" at some earlier date. No small power of observation was demanded and it was gratifying to find so many were able to submit a completely correct solution. After very careful consideration the prizes were awarded as follows:—1. Miss H. HOLLBY (Bexhill-on-Sea); 2. B. BIRD (Wood Green, N.22); 3. T. E. RYMAN (Peterborough).

To enable competitors to check their solutions we append the correct list of stamps illustrated. 1. Austria; 2. Canada; 3. British Guiana; 4. Hawaii; 5. Egypt; 6. Jamaica; 7. Bulgaria; 8. Ecuador; 9. Argentina; 10. Chile; 11. Germany; 12. Dominica.

Cover Voting Contest

Once again the popularity of voting contests was demonstrated by a large entry and the outcome of the poll revealed a very surprising result. It would be unfair to the Oversea competitors to give a detailed review for such would unconsciously affect the opinion of readers in European countries who may happen to read this note before submitting their entries. We would add however that no competitor succeeded in giving a completely accurate forecast.

The prizes were awarded to the following competitors:—1. L. M. ALLEN (Pangbourne, Berks.); 2. H. W. SIDWELL (Coventry); 3. D. PEEL (Norbury, S.W.16); 4. E. R. PHILLIPS (Hove). Consolation Prizes: B. ELLIOT (Norwich); A. JACOBS (Wandsworth Common, S.W.12); N. WOODARD (Tottenham, N.17).

Competition Suggestions

Prizes have been awarded to the following entrants:–1. G. E. PARKER (Southampton); 2. L. H. DAY (Walsall); 3. O. A. KIMMINGS (East Acton, W.3). Highly Commended: A. BARNES (Dublin); H. E. FISHER (Cheltenham); F. S. HALL (Derby); L. MORPHEW (London, S.E.24).

(*Competition Results continued on page* 555)

OBJECTS of the GUILD

To make every boy's life brighter and happier.

To foster clean-mindedness, truthfulness, ambition and initiative in boys.

To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

The Meccano Guild

With the Secretary

The Summer Session

Outdoor activities are now in full swing with the majority of clubs and judging by the reports I have already received this is going to be a more successful summer than any previous one, regarded from the Guild point of view. With a few exceptions, due to unusual circumstances, all Meccano Clubs are making definite arrangements to carry on club life throughout the summer. There are many signs that the old practice of allowing clubs to practically die out during the summer has gone for ever. Leaders generally realise to-day that this practice involves the members missing a great deal of splendid outdoor fun, and also makes it an extremely difficult task to bring the club together again for the first winter session.

Games Evenings

A notable feature during the past two or three sessions has been the increasing number of clubs that have adopted Games Evenings as a regular feature of the syllabus. Many Leaders have commenced such evenings with considerable misgiving, but in almost every case they are now quite enthusiastic about the idea. There is certainly no doubt about the popularity of such evenings among members. Some clubs have elected a Games Committee and this plan has proved very successful because, in order to obtain the greatest possible fun from any game, a certain amount of organisation and preparation is necessary.

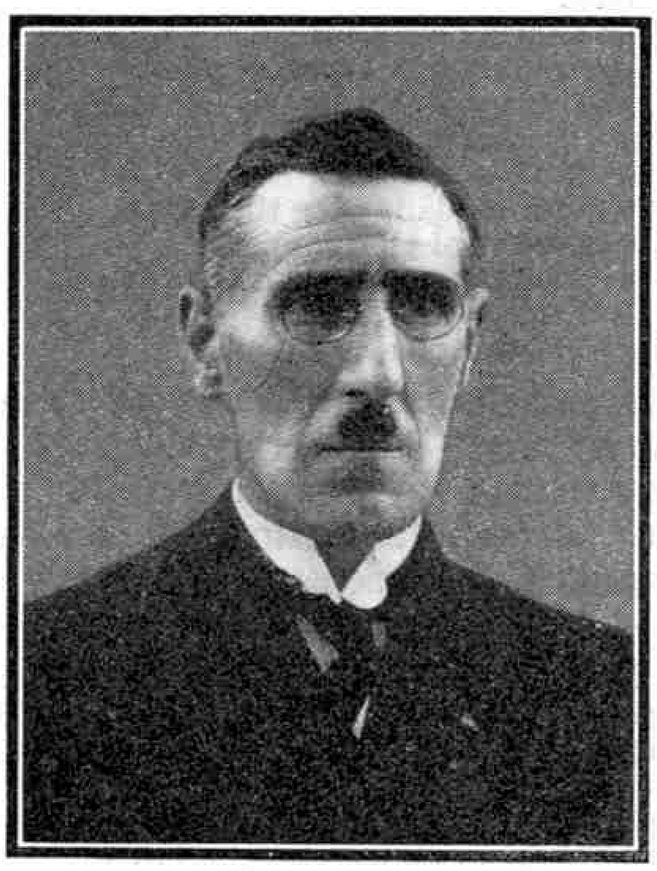
Table Tennis appears to be the most popular game at the moment and this is not surprising, for it lends itself excellently to quite interesting tournaments. In a few cases clubs have challenged other clubs in their neighbourhood and the resulting struggle has been almost as exciting as the fight for the Association Football Cup! It is interesting also to note that Miniature Rifle Shooting is becoming very popular and the Editor has promised to include in an early issue of the "*M.M.*" an article on this pastime written by an expert.

Filling Up a Wet Spell

During the summer, of course, indoor games lose their attraction, but now and then outdoor arrangements are bound to be upset by rain and on such occasions, if the club room is available, it is better to spend a couple of hours playing indoor games than for the party to break up and the members wander disconsolately home. An interesting scheme tried by a certain club may be recommended as an emergency pastime to fill up a short period of rain. The Leader chooses a subject suitable for a short address. This need not necessarily be a serious subject and in fact a humorous one is often more successful. Each boy then writes his name on a small slip of paper, these slips are shuffled up in a hat and the Leader draws one. The member whose slip is drawn must then commence an address on the subject and continue it for two minutes, after which the Leader draws another name from the hat and this boy continues the address at the point where the first boy left off. This goes on until every boy has had a turn. The results are intensely amusing, particularly if the members present have a good sense of humour and enter into the spirit of the thing. If time is limited the period allowed to each speaker may, of course, be shortened.

Meccano Club Leaders

No. 32. Mr. W. C. Watts



Mr. W. C. Watts is Leader of Beccles Meccano Club, which was affiliated in March, 1926, and has made consistent progress. The club's activities are centred mainly on model-building. A display of models built by members was incorporated recently in the local Flower Show and won high praise from the large number of people who examined the work, thus gaining for the club a considerable amount of welcome publicity.

The club is fortunate in having for President the Rev. H. Hardy Holder, whose encouragement is greatly appreciated.

To Secretaries

Once more I must appeal to club secretaries to give me more information in their monthly reports. I am afraid that many secretaries regard the writing of these reports as an irksome task to be postponed to the last minute and then rushed off as quickly as possible! The result is that I am continually receiving reports giving me absolutely no details whatever, but merely a few general remarks. In such cases I find it extremely difficult and often quite impossible to prepare a paragraph for the "*Club Notes*" page. The inevitable result is that those clubs whose secretaries send me good reports obtain more frequent and longer paragraphs in the "*M.M.*" I should like secretaries to remember that the "*Club Notes*" page is not intended to be merely a record of events of interest only to the individual clubs concerned, but is designed to provide hints and suggestions to other clubs. To members who feel that their clubs are not receiving a fair share of recognition on the "*Club Notes*" page I would say: "Tackle your secretary and find out what kind of reports he is sending in."

* * * *

Leaders who have decided to hold a club camp during the summer or who are contemplating doing so should study carefully the article on camping that appears on page 492 of this issue. This article has been specially written by a member of the Camping Club of Great Britain and Ireland.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places and boys interested should communicate with the promoters whose names and addresses are given:—

BIRMINGHAM (King's Norton).—E. T. Cooke, 340, Selby Oak Road, King's Norton.

BOURNEMOUTH.—Reginald D'Arcy Ford, Top Floor, 70, Seabourne Road, West Southbourne, Bournemouth.

CARLISLE.—W. S. Purves, "Tynedale," Warwick Terrace, Warwick Road, Carlisle.

CHESHAM.—L. Howard, 41, Red Lion Street, Chesham, Bucks.

HARLE SYKE (Burnley).—L. Shoesmith, 16, Cross Street, Harle Syke, Nr. Burnley.

MEXBROUGH.—Ellis Ainley, Main Street, Mexbrough, Yorks.



CLUB NOTES



Barrow M.C.—A successful Hornby Train Night was held recently and the layout was quite large. During the summer fortnightly meetings are to be held. An Exhibition is to be held and preparations are in full swing. Invitation cards are being printed. A Model-building Night brought forth many excellent models, including a Leather Beater, a Boring and Planing Machine and a model of the famous racing car "*Babs*." The Meccano Lecture, "*The Story of the Motor Car*," was loaned from Headquarters and this was greatly appreciated by all the members. Club roll: 29. *Secretary*: W. E. Kelly, 157, Abbey Road, Barrow-in-Furness.

Chalmer's Church (Alloa) M.C.—The Rev. R. A. Agnew recently gave a very interesting Lecture on "*Northern Africa*," well illustrated by slides taken by himself. A Bagatelle Competition was a success, being keenly contested. Club roll: 45. *Secretary*: G. Campbell, Grange Manse, Alloa, Scotland.

Morison Memorial (Scotland) M.C.—Many interesting Lectures have been given by the Leader, Mr. Fraser. Next session it is hoped that the club roll will show a great increase for all the boys are very enthusiastic. During the summer members hope to visit several large power stations, including the Dalmarnock Power Station and the Singer's Power Station. The boys are gathering silver paper for the hospitals and already a large amount has been collected. Club roll: 40. *Secretary*: Ernest Bayes, 43, Livingstone Street, Clydebank, Scotland.

