minimum of effort—the graceful jib, with its two pulley blocks; the wheel and roller race, to minimise friction, and the screw mechanism—by which the jib is raised or lowered—perfectly demonstrated by the Meccano Threaded Rods.

We strongly advise every boy to build this fine model if possible, for it affords endless amusement as well as imparts very sound ideas on the general construction of giant cranes such as the one from which it is modelled.

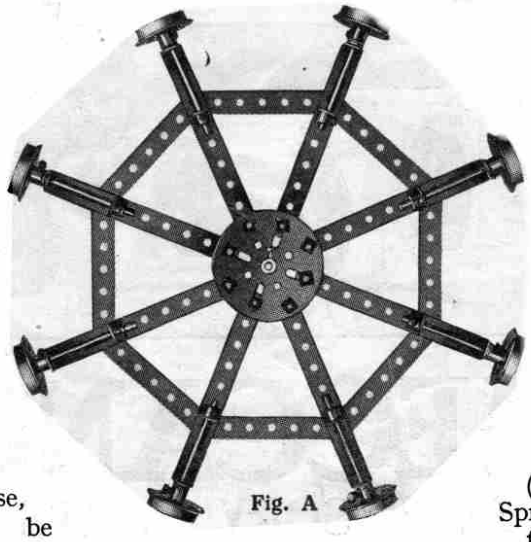


Fig. A

Constructing the Model

The construction of the base, jib, etc., of the Crane may be clearly followed in the general view.

The wheel race (4) is identical to that used in the Hammerhead Crane and is clearly shown in the section of that model shown in Fig. B. It will be seen from this illustration that the lower race (30), formed of Channel Segments, is secured to the base, and an upper race (31) is bolted to the body of the model.

The spider frame (32) carries a series of Flanged Wheels (33), which run on the edges of the upper and lower races (30 and 31). Both the spider frame (32) and the upper race (31) swivel freely round a vertical Rod (34) which is secured in a Bush Wheel bolted to the centre 18½" Angle Girder (35) in the base of the Crane. A Collar with set-screw should be placed on the Rod (34) above the Face Plate of the upper race (31). The spider frame (32) is shown in detail in Fig. A.

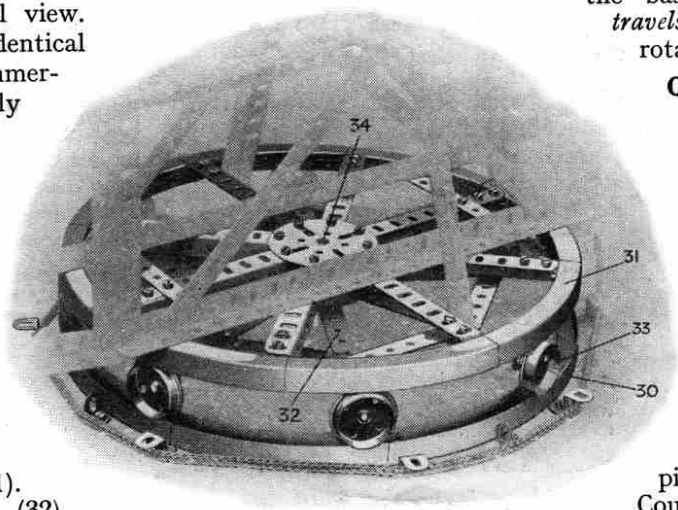


Fig. B

Rotating the Crane

Two 12½" Angle Girders (36) are bolted to the upper race (31) and the 5½" × 3½" Flat Plate (37) secured in the last holes at one end of the Girders (36). This Plate (37) carries the Electric Motor (1) which drives a secondary Rod (2a Fig. C) by means of the Pinion (10) and Gear Wheel (11).

The Rod (2a) which carries a further Pinion (27), slides in its bearings, and is arranged so that on operation of the lever (28), it alternatively engages a Contrate Wheel (29) or the Pinion (12), although the Gear Wheel (11) remains constantly in mesh with the Motor Pinion (10).

A Worm Wheel (38) on the Rod of the Pinion (12) engages with a Gear Wheel on a vertical Rod (39).

On the lower end of the Rod (39) is mounted a 1" Sprocket Wheel engaging the Sprocket Chain (40) which passes firmly round the lower fixed race (30). Thus by throwing the Gear (11) into mesh with the Pinion (12) the Sprocket Wheel on the Rod (39) is rotated, and since the Sprocket Chain (40) tends to grip the base (30) the Sprocket Wheel *travels round the Chain* (40), so rotating the Crane.

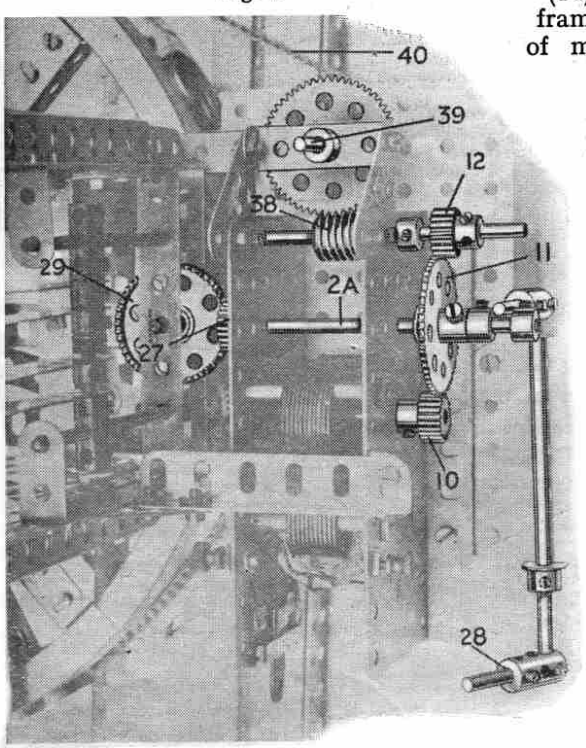


Fig. C

Operating the Jib

Now turn to Fig. F. The Contrate Wheel (29), which may be engaged by the Pinion (27), is mounted on a short Rod, to which a 1" Gear Wheel (41) is secured also. The latter meshes with two other Gears (42 and 43) mounted on the Threaded Rods (44) on which are journalled Threaded Couplings (45)

Four 5½" Strips (13) are pivotally connected to these Couplings and to the Rod (14) carried on the triangular framework (15, see general view of model).