Westbury M.C.—Two Lectures entitled respectively "*The Amazing Animal Kingdom*" and the "*East Coast Route*" were much enjoyed. Visits to various parts of London have been proposed for the summer session, but arrangements so far are not very definite. Club roll: 19. *Secretary*: Eric Moye, 24, Burnell Rise, Letchworth, Herts.

Sandwich M.C.—Model-building and Lectures are popular, but owing to the 'flu epidemic many meetings have had to be postponed. A very appropriate Lecture was given by the Leader, Mr. A. Craig, "*How to Rid Yourself of the 'Flu.*" Club roll: 21. *Secretary*: W. Barlow, 9, Paradise Row, Sandwich, Kent.

West Bridgford M.C.—A Whist Drive realised about £6 and this has been expended on camp equipment. Many more members wish to join the club but accommodation prevents any more boys being enrolled. The Annual Party was a great success and a very excellent tea was provided by the parents of the boys. Sixty boys were present. After tea a performance of "*Aladdin*" was given by the boys of another Y.M.C.A. club. Club roll: 50. *Secretary*: Mr. N. C. Whitehead, Y.M.C.A., Mansfield Road, Nottingham.

Guildford M.C.—A Visitors' Night proved a huge success and about 250 people were present. Prizes for Model-building were presented by the Mayor, who gave an interesting address and congratulated the boys on their work. The Mayor also offered a prize of one guinea, with the promise of another from the Mayoress, for the winners in the next competition to be held at the club. During the proceedings one of the boys presented the Mayoress with a bouquet. Leader: Mr. G. W. Bartlett, 4, Friary Street, Guildford.

St. Albans M.C.—A successful Exhibition has been held at which a good sum of money was realised. Among the greatest attractions was a Transporter Bridge model loaned from Headquarters. Several members paid a visit to the printing works of the local newspaper and greatly enjoyed all they saw. Afterwards three of them wrote papers on the printing of a newspaper and read them at the club. All three papers were published subsequently in the newspaper. Club roll: 16. *Secretary*: H. N. Upward, 19a, Worley Road, St. Albans, Herts.

Northwood (Middx.) M.C.—Several interesting talks on Plants and Plant Life have been given and a talk on Wireless given by a popular patron of the club was greatly enjoyed. The Leader, Mr. Edwards, recently gave a short paper on "*What is Electricity?*" Games Evenings are held frequently with great success. Club roll: 12. *Secretary*: F. C. Brown, 27, Hallowell Road, Northwood, Middx.

St. Mary's Brookfield M.C.—A Lantern Lecture on "The Underground Railway" was recently given and Mr. Burgess, the Leader, explained the slides. Games Nights are popular and a Question Evening is to be arranged, when members will be given various questions to answer. A new secretary has been elected in Miss Enid Farwell of 46, Bickerton Road, Junction Road, London, N.19. Club roll: 35.

Stonefield Parish Church (High Blantyre) M.C.—A recent Exhibition attracted about 150 people and was thoroughly successful. The visitors were greatly impressed by the models shown, particularly the larger ones, which included a Loom, Chassis, Eiffel Tower, Meccanograph, Workshop with Lathe, Planing Machine, Vertical Drill, Punching Machine and Overhead Travelling Crane. A fine model railway layout was operated by two Pullman expresses, one express goods train and a local passenger and a slow goods train. *Secretary:* J. Gillespie, Auchenraith Road, High Blantyre.

Falmouth "Wesley" M.C.—This club is fortunate in having a very comfortable room and meetings are held under ideal conditions. Alternate Wednesday evenings are set aside for Meccano Model-building while other evenings are devoted to Lectures and Talks by various people. Two Sick Visitors have been appointed and it is their duty to visit any boy who is ill. Club roll: 20. *Secretary*: V. Jordan, 11, Langton Terrace, Falmouth, Cornwall.

Holy Trinity (Barnsbury) M.C.—A special Model-building Competition was organised and most of the younger boys entered. The competition was divided into two sections, one for boys possessing outfits over No. 2 and the other for boys with smaller outfits. Mr. Smart, a member of The Model Railway Club, gave a very interesting Lecture, accompanied by several lantern slides, on "*Model Railway Construction and Operation.*" This Lecture was well attended and greatly appreciated. It is hoped to secure the services of a local gentleman as President. Club roll: 44. *Secretary*: Frederick W. Johnson, 23, Market Street, Edgware Road, Paddington, W.2.

Elm Road (Beckenham) M.C.—Is making good progress and Model-building is popular. A "Mystery Night" was a huge success for it was a real mystery, even the committee having no idea of what it was going to be! It turned out to be a set of games with prizes of Meccano parts for the winners. At a recent meeting a Hornby Railway was laid down and was unanimously voted excellent. Club roll: 17. *Secretary*: C. W. Price, 52, Queen's Road, Beckenham, Kent.

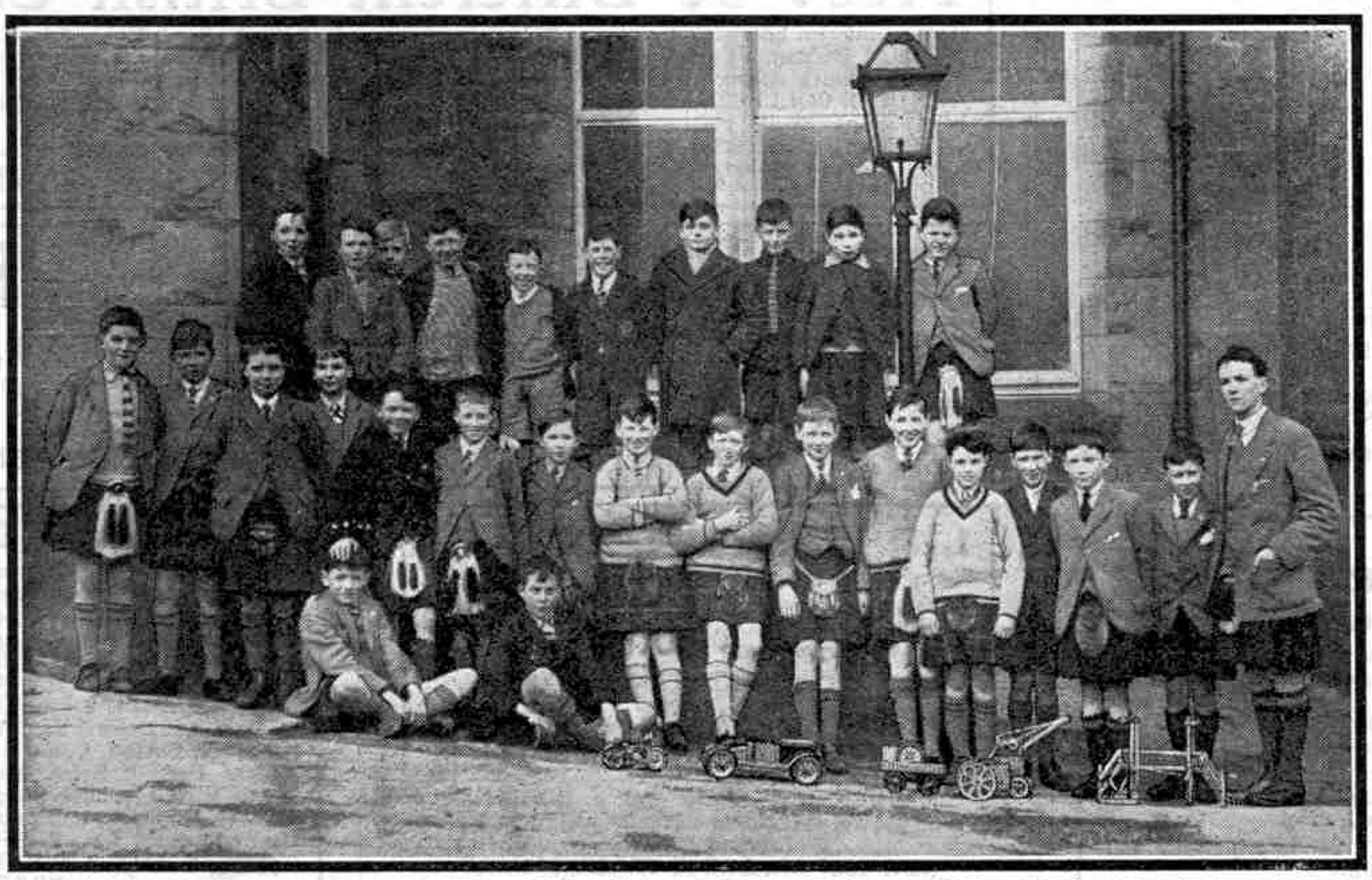
Golders Green Crusaders M.C.—"*The History of the General Omnibus*" was the subject of a recent lantern lecture. Over 100 slides were shown and a record attendance was reported. Non-members were admitted. Railway Night is popular and at a recent Hobby Night interest was centred on electrical experiments. Games Night is a prominent feature of the syllabus and is usually a riotous affair! Arrangements are to be made for an Exhibition and Concert. Club roll: 40. *Secretary*: Raymond Powditch, 78, Erskine Hill, Golders Green, London, N.W.1.

King Edward VI. School (Aston) M.C.—Several lectures by the Leader, Mr. W. B. Chivers, have been very popular and have aroused general interest. This was particularly the case in regard to a demonstration of X-Rays. Other lectures delivered during the session dealt with "*Meteorology*," "*The Cinematograph*," and the "*Motor Engine.*" Club roll: 40. *Secretary*: A. L. Noke, 90, Trinity Road, Birchfield, Birmingham.

Tenterden M.C.—The annual Exhibition was very successful and great interest was aroused by the models displayed, which included the Eiffel Tower, Meccanograph, Workshop, Big Wheel and Aeroplanes. Another very interesting item was a working model of a Meccano Clock exhibited by one of the local dealers. Medallions and prizes were awarded and the proceedings terminated with a wireless demonstration by Mr. A. Rogers. Leader: Mr. H. Clare Station Road, Tenterden.

(*Continued on page* 558)

Greenock Academy M.C.



Our photograph shows a group of members of the Greenock Academy Meccano Club. This flourishing school club was affiliated in March, 1926, and since that time has had the advantage of the enthusiastic and skilful Leadership of Mr. J. H. Kinloch, M.A., a master at the Academy. Membership of the club is confined to the younger boys, who bring their models to meetings week by week to be examined and criticised by the Leader. Marks are awarded each week and at the end of the session prizes are given to the boys having the highest total

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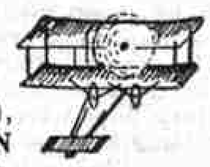
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(*STAMP ADVERTS.—Cont. p.* 558)



Stamp Collecting

VASCO DA GAMA DISCOVERS THE SEA ROUTE TO INDIA

PORTUGAL from its early days has been closely associated with exploration and enterprising seamanship, a feature of its history that has been commemorated in its stamp issues. The first commemorative issue made by the country appeared in 1894, and depicted three incidents in the life of the Portuguese prince, Henry the Navigator, who was born in March, 1394. It is not with that issue that we propose to deal in this article, however, but with another commemorative set issued in 1898 to celebrate the fourth centenary of Vasco da Gama's great voyage to discover the ocean route to India.



The issue consists of eight stamps, their face values being 2½, 5, 10, 25, 50, 75, 100 and 150 reis, and Messrs. Waterlow & Sons of London were responsible for the engraving and printing. The three smaller values depict incidents of the voyage, while the remaining five consist of two pictures of da Gama's flagship, the 50 and 100 reis, and three allegorical designs relative to the enterprise. The first of the latter, 25 reis value, shows a picture of the Muse of History gazing across a vast expanse of sea toward the east. On the horizon a rising sun is shown and it is presumed that the designer intended to convey that da Gama's discovery was the dawning of a new era in Portuguese affairs. The 75 reis shows the Archangel Gabriel, the patron saint of the expedition, after whom the flagship was named, half resting, half hovering, over the flagship, and is symbolical of the Archangelic protection for which the crews said masses before the commencement of the voyage.



The 150 reis value shows da Gama standing in the forecourt of an Indian palace. At his right side a mermaid holds aloft a model of the "*Santo Gabriel*," while on his left an Indian serpent writhes under the sword that da Gama carries. In the background are the towers of a luxurious palace, a richly caparisoned elephant and palm trees, all symbolical of the great wealth of India.



Of the remaining stamps only one, the 50 reis value, calls for special comment. Here appears a picture of the flagship, with the arms of Portugal occupying the upper portion of the sky. Immediately above are portraits of da Gama on the left, and on the right of Lois de Camoens, the great Portuguese poet who immortalised da Gama's exploits in his "*Os Lusiados*."



Vasco da Gama was born in 1460 at Sines, a small seaport town in the province of Alemtezo. His father was a bold adventurer who later was chosen by King Manoel to lead an expedition to discover the rich lands in the east, of which earlier adventurers had sent word. When his father died, a few months before the arrangements for the voyage were complete, Vasco, who already had shown a great love for the sea, stepped forward and applied for the honour of commanding the enterprise. To his delight, the King gave his assent to the suggestion and early in the summer of 1497 granted da Gama an audience at Lisbon, during which the navigator was invested with a silken banner on which was emblazoned the Cross of the Order of Christ.

In the meantime preparations for the great expedition went on apace, for the King, himself a born sailor, was very desirous of adding these much talked of lands to his possessions.

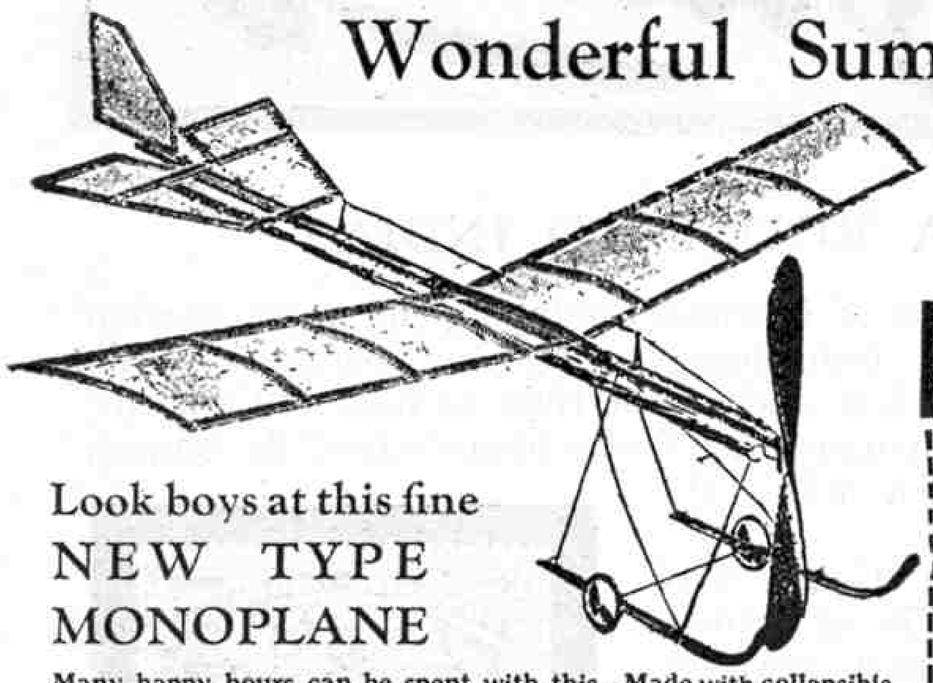
Earlier expeditions had discovered land to the "east of the southernmost extremity of the great African continent." It was known that a seaward passage to the eastern countries existed, because a few years earlier another Portuguese navigator, Dias, had reported that when sailing southward he was carried far to the east by a succession of fierce storms, past what he discovered on his return voyage was the southernmost point of Africa. To this, because of the fearful storms he had encountered, he gave the name "*Cape of Storms*." The King thought this name inauspicious, however, and, by reason of the discovery lending justification to his hopes of adding new rich lands to his kingdom, changed the name to "*Cape of Good Hope*."



Da Gama's command consisted of four ships, two of which, the "*Santo Gabriel*," his flagship, and the "*Santo Raphael*," commanded by his brother Paulo, each of approxi-

GAMAGES

Wonderful Summer Show for Meccano Readers



Every possible thing imaginable to encourage healthy sport and recreation for the modern boy is catered for to the minutest detail. A day spent at Gamages is a day well spent—if it is impossible to call write and tell us all about your Hobby and we will send you full particulars of your wants.



Look boys at this fine NEW TYPE MONOPLANE

Many happy hours can be spent with this. Made with collapsible Chassis. Packed in strong cardboard box. This machine has been thoroughly tested and is guaranteed an excellent flier. Packing and Post 1/- Price **7/9**

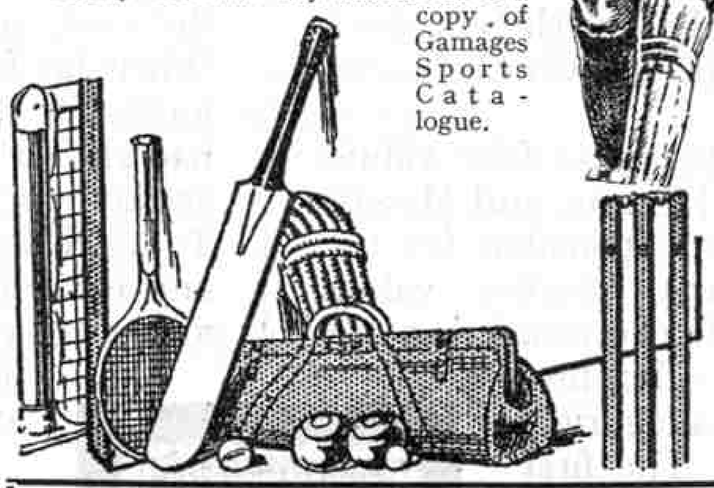
Play the Game!

And be proud of it—but only with Gamage Kit. Here are a few examples of prices.

The Famous Yorkshire Driver Bat	9/6
Batting Gloves	4/6
Referee Ball	10/6
Leg Guards	6/11
White Flannel Trousers ...	10/6
Blue Blazers, smart fitting	15/6
White Shirts	4/6
Grey Shirts...	4/11
Grey Tennis Hats ...	3/6
Cricket Caps in School Colours	2/11
Serviceable Cricket Boots	10/9



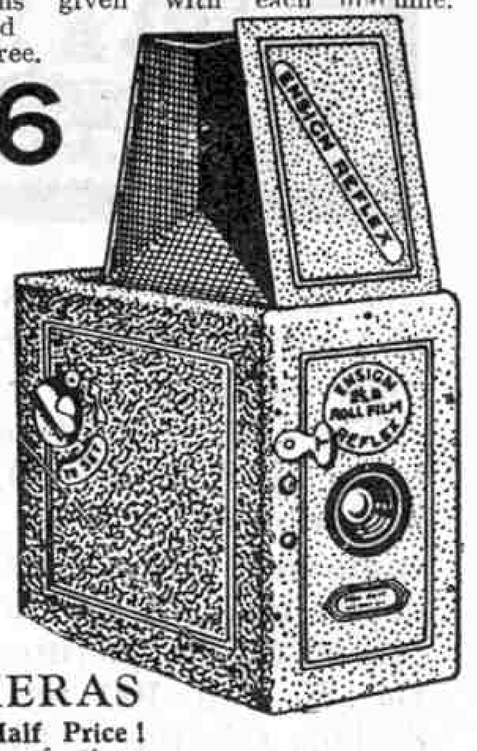
Every Meccano boy should have a copy of Gamages Sports Catalogue.