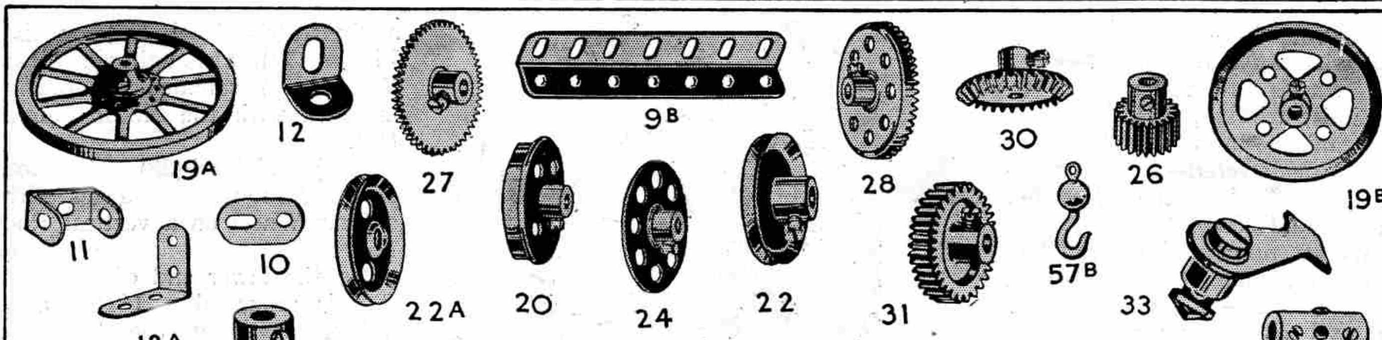
This framework (15) is pivoted at (16) and connected to the Jib (2) by the Links (18). The Jib (2) is mounted on a Rod (3, Fig. D).

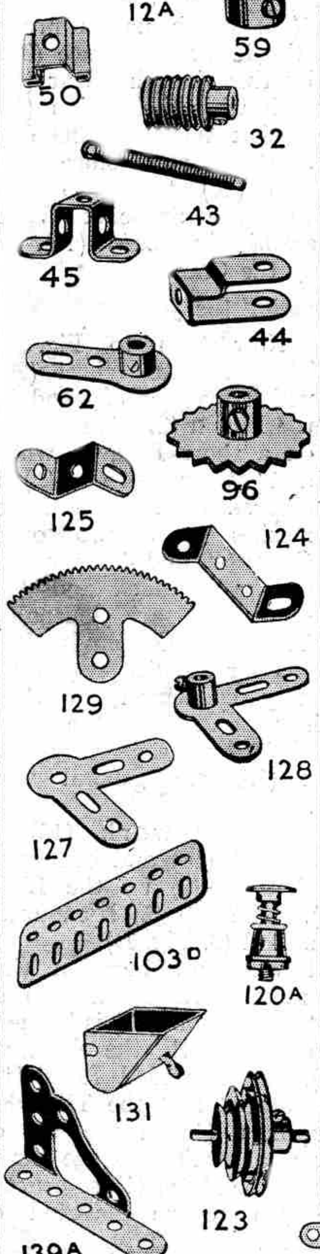
It will now be seen that on moving the lever (28) so that the Pinion (27) is brought into gear with the Contrate (29), the Threaded Rods (44) are rotated and the Threaded Couplings (45) move up or down, according to the direction of the Motor (1), so causing the Jib to be elevated or lowered.

The Hoisting Blocks

The other Electric Motor (5) is mounted in a framework (46, Fig. E) formed by 9½" Angle Girders bolted to Flanged Plates (47) which in turn are bolted to the transverse 12½" Angle Girders (36). This motor

(*Continued on page 125*)