The Warneford MODEL AEROPLANE

As illustration. Noted for sound construction, excellence of design and stability. A real model aeroplane. Perfect flight guaranteed. Complete instructions given with each machine. Post and packing free.

5/6



When at Gamages don't forget to visit the Zoo Department with its host of fascinating and interesting inhabitants.



FOR THE YOUNG NATURALIST

BUTTERFLY CABINETS

Stained Deal. Drawers with sliding glass tops. Corked and papered.

Drw.	Ht.	Wth.	Dth.	Pce.
4	13″	12″	8″	27/6
6	15″	16½″	9″	36/–
8	18″	22″	11″	66/–
10	19½″	27½″	12″	£5

In old Oak **33/–, 45/–, 84/–, £515/–**

Carriage extra. Crates (returnable) charged 2/6.

We have on View a Large Range of other High Class Model Yachts and Boats.

WE STOCK ALL HORNBY AND MECCANO PARTS.



THE "EZYRIG" MODEL SAILING YACHT (British Made)

A real Racing Craft, made of first-class Yellow Pine and Honduras Mahogany. Guaranteed to sail. Fitted with the new 'Ezyrig' by means of which they may be instantaneously rigged.

Varnished Series.—Hollow, 12 in. long, **4/6**, Post 6d. Hollow, 14 in. long, **6/9**, Post 6d. Hollow, 16 in. long, **9/11**, Post 6d. Hollow, 18 in. long, **14/6**, Post 6d. Hollow, Lined Deck, 21 in. long, **19/6**, Post 6d. Hollow, Lined Deck, Topsails, 24 in. long, **27/6**, Post free. Hollow, Topsails and Jib, 27 in. long, **47/6**, Post free.

THE WEBLEY AIR PISTOL



·177 or ·22 Calibre.

Each pistol is supplied in Box containing "Webley" special Pellets, spare Barrel Joint, Washers and Cleaning Rod.

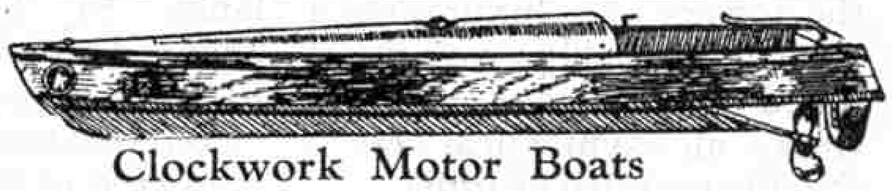
GUARANTEED ACCURACY. *All Pistols before leaving the Factory are mechanically tested for accuracy up to 10 yds.*

The Pistol illustrated is extremely accurate and highly recommended. Weight 22 oz. The Barrels are interchangeable. Price **30/-**

Extra interchangeable Barrels **10/–** net.

·177 Pellets, **2/6** per 1,000. ·22 Pellets, **2/6** per 500.

Model de Luxe, specially designed for Target Practice, with adjustable backsight (both lateral and vertical) and special vulcanite Stock Grips. Price **40/-**



Clockwork Motor Boats

As illustration. Built of African Mahogany, nicely enamelled and finished in three colours.

No. 1.	16 ins.	Price	6/6 Post 6d.
No. 2.	18 ,, ...	,,	8/6 ,, 6d.
No. 3.	21 ,, ...	,,	10/6 ,, 6d.

CAMERAS

Nearly Half Price! Get one of these Reflex Roll Film Cameras. Daylight loading for standard size Films, 2¼×3¼ British made by HOUGHTON. Takes beautiful pictures. List Price 38/6. Gamages Price to "Meccano" Boys. Post 8d.

21/-

Films (any make) per spool of 6 **1/2**



The Bike that will Delight

The famous Boy's Gamage Popular will last for years and stand up to hard usage, with a good specification and beautifully finished throughout. Price **85/-** Carriage Paid.

A. W. GAMAGE LTD., HOLBORN, LONDON, E.C. 1

CITY BRANCH: 107, CHEAPSIDE, LONDON, E.C. 2.

mately 120 tons burden, had been built specially for the project. These two vessels had sufficient accommodation to house both officers and crew without discomfort, a feature of no small importance in a voyage of that type. They were low amidships, with high castles towering above the water fore and aft, and square sterned and bluff bowed with a length approximately three times their beam. Each vessel had three masts, the fore and main masts carrying two sails each, while the mizzen had a single lateen sail. The bowsprit resembled a further mast, so high was it tilted, and a square sail was run up from this.

The fleet was completed by the "*Derrio*," a caravel ship of 50 tons and a storeship of 200 tons. All told, the personnel was between 150 and 170 strong, this number including a squad of convicts detailed for the anticipated dangerous work ashore when the ships found land. Supplies sufficient for a three years' cruise were carried.

It seems almost ludicrous to contemplate ships of this size attempting so hazardous a voyage and the daring of these mariners is further emphasised by the record of their navigating instruments, which included one large wooden and several small brass astrolabes, instruments used for calculating the altitude of the stars and now superseded by the sextant and quadrant, a "Genoese Needle," known to-day as the mariner's compass, hour glasses and sounding leads.

The embarkation of the ships' crews and the departure of the fleet from the Tagus on the 7th July, 1497, is depicted on the 10 and 2½ reis values respectively. In the former stamp da Gama is shown standing in a rowing boat that is to bear him to his ship, saying farewell to friends gathered on the shore. In the 2½ reis stamp a general view of the fleet is shown, the scene being enclosed within a belt upon which are superimposed the arms of Portugal and a replica of the cross emblazoned upon da Gama's banner.



The early days of the voyage passed without incident and the ships left their first port of call, the Cape Verde Islands, on 3rd August. From there a course approximately parallel to the African coast was followed and a wide sweep made to the east around the Cape of Good Hope. Having sailed to the eastern limit of the course set without sighting land, the fleet turned North and later apparently swung on to a North-Western course, for on 7th November anchor was dropped in St. Helena Bay. Since leaving Cape Verde the ships had spent 96 days at sea, covering over 4,500 miles and being at one point within 600 miles of the continent we now know as S. America. This is the longest known voyage ever covered without sighting land.

The log of the ships up to this point makes interesting reading, if only for the quaintness of the entries, which disclose a voyage of monotonous tranquillity. The only breaks in routine were provided by small incidents, and closely detailed records such as "in the last week of October a flock of seafowl resembling herons came in view, flying straight to S.S.E. as though towards land" clearly indicate the relief afforded. In St. Helena Bay the voyagers had their first experience of natives, and on landing they were met by Hottentots who were described as "tawny folk whose dogs barked like those of Portugal."

Setting sail from St. Helena Bay, Vasco da Gama continued up the Eastern coast of Africa and it was during this stage of the voyage that Natal was sighted on Christmas Day. The naming of that land appropriately commemorates the day of its discovery. Mozambique, a Portuguese colony to this day, was reached on 2nd March, 1498, and there the voyagers had their first brush with the inhabitants of the places at which they were calling. No serious damage was done to either side, but da Gama captured several prisoners, including two men who were capable of acting as pilots, and these, under fear of death, were compelled to guide the fleet into Mombasa, which was reached on the eve of Palm Sunday.

The crews of the ships, observing that the town bore many obvious signs of civilisation, were eager to get ashore to attend masses in the churches of the supposed Christian population. But, to their amazement, they found the inhabitants to be Mohammedans who, in their turn, were disgusted to learn that their visitors were "dogs of Christians." A small edition of a religious war became imminent. Signs of open resentment of their presence became frequent, and da Gama wisely concluded that an attack on his fleet was pending.

The sudden flight of his pilots, who by now had earned their freedom, lent colour to his suspicions and caused him to cross-examine closely two prisoners who were believed to have been apprised by the Mohammedans of the details of the coming fight. A "judicious application of boiling oil" proved a fruitful means of extracting information that enabled the subsequent encounter to be more of a "surprise" to the attackers than the defenders!

Leaving Mombasa, the ships sailed North-east and on 21st May, 1498, anchor was dropped outside Calicut, the Malabar seaport for what is now the Madras Presidency.



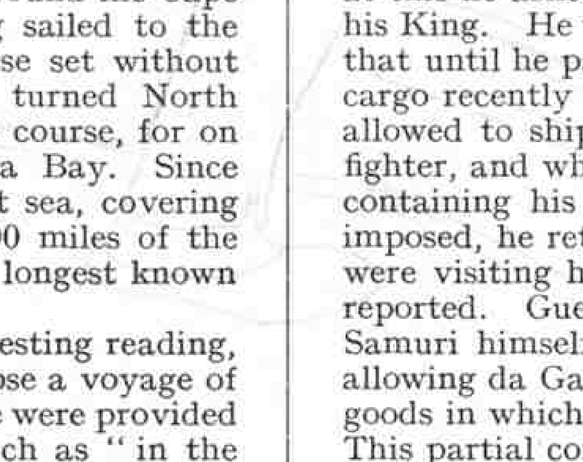
Vasco da Gama had achieved his first object, the discovery and charting of the sea route to India. The arrival of the fleet at Calicut is shown on the 5 reis value stamps.

There still remained the further object of ascertaining the value of the country's resources and the opening up of trading relations with its merchants. At first all went well. The Moorish merchants were only too eager to trade, for the opening up of another outlet for their goods spelt good business. But alas for da Gama's hopes! His visit to the Samuri, the ruler of the town, proved a sad awakening. He had brought gifts of wash basins, casks of oil, and strings of coral beads, and to say that the Samuri and his court were amused is to understate the case considerably. The court was openly hilarious and, indeed, the presents were far more suitable for an African headman than the potentate of one of the world's richest provinces! Gold and silver were demanded, but of that the voyagers had none, and it was only after much pleading that da Gama was allowed to land his cargo.

The meeting of da Gama and the Samuri is illustrated on Portugal's first postage due stamps, issued in 1898. This set of P. Ds. ranges from 5 to 200 reis and was issued simultaneously with the ordinary postage set. An issue of P. Ds., bearing a commemorative design, is, by the way, almost unique in the philatelic world.



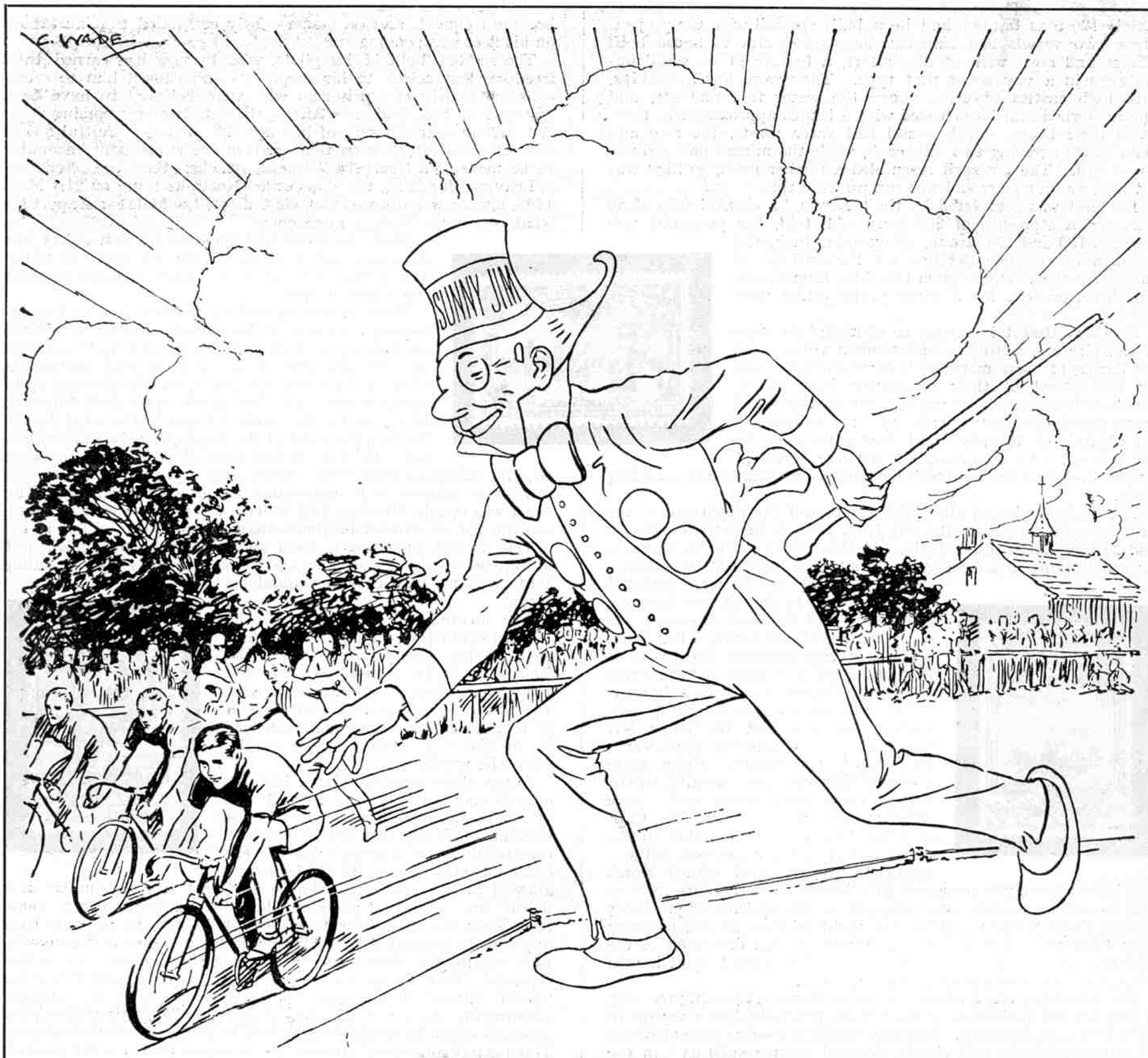
A few days later da Gama had his second audience with the Samuri and at this he asked for a cargo of spice for his King. He was then boldly informed that until he paid custom's dues on the cargo recently landed, he would not be allowed to ship anything. Vasco da Gama was nothing if not a fighter, and when that portion of his crew guarding the warehouse containing his goods was seized on his refusal to pay the dues imposed, he retaliated by taking as hostages eighteen Hindus who were visiting his ships when the news of the Samuri's action was reported. Guerilla tactics prevailed for some days until at last the Samuri himself gave way to the extent of releasing his captives, allowing da Gama a small cargo of spice and suggesting the type of goods in which he would be prepared to trade on future occasions. This partial concession satisfied the voyagers that, for the present, at least, they had accomplished all that lay within their power. They had discovered "Christian" India and their country's interests would best be served by a speedy return home to arrange for further expeditions.



The passage home, unfortunately, proved ill-fated. Disaster followed disaster and after heavy storms and a violent outbreak of disease the valiant company was so reduced in numbers that only six or seven men remained to work each ship. To ease the burden, the "*Santo Raphael*" was set on fire and abandoned. Vasco da Gama's troubles had not ended, however, and the crowning tribulation came for him when his brother Paulo died of consumption before Lisbon was reached on 9th September, 1499. The voyage lasted two years and only 55 men out of 170 returned.

The official welcome to the returned voyagers was celebrated on 18th September, and amid much rejoicing Portugal was proclaimed "Mistress of the sea route to India." The heavy cost of the expedition was reckoned as nought beside that which had been accomplished. Da Gama was created a noble and granted a monetary reward for his great feat "in bringing back the solution of a great problem that was destined to raise his country to the acme of prosperity."

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.



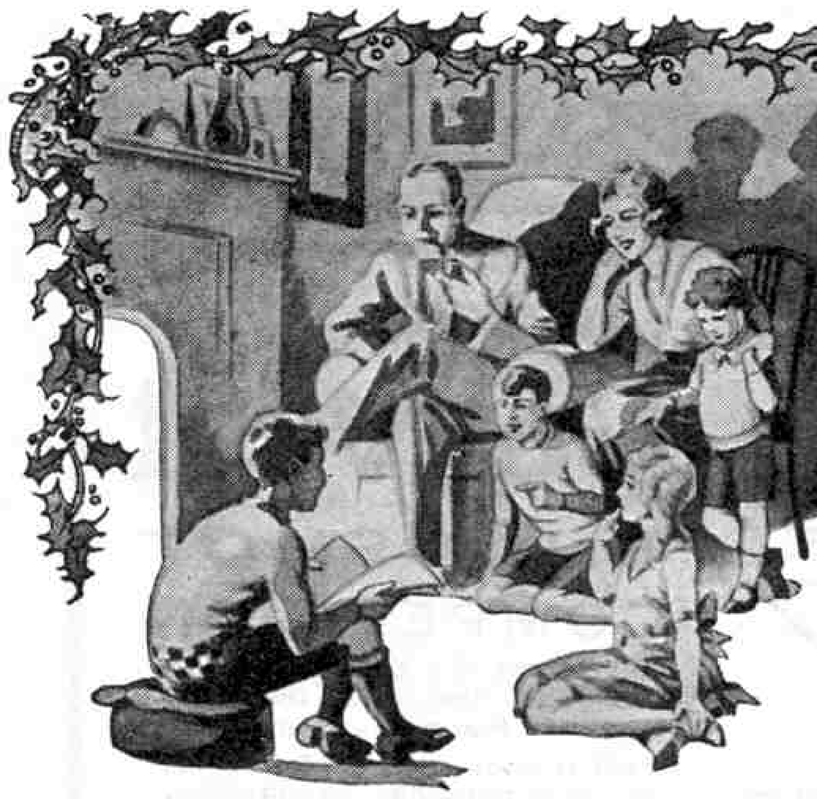
THERE'S "FORCE" BEHIND THAT!



Jim trained on "Force." He had that extra energy that got him the lead at the crack of the pistol. He was first in the half-mile speed test.

Boys! When you too eat "Force" day after day, week after week, you'll get that same feeling of extra power, extra energy. It will seem as though Sunny Jim himself were with you, helping you win through. "Force" puts the strength of whole wheat into a form that's jolly good to eat. "Force" builds up muscle, gives health, and makes you able to do the things you've always felt you'd like to do. Eat "Force," all grocers sell it, 9½d. packet.

TRY "HOLFORCE" MADE FROM "FORCE," BUTTER, EGGS, MILK, SUGAR AND FLOUR—6d. PER PACKET, 1/- PER TIN.



Fireside Fun

AN UNEXPECTED RESULT

A little boy one evening, after he had been put to bed, began to cry pitifully. To soothe him, Mary, the maid, was sent upstairs.

After a short lull the crying broke out again with renewed vigour, and the youngster's father was instructed to investigate the trouble.

"What's all this noise about, you young rascal?" he asked in mock anger.

"Well, Mary said if I kept on crying a mouse with great green eyes would come and sit on the end of my bed. I've kept on crying, but it hasn't come yet!"

* * * *

Polite Listener: "But if the fish was as long as you say, sir, how in the world did you manage to get it home?"