MECCANO

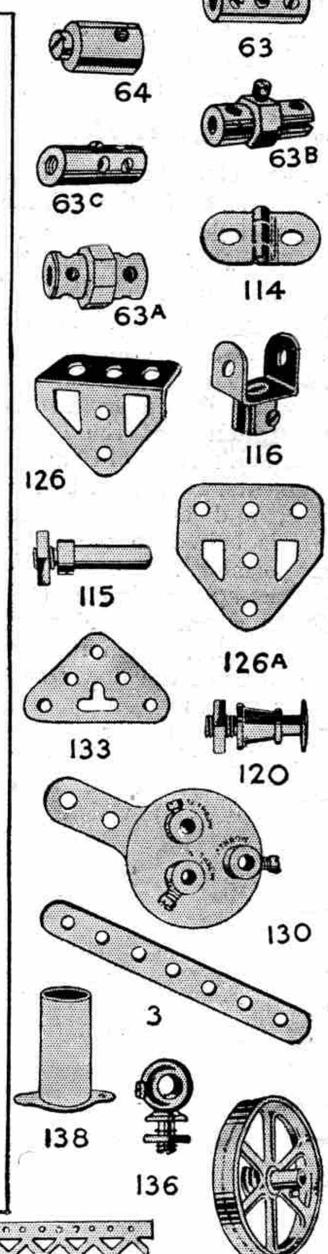
ACCESSORY PARTS

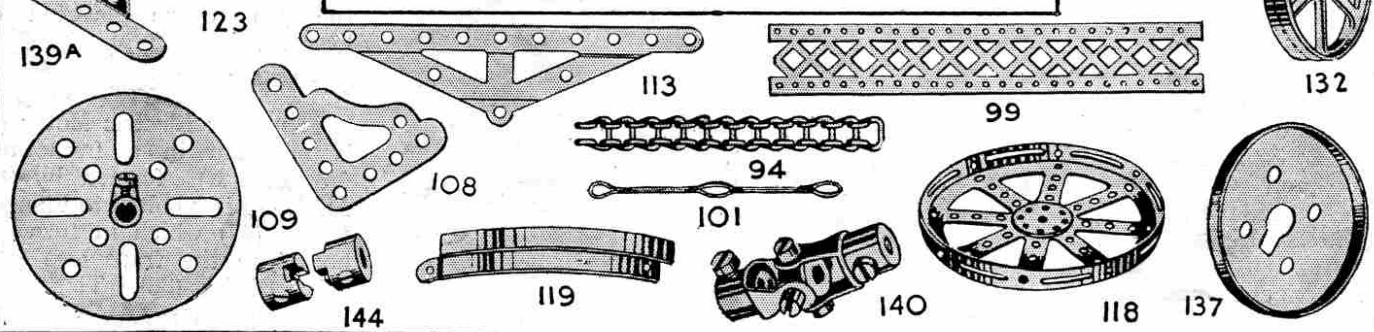
We illustrate a selection of accessory parts that every Meccano boy will find useful in building the larger and more interesting models. Many of these parts have been only recently introduced, and although we know that they have a universal use (were it otherwise they would not have been added to the system) we may not yet know all their applications. There are endless possibilities in the employment of Meccano parts; indeed, we wonder if there is now a mechanical movement known to engineering that any boy cannot duplicate with Meccano.

No.	Part		s.	d.
10.	Flat Brackets	½ doz.	0	2
11.	Double Brackets	each	0	1
12A.	Angle Brackets, 1″ × 1″	„	0	1
19A.	Wheels, 3″, with set screw	„	0	8
20.	Flanged Wheels	„	0	6
	Pulley Wheels :			
19B.	3″ dia., with set screw	each	0	8
22.	1″ „ „ „ „	„	0	4
22A.	1″ „ without set screw	„	0	2
24.	Bush Wheels	„	0	6
25.	¾″ Pinion Wheels ...	„	0	6
26.	½″ „ „ ...	„	0	4
27.	Gear Wheels, 50 teeth...	„	0	9
27A.	„ „ 57 „ ...	„	0	9
28.	1½″ Contrate Wheels ...	„	0	9
29.	¾″ „ „ ...	„	0	6
30.	Bevel Gears	„	0	10
31.	1″ Gear Wheels, 38 teeth	„	1	0
32.	Worm Wheels	„	0	6
33.	Pawls (complete) ...	„	0	4
43.	Springs	„	0	2
44.	Cranked Bent Strips ...	„	0	1
45.	Double Bent Strips ...	„	0	1
50.	Eye Pieces	„	0	2
57B.	Hooks (loaded)	„	0	5
59.	Collars and Set Screws	„	0	2
62.	Cranks	„	0	3
63.	Couplings	„	0	6
63A.	Octagonal Couplings ...	„	0	8
63B.	Strip Couplings	each	0	8
63C.	Threaded Couplings ...	„	0	6
64.	Threaded Bosses ...	„	0	2

No.	Part		s.	d.
94.	Sprocket Chain	per length	0	6
96.	Sprocket Wheels, 1″ ...	each	0	3
101.	Healds, for Looms ...	doz.	0	9
108.	Architraves	each	0	2
109.	Face Plates, 2½″ diam.	„	0	4
113.	Girder Frames	„	0	2
114.	Hinges...	per pair	0	4
115.	Threaded Pins	each	0	2
116.	Fork Pieces	„	0	3
118.	Hub Discs (5½″ diam.)	„	1	3
119.	Channel Segments (8 to circle, 11½″ diam.)	„	0	4
120.	Buffers	„	0	2
120A.	Spring Buffers ...	per pair	0	8
123.	Cone Pulleys	each	1	3
124.	Revsd. Angle Brackets, 1″	½ doz.	0	10
125.	Revsd. Angle Brackets, 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
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
144.	Dog Clutch	„	0	6

You may obtain Meccano Parts from your Dealer





The New Meccano Pontoon Crane—*(continued from page 123)*

drives through Bevels (19, 23 and 24) either one or other of the axles (48 and 49).

The change-over is effected by means of the lever (20) pivoted at (21) which slides a Rod (22), this in turn sliding the shaft carrying the Bevels (19) to which it is connected by a Crank (50). Thus if the lever (20) throws one of the Bevels (19) into gear with the Bevel (23) on the Rod (48), the Pulley Block (9) is raised or lowered by means of the cord (7) which passes over one of the 1″ Pulleys set between the two Bush Wheels (51) and over another Pulley similarly situated at (52); from there it is led to one of the Pulleys in the block (9), thence round the second Pulley at (52) and then over the second Pulley in the Block (9), finally being secured to one of the Bush Wheels at (52).

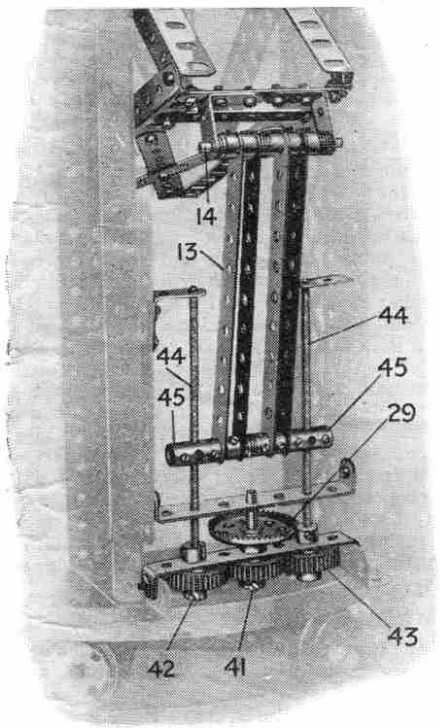


Fig. F

In a similar manner the Pulley Block (8) may be operated from the Rod (49), the cord (6) from which is led over the second Pulley at (51) to the Pulley in the end of the Jib (2); from there it passes over a ½″ Pulley in the Block (8) and is secured to the Jib (2).