Fisherman Story-teller: "I had to wait two hours, sir, for the next corridor-train."

* * * *

"The fog and the mist is 'orrible, Mrs. Brown."

"Oh, yes, Mrs. Green, but if we don't have that, we have the equally noxious gales."

* * * *

HARDLY



Visitor: "I suppose you will be glad when your time is up?"

Convict: "Hardly. I am in for life!"

* * * *

Speaker: "I want reform. I want Government reform. I want labour reform. I want———"

A voice: "Chloroform!"

FROM THE LIMERICKS COMPETITION

There once was a daring young Mr.
Walked out with a girl, name of Lr,
Who blushed when he teased her,
And smiled when he squeezed her,
And gurgled with joy when he Kr.

* * * *

Artist: "Ah! I see you're rather busy now. I'll look in again when you have a couple of hours to spare."

The Editor (wearily): "Oh, thanks! Then you'll be present at my funeral."

* * * *

R-R-REVENGE!



"That young student upstairs has a lot of correspondence, postman; you always have something for him."

"Yes, I quarrelled with him once, and ever since he has sent himself a postcard every day, because he knows that I have to mount five flights of stairs to deliver it!"

* * * *

A sufferer from chronic indigestion was staying with a friend at the seaside, and when the two were out for a walk he said to his host, "I took a couple of tablespoonfuls of salt water from the sea yesterday, and thought I derived benefit from it. Do you think I might take some more?"

"Well," replied the host, "I don't think two more would be missed."

* * * *

NEEDS A SHOCK ABSORBER

Diner: "Waiter, what kind of meat is this?"

Waiter: "It is spring lamb, sir."

Diner: "I thought so! I've been chewing on one of the springs for an hour."

THRIFTY

A Jew had his little son, Ikey, ill in bed, so he called in the doctor.

When the doctor arrived he told the Jew to open the window, as the room was so stuffy with the window shut and the fire alight.

The Jew replied: "Vat you think I buy my coal for? To varm the street?"

* * * *

While carrying a ladder through the crowded streets of London, an Irishman was so unfortunate as to break a plate-glass window in a shop. Immediately dropping his ladder, he broke into a run; but he had been seen by the shop-keeper, who dashed after him and caught him by the collar. "Look here," angrily exclaimed the shop-keeper, when he had regained his breath, "you have broken my window!"

"Sure, I have," answered Pat; "and didn't you see me running home to get the money to pay for it?"

* * * *

"Well, what did you think of our service this morning?" said a clergyman to a gentleman who had just come to reside in the parish.

"I cannot say that I am very pleased with your choir," was the reply; "in fact, it occurred to me that you might do well to make a trifling alteration in the Litany for the next few weeks, and let your choristers chant: 'Have mercy upon us, miserable singers!'"

* * * *

Jim: "The stars are numerous to-night."

Joe: "Yes, and there's plenty of them!"

* * * *

AN UNPLEASANT VIEW



"How are you, Dennis?"

"Terrible bad, Tim. Sure starvation's staring me in the face."

"Bedad, but it can't be pleasant for either of ye."



PLEASING THEM BOTH!

Harry and George are both camera enthusiasts. But Harry's an expert and George just takes snapshots. Harry talks about "lights and shades" and "halation." George takes a snap at anything and hopes for the best.

Now, Harry and George both use the same Roll Film and when the spools are developed an impartial critic will tell you that George's negatives are just as good as Harry's.

Harry swears by Ilford Roll Film because it has high speed, perfect latitude, and orthochromatic qualities. George swears by Ilford Roll Film because it always gives him excellent snaps. And both are satisfied!

The Film that never disappoints!

ILFORD ROLL FILM

The British Made Film in the Red Carton.
In sizes to fit all Roll-Film Cameras.
From Photographic Dealers Everywhere.

ILFORD, Limited. ILFORD, London, England

Money for YOUR SNAPS

Send them in for the **Gayvert SNAPSHOT COMPETITION**

ANY SIZE
ANY SUBJECT



GET OUT YOUR CAMERA and start NOW



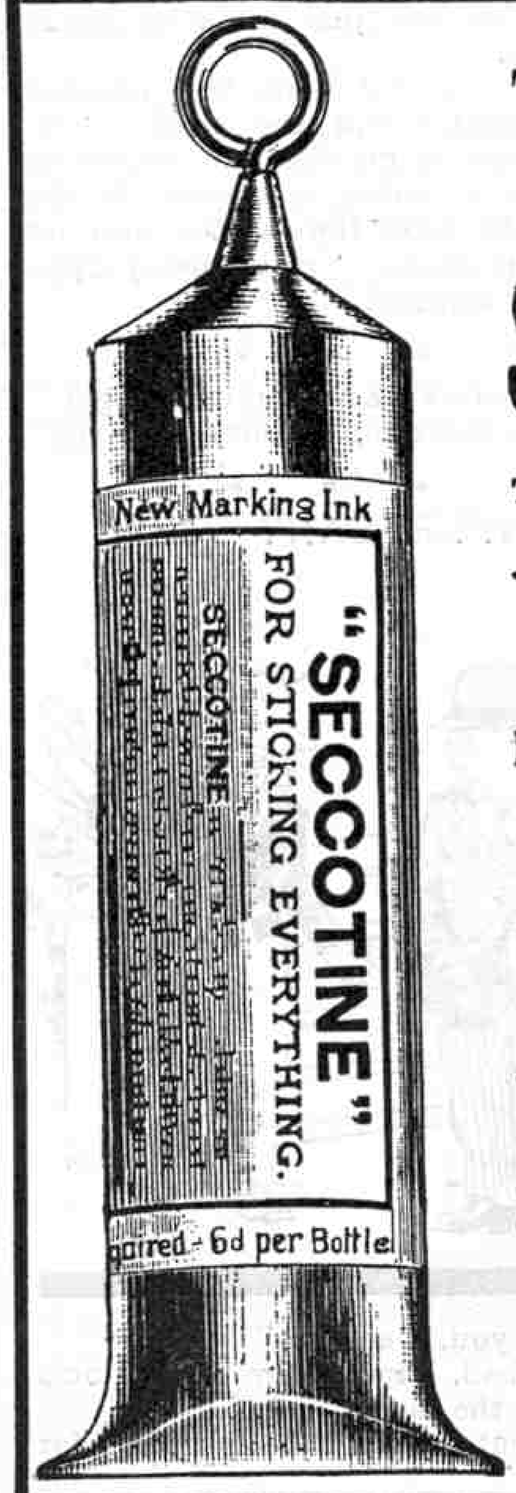
Cash Prizes EVERY MONTH.
One of £5. One of £3. One of £2.
Five of £1. Four of 10/–. Twelve of 5/–.

Send as many prints as often as you like up to Sept. 30th. No entry form. Just a few simple rules.

1. Put name and address on back of each print. "GAYVERT" film *must* be used, ROLL or PACK. Send an empty carton with *every* print.
2. Mark your envelope "Competition M" and post to address below.
3. If the Dealer fills your camera—specify "GAYVERT" and ask for the carton ("GEVAERT" or "GAYVERT" is all the same).
4. Prints cannot be returned and no correspondence entered into.
5. List of Cash awards will be published in Amateur photographic papers. Prizes will be awarded for the *best results*, and the decision of Gevaert Ltd. is final.
6. Remember to send the empty GAYVERT carton or cartons.

GEVAERT LTD., Walmer Rd., London, W.10

ASK FOR GAYVERT *Ultra-Rapid* FILM



THE MECCANO BOY'S STAND-BY
THE TUBE OF
SECCOTINE

The World's Great Adhesive. **Registered Trade Mark.**

WITH it he can mend a thousand things—his bats, balls, boats, boxes, bags, books, &c. He can make numberless things that a boy likes. He can help his mother by mending breakages in house furniture, anything—everything.

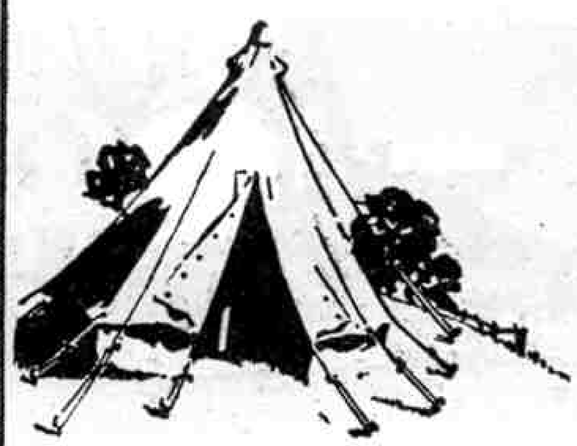
NOTE. There is nothing messy about Seccotine. Use the spike or pin supplied to open a new tube—at top of cone—press gently at end of tube (at folded part) for as much adhesive as is needed—then replace spike or pin which acts as stopper. Keep folding tube end as contents are withdrawn. Give mended article adequate time for drying.

TUBES are 4½d. (vest pocket box), 6d. and 9d. each. Sold everywhere.

Mothers should know that cups, saucers, tumblers, etc. intended to hold liquids, hot or cold—should be mended with FIRMAS (Heat Seccotine). Tubes 6d. each.

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Illustrated Bicycle List post free.

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ALL-WEATHER
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—all are available in the "Vindec" range. Every machine is a model of constructional excellence and embodies only the finest guaranteed materials.

The "Vindec" Roadster (Model 'M') illustrated is a splendid example of value. Complete with Dunlop Tyres.

£5 : 15s. : 6d.
From all Cycle Agents.