The shafts (48 and 49) carry at their extreme ends two 1″ Pulleys, the grooves of which are gripped by cords tied to Cranks secured to two 8″ Rods arranged on either side of the Motor (5). These 8″ Rods carry Couplings and shorter Rods (25 and 26) which act as brake levers in controlling the loads on the Pulley Blocks (8 and 9).

List of parts required;

12	of No.	2	1	of No.	17	1	of No.	53
11	„ „	2A	3	„ „	18A	1	„ „	57
12	„ „	3	8	„ „	20	1	„ „	57B
15	„ „	4	2	„ „	22	62	„ „	59
4	„ „	5	7	„ „	22A	3	„ „	62
1	„ „	6	1	„ „	23	6	„ „	63
3	„ „	6A	5	„ „	24	4	„ „	70
11	„ „	7A	4	„ „	26	3	„ „	76
8	„ „	8	5	„ „	27A	2	„ „	80
8	„ „	8A	4	„ „	30	1	„ „	94
6	„ „	8B	3	„ „	31	1	„ „	96
2	„ „	9	1	„ „	32	1	„ „	97
10	„ „	9A	135	„ „	37	2	„ „	99
1	„ „	9B	58	„ „	38	4	„ „	103A
1	„ „	9D	1	„ „	40	4	„ „	103B
4	„ „	12A	1	„ „	45	1	„ „	103F
16	„ „	12B	1	„ „	48	3	„ „	111
2	„ „	13A	1	„ „	48A	16	„ „	119
2	„ „	15	4	„ „	48B	2	„ „	126
5	„ „	15A	2	„ „	48D	2	„ „	126A
6	„ „	16	2	„ „	52	5	„ „	133
13	„ „	16A	2	„ „	52A			

NEXT MONTH:—

AUTOMATIC BAGATELLE TABLE

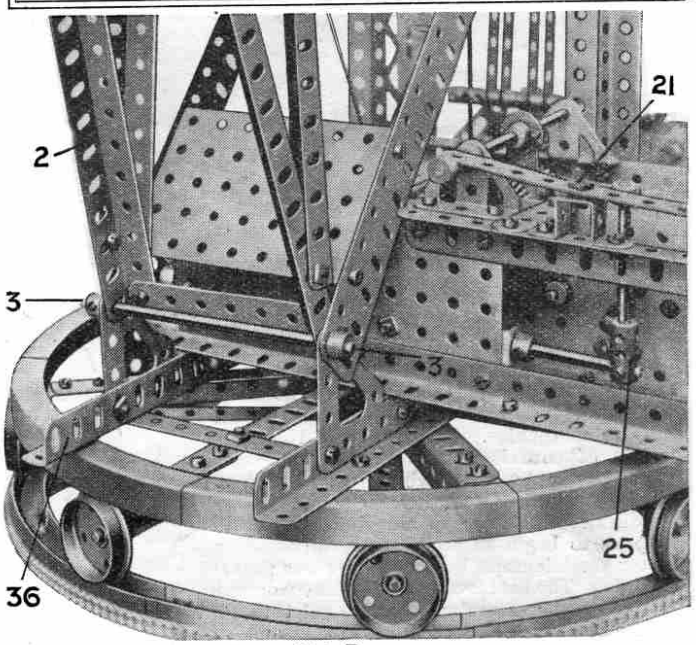


Fig. D

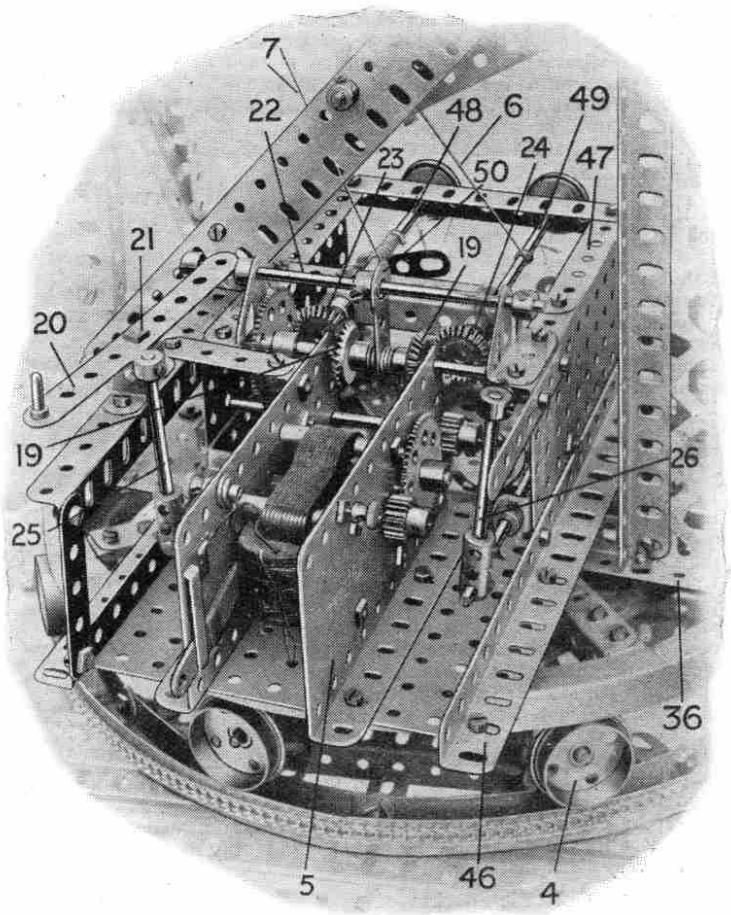
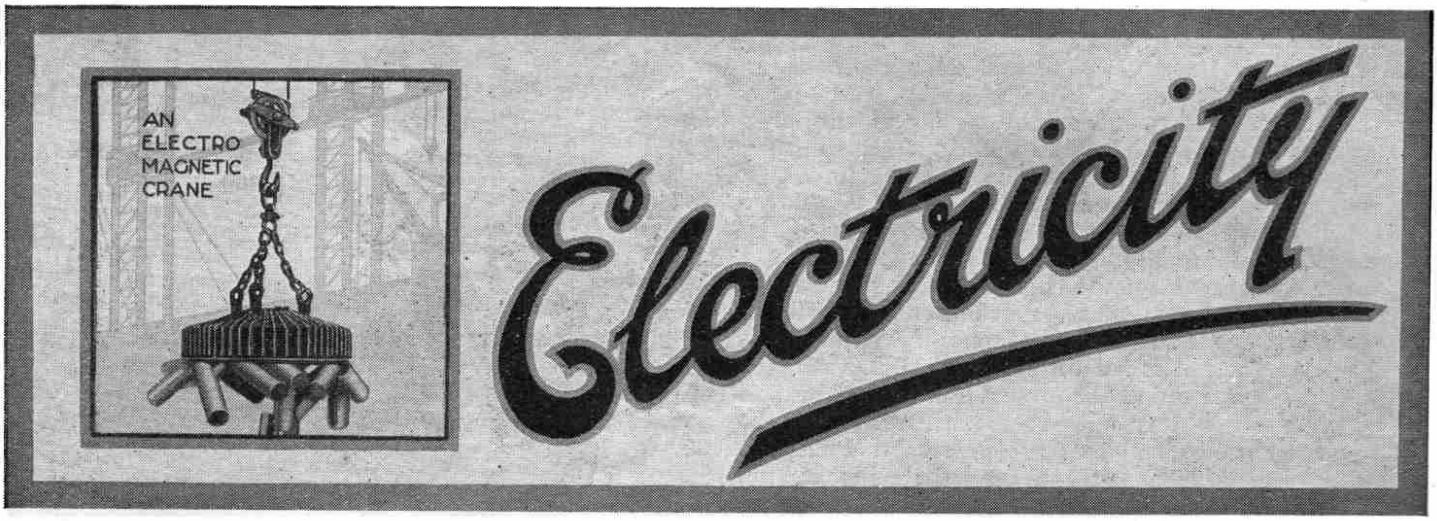