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WHOLESALE ONLY
Great Eastern Street
London, E.C.2

THE BICYCLE WITH THE KEYSTONE TRANSFER

Wormar Steam Engines for Meccano

NEW SUPERHEATED MODELS

Specially designed for Meccano, with standard drilled base (by kind permission of Messrs. Meccano Ltd.) the new improved Wormar engines offer the following advantages which are shared completely by no others, *regardless of price.*

BRITISH MADE

1. Meccano drilling. The only engine really suitable for building into any Meccano model.
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4. Superheated steam giving great power and speed. Double power of foreign engines and more than most British ones, even at higher prices.
5. Mods. E & C will take Meccano chain drive.



EXPERIENCE COUNTS

We have concentrated on Meccano steam engines. We know your needs. This unapproachable **5/11** *model is the result.*

Interesting booklet free

Three Models of Solid Brass and Steel only

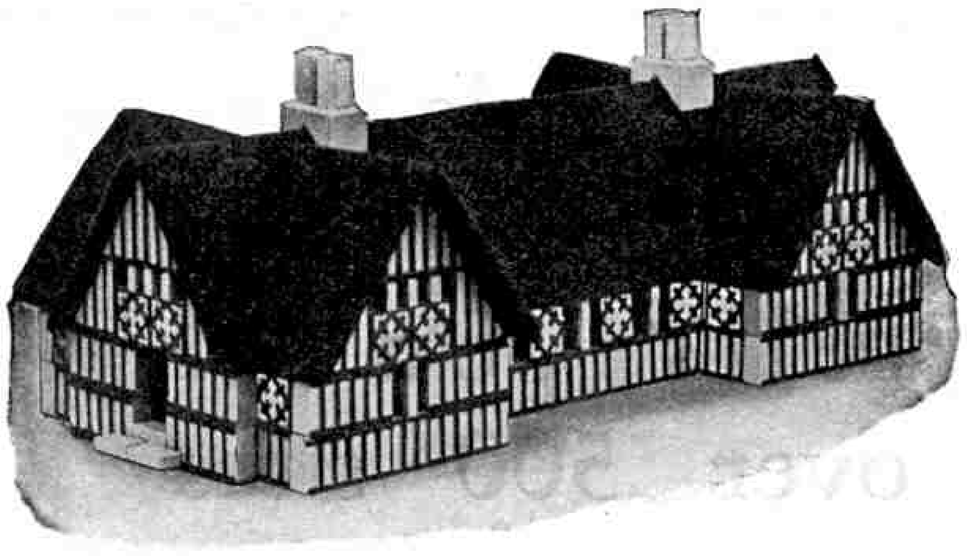
Mod. D. Single Cyl. as illustrated. With filler. Post 7d. extra. **5/11**

Mod. E. Single Cyl. with geared drive and nickel plated finish. Post 9d. **10/6**

Mod. C. Twin Cyl. with geared drive and super finish. Post 9d. **21/–**

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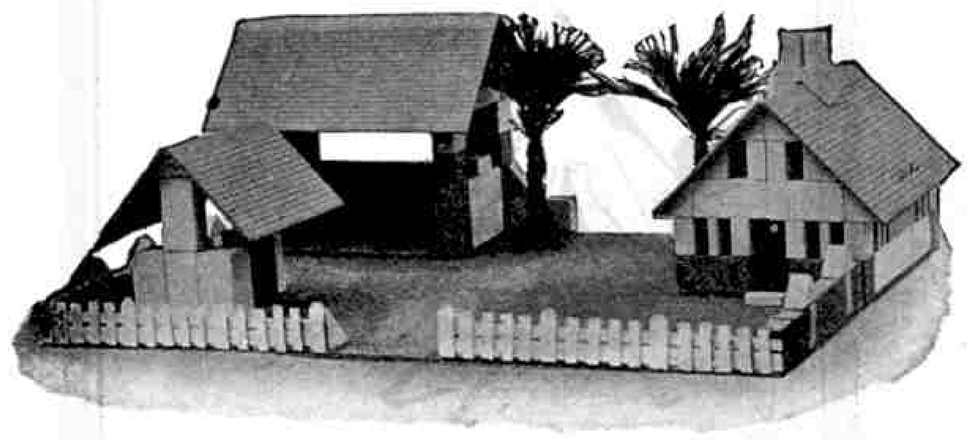
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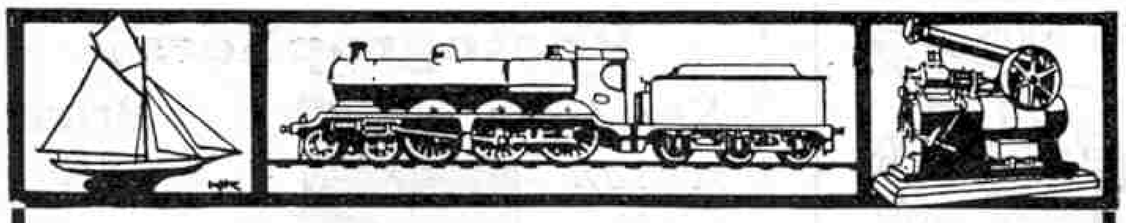
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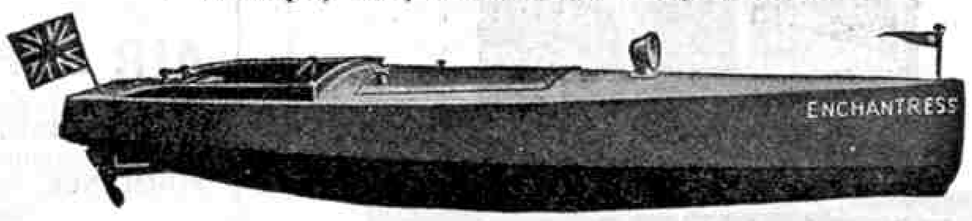
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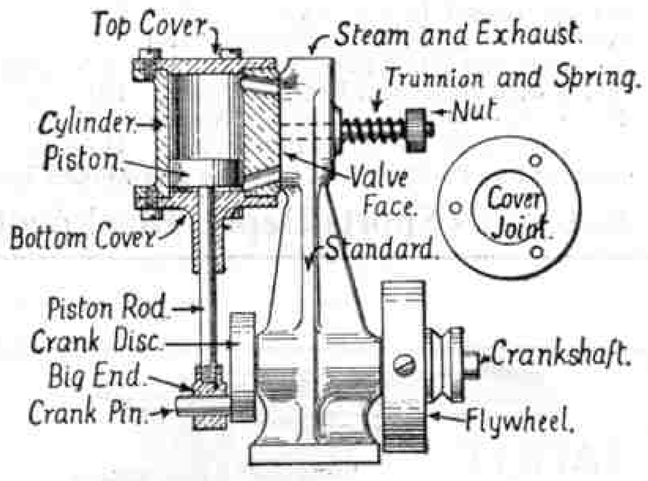
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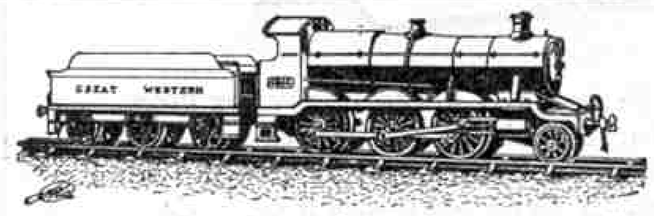
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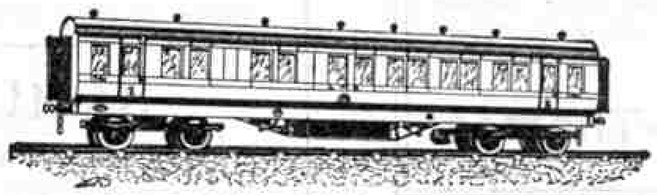
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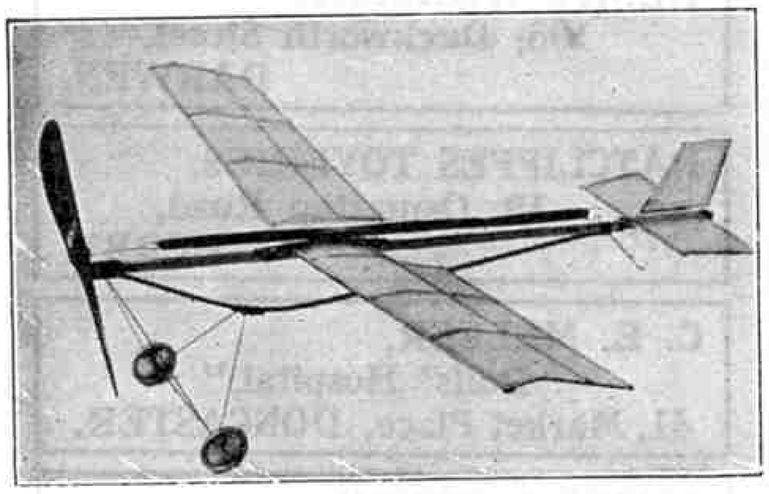
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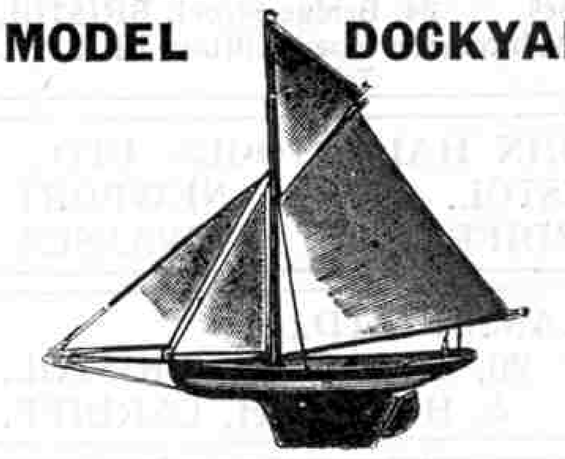
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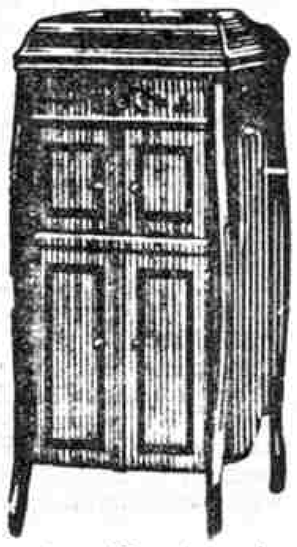
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Clean Cigarette Cards, 3d. per 100. Postage extra.—Box 603.