Fig. E



XIII. THE ELECTRIC TELEGRAPH

AT the beginning of 1920 there were over six million miles of telegraph wire in use throughout the world, not including wires reserved for the exclusive use of the railway companies. Nearly half of this huge length of wire is in Europe and one-third is in North America, while there are over 300,000 miles in Great Britain alone.

Consideration of these amazing figures will help us to begin to realise how important a factor the telegraph has become in our everyday life. The business man of to-day wonders how his predecessors managed to get through all their work when the quickest means of communication between any two places was by messenger, who, even in the most favourable circumstances, travelled on horseback. Without the telegraph the world's news would travel at what would now appear to be a snail's pace. For instance, we should not know the result of a cricket match played in Australia until several weeks after the game had been won and lost.

Early Attempts to Transmit Signals

It is interesting to read of the early attempts made to transmit signals by means of electricity, and to follow the path of progress up to the present day when six or seven different telegrams can be sent each way on one wire at once, and when a single wire can be used for telegraphing and telephoning at the same time.

Morse Code as used with Single-Needle Telegraph

As early as 1727 it was known that an electric discharge could be transmitted to a considerable distance through a conducting substance such as a wire or a moistened thread, and this fact suggested the possibility of a method of electric signalling.

In 1753 a Scottish doctor named Charles Morrison contributed to "*Scott's Magazine*" an article outlining an ingenious scheme based upon the attraction between an electrified body and any light substance. His telegraph consisted of 26 separate parallel wires, each wire having a small metal ball suspended from it at each end. Close to each ball was placed a small piece of paper upon which was written a letter of the alphabet, the arrangement of the paper letters at each end of the wire being identical. The apparatus was worked by an electric machine. When any wire was charged with electricity the paper letters at each end of it were attracted towards the metal balls and in this way words and sentences were spelled out.

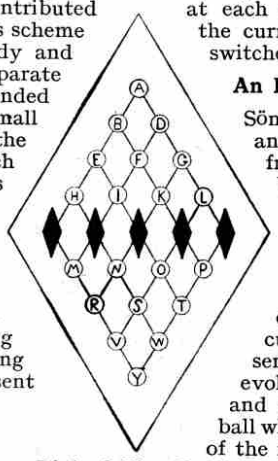
This system was interesting from an experimental point of view, but was of no use for practical purposes. Two of its greatest disadvantages were the cost of erecting 26 separate wires between each pair of communicating stations and the fact that messages could only be sent over a very short distance.

Signalling by Electric Shocks

Some 40 years later a Spaniard, Don Francisca Salva, announced before the Academy of Science at Barcelona, a scheme that was not only interesting but which contained many features of importance. Salva based his telegraph upon the fact that if wires were laid between two points, a man at one point holding the ends of the wires could be given a shock from a Leyden jar at the other point. Thus, by having 18 or 20 wires and the same number of Leyden jars, with a man holding each jar and representing a letter of the alphabet, it would be possible to transmit messages. Salva later suggested that the number of wires, jars and men could be reduced to six, or even less, by making each man interpret three or four different letters from the signals he received. Salva also proposed to insulate his wires and place them in a single cable, and he even suggested that such a cable might be laid under water—an anticipation of the submarine cable of to-day.

A Chemical Telegraph

With the invention of the voltaic cell, inventors' ideas took a new direction and several telegraphs were quickly proposed. One of the most interesting of these was that of a Bavarian named Sömmering, which made use of the discovery that an electric current could decompose water. As we explained in the June 1924 issue of the "*M.M.*," if two metal strips are placed in water to which a small amount of acid has been added, and are then connected to an electric battery, the water is decomposed into its constituents, oxygen and hydrogen. Oxygen is formed at the strip connected to the positive pole of the battery and hydrogen at the other strip, and the formation of these gases is indicated by streams of small bubbles appearing at each strip. The bubbles commence to form immediately the current is switched on and they cease immediately it is switched off.



Dial of Five-Needle Instrument

An Ingenious Contrivance

Sömmering's apparatus consisted of 35 wires, for letters and numbers, each connected to a gold pin projecting from below into a glass vessel filled with acidulated water. When the current was sent along any particular wire, bubbles of gas formed at the pin at the end of it and so a letter or number was indicated. A very ingenious contrivance in Sömmering's chemical telegraph enabled the attention of the receiving operator to be attracted at any time. The pin at the end of one particular wire was fitted with a sort of inverted cup attached to a lever. When the sending operator sent a current through this particular circuit, gas was evolved from the pin and filled the cup, causing it to rise, and this movement lifted the lever and released a metal ball which fell upon a small gong and so attracted the attention of the receiving operator.

It is very interesting to arrange an experimental telegraph on the lines of Sömmering's scheme. There

is no difficulty in doing this and a great deal of fun may be had from a simple chemical telegraph of this kind.

Wheatstone and Cooke, Morse and Steinheil

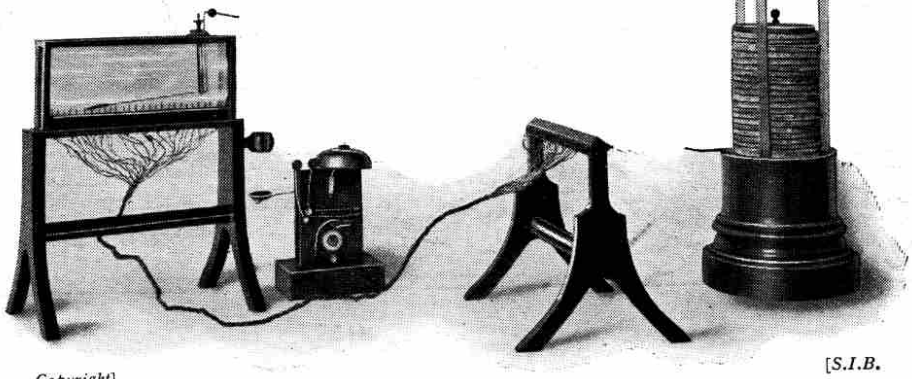
Sömmering's telegraph, like its predecessors, never came into practical use, and little or no progress was made until 1819, when the Danish scientist Oersted discovered that a magnetised needle could be deflected by a current of electricity flowing through a wire held over the needle. This discovery laid the foundation of the first really practical telegraph, but progress was delayed for some years on account of the fact that the existing forms of voltaic cells polarised so rapidly that it was impossible to obtain from them a constant current. The invention of the Daniel cell removed the difficulty in this respect, for this cell gave a steady current, as was explained in the June 1924 "*M.M.*"

About the year 1837 three separate practical telegraphs were produced—by Morse in the United States, by Wheatstone and Cooke in England, and by Steinheil in Germany.

Five-Needle Instrument

The first telegraph of Wheatstone and Cooke consisted of five magnetic needles pivoted on a vertical dial on which the letters of the alphabet were marked. The needles were deflected as required by currents made to flow along wires when certain keys were depressed, in such a manner that two needles would point towards the required letter. This telegraph was tried with success on the London and North Western Railway over a wire a mile and a half long. Wheatstone and Cooke subsequently invented a single-needle telegraph in which the letters were indicated by movements of the needle to the right or to the left, according to the direction of the current sent through a coil of wire.

In the United States Morse had devised a scheme of telegraphy in 1832, but it was not until five years later that he got his apparatus into working order. He was an artist by profession, but was not very successful, and for a long time lack of money prevented him from developing his telegraph. Ultimately he succeeded in obtaining a State grant for the construction of a telegraph line between Baltimore and Washington, and the first message over this line was sent in 1844. Morse also devised a telegraphic code which is practically the same as that in use throughout the world to-day. Among the most interesting features of Morse's telegraph were the "relay" and a receiving instrument that automatically recorded messages on a moving paper ribbon by means of a pen actuated by an electro-magnet.



Copyright] [*S.I.B.*

Sömmering's Chemical Telegraph Apparatus

Courtesy] [*Messrs. Siemens Bros. & Co. Ltd.*

Single-Needle Telegraph

Steinheil, a German, made the very valuable discovery that a second wire for the return of the electric current was not necessary, and that the earth itself could be used for the return part of the circuit.

Telegraph proves its Value

The electric telegraph, like many other great inventions, was treated by the general public for a long time with utter indifference. In England no one had a good word for the telegraph until its use made possible the capture of a murderer who otherwise would have escaped. The crime was committed near Slough, and the murderer succeeded in taking train for London. Fortunately the Great Western Railway had a telegraph line between Slough and London, and a description telegraphed to Paddington enabled the police to arrest the murderer on his arrival. In the United States the indifference was equally marked. The rate for messages on the line between Washington and Baltimore was one cent. for four words, and the total amount taken during the first four days was one cent.!

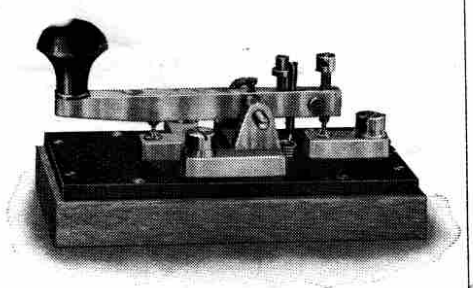
Single-Needle Instrument

The single needle instrument is one of the simplest forms of telegraph. It consists essentially of a magnetic needle fixed to a spindle at the back of a vertical board through which the spindle passes. On the same spindle, but in front of the board, is fixed a dial needle which moves along with the magnetic needle behind. A coil of wire passes round the magnetic needle and this is connected to a "commutator" for reversing the direction of the current. The current is made to flow through the coil by turning a handle, and upon the direction in which the handle is turned depends the direction of the current and consequently the direction in which the needle will move. Two keys may be used instead of a handle, the movements of the needle depending upon which key is pressed. With this instrument the Morse code with its combination of dots and dashes is used, a movement of the dial needle to the left signifying a dot and a movement to the right a dash. The code as used in the single-needle instrument is shown on page 126. With this instrument a good operator can transmit messages at the rate of about twenty words a minute.