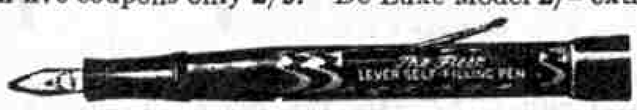
Wanted. "Meccano Magazine," September and November (1924), also January 1925.—Hon. Mrs. Scott, Harden, Hawick.

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"*M.M.*'s." Jan. 1923—April 1927 (Feb. 23, Aug. 23, Sept. 25 missing). "Chum's Annual," 1921.—What offers?—H. Bevan, Bosavern, St. Just, Cornwall.

Wanted. "Meccano" Electric Motor. Exchange Wireless Apparatus.—Lane, 157, Osborne Rd., Brighton.

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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.

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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.

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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.

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.

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SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), Textile House, Von Brandis St., Johannesburg.

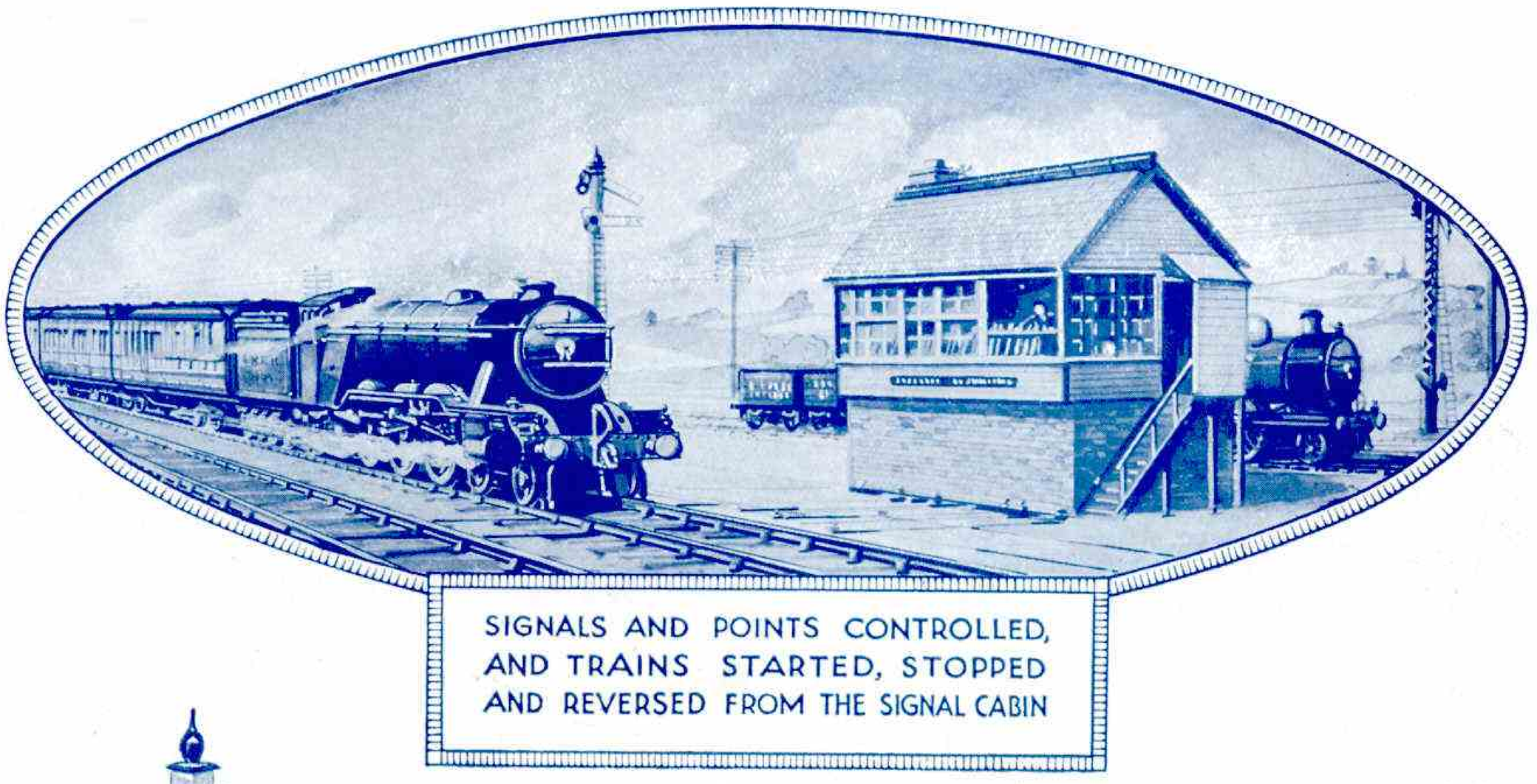
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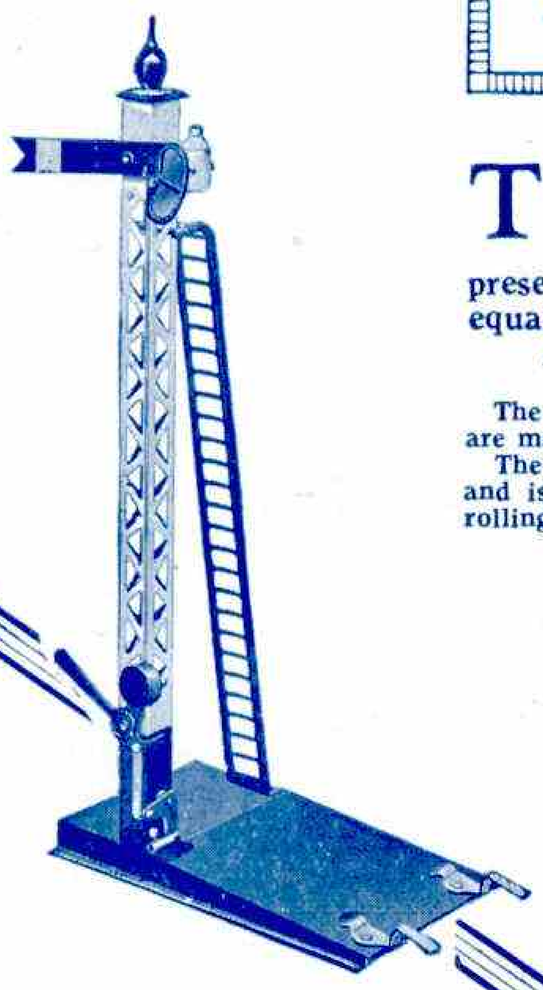
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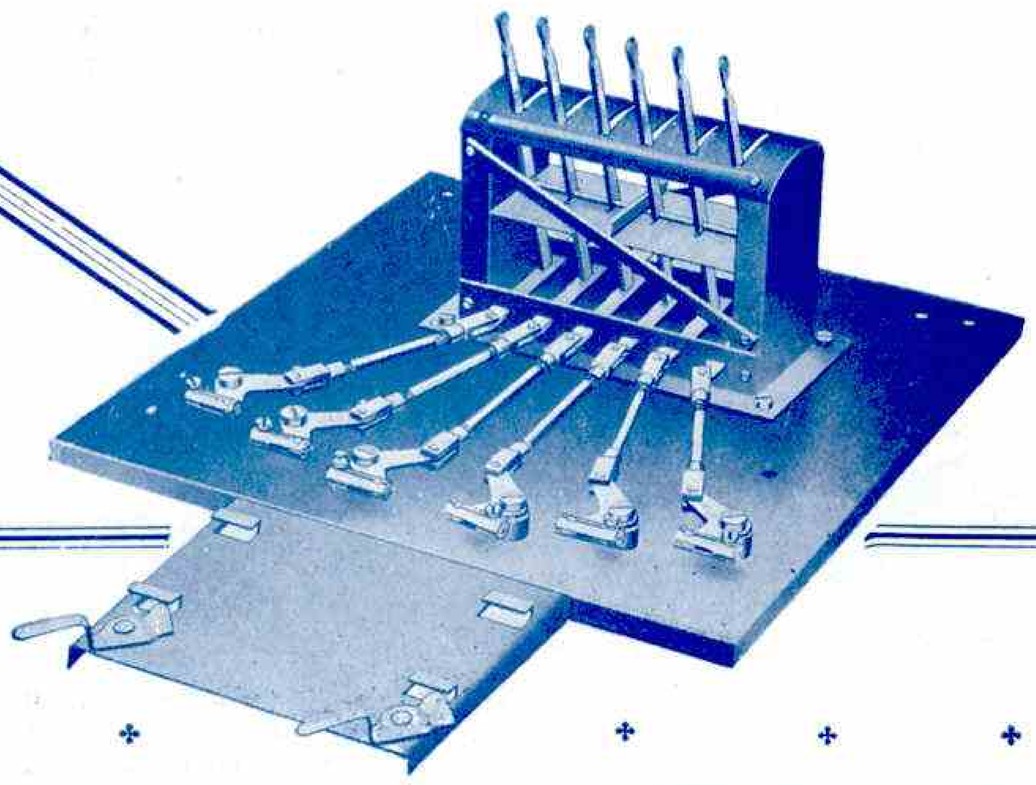
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