The "Sounder"

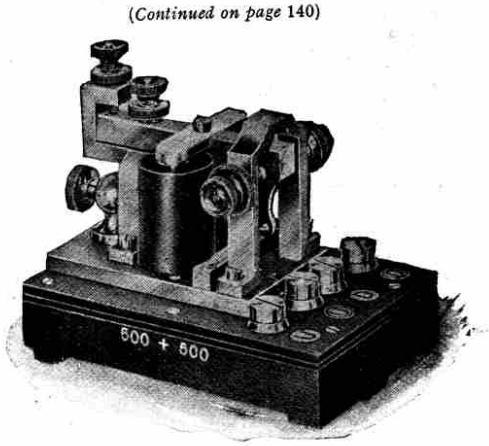
The single-needle instrument in a modified form is used for messages between signal cabins on railways, but for telegraphic work in general an instrument called the "Morse sounder" is used. The sounder consists of an electro-magnet which, when a current flows round it, attracts a small piece of iron fixed at one end of a pivoted lever, the other end of which moves between two stops. The sending operator closes a battery circuit by pressing a key. The electro-magnet of the sounder at the receiving station then attracts the iron and the lever flies from one stop to the other with a sharp click, returning

(*Continued on page* 140)



Courtesy] [*Messrs. Siemens Bros. & Co. Ltd.*

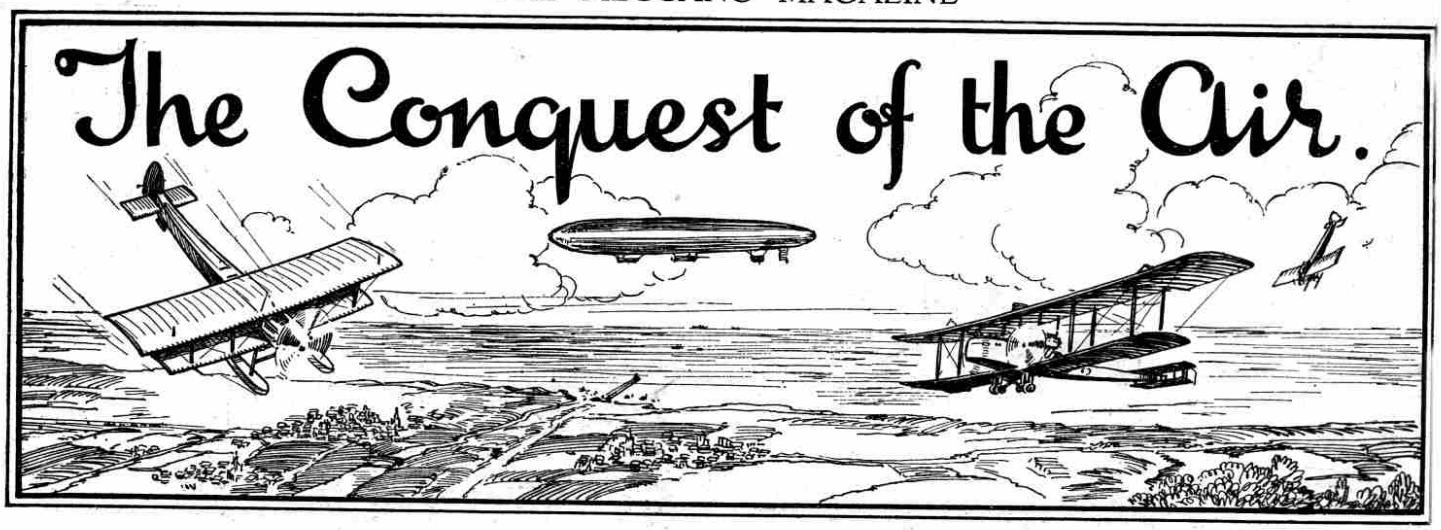
Transmitting Key



Courtesy] [*Messrs. Siemens Bros. & Co. Ltd.*

Sounder

The Conquest of the Air.



I. THE LYMPNE TRIAL FOR LIGHT MONOPLANES

DURING the past year or two so much has been written about the giants of the air—the huge bombing-planes of the Air Force and the passenger-carrying machines of the Cross-Channel Service—that the amazing development in the other extreme has been almost overshadowed. To many people the coming of the light monoplane remained almost unnoticed until a few months ago, when their attention was drawn to the matter by the trials at Lympne. These trials, for two-seater light aeroplanes, were initiated by the Air Ministry and endowed with prizes totalling nearly £4,000.

In our future issues we hope to give some description of the remarkable light monoplanes that took part in these trials, and this month we commence this series with some account of the winner of the trials, the Beardmore light monoplane "*Wee Bee I*," fitted with a Bristol "Cherub" two-cylinder air-cooled engine.

Contests Designed to Encourage Slow Planes

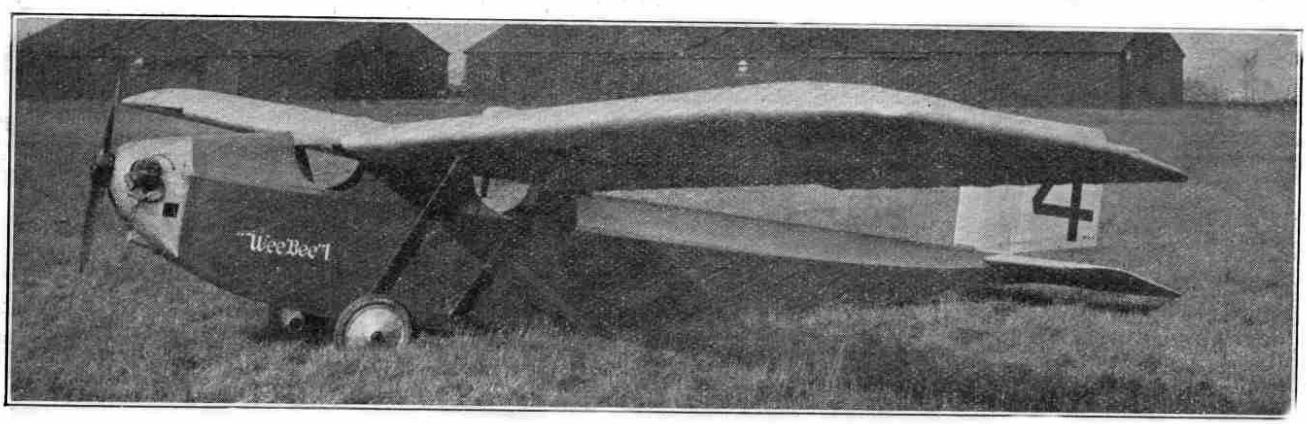
The main object of the Lympne competition was to encourage the production of two-seater aeroplanes with engines not exceeding 1,100 c.c. and those low in first cost and economical in operation. It was considered that the desirable qualities in such machines were those that would be found in aeroplanes having a wide range of speed. That is to say, aeroplanes capable of a fairly high maximum speed and yet able to land sufficiently slowly to avoid the risk usually associated with the landing of very fast machines. Consequently, the rules of the competition were drafted so as to encourage the slow rather than the fast aeroplane. Thus it was that the basis of the award of marks in the speed range competition was a special formula that gave a high figure to the aeroplane showing the greatest flexibility between high and low speeds.

Those of our readers who are keen on maths. will be interested to learn that this formula was $\frac{V-v}{v}$ where V is the maximum speed and v the minimum speed at which the machine is able to fly. It was stipulated that no marks would be awarded for a speed range of less than 33⅓ per cent. and that eight marks be awarded for each per cent. above 33⅓ per cent., expressed as a percentage of the slow speed.

In addition to the speed-range tests there were tests for quickness in getting-off and in alighting. In the former, one mark was awarded for each yard by which the distance required to clear a barrier 25 ft. in height was less than 450 yards. In the latter, one mark was awarded for each yard by which the distance from a 6 ft. barrier—over which the machines had to alight—was less than 150 yards, measured from the centre of the barrier to the centre of the wheels of the aeroplane's undercarriage.

Cash Prizes of £4,000

In order to be eligible for the various prizes, competing machines had to accomplish at least ten hours' flying during the competitions. Only certain parts of machines and engines were permitted to be changed or replaced, otherwise competitors were required to start all over again. The high-speed course was triangular, the complete circuit measuring 12½ miles. Competitors



The Monoplane at rest at the Lympne Trials

Photo courtesy "The Aeroplane"

were required to fly five laps (62½ miles) without landing, then alight to fill up with petrol and oil only, and then fly another five laps. The remaining tests were carried out over the aerodrome.

The following prizes were offered :

A first prize of £2,000 and a second prize of £1,000 by the Air Ministry for the highest and next highest number of marks awarded in the speed-range, getting-off and pulling-up tests.

£500 by the Duke of Sutherland for the best performance in the getting-off and pulling-up tests.

£100 by Capt. C. B. Wilson, M.C., for the next best performance in getting-off and alighting.

£150 each by the Society of Motor Manufacturers and Traders and by the British Cycle and Motor-Cycle Manufacturers' and Traders' Union for the greatest number of laps flown over the triangular course.

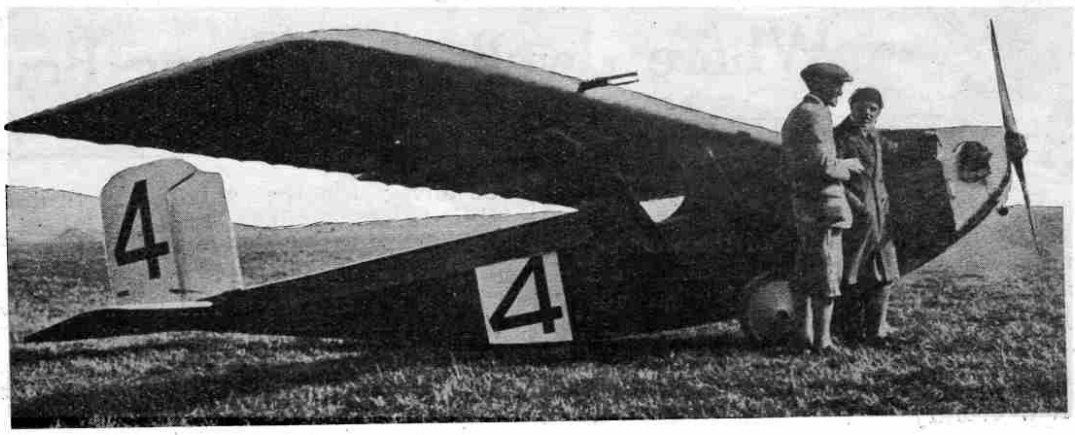


Photo courtesy] [*Messrs. Wm. Beardmore & Co. Ltd.*

"Wee Bee I," with her designer, Mr. W. S. Shackleton (on left), and Pilot, Mr. M. W. Piercey

"Wee Bee I" Holds its Own

During the eliminating trials, the competitors were required to dismantle and re-erect their machines within two hours. They also had to fly two circuits of the course, one with the pilot occupying the front seat and one in which he sat in the rear cockpit (in order to demonstrate that the machine could be flown from either cockpit). It is surprising to learn that 10 out of the 18 machines entered failed to satisfy the preliminary conditions.

On the opening day of the competition, "*Wee Bee I*," piloted by Mr. M. W. Piercey, was the first machine to complete the prescribed ten laps of the high-speed course. Although not running at full throttle, the "Cherub" established what remained to the end of the competitions the highest speed. This was slightly over 70 miles per hour.

"*Wee Bee I*" had proved herself to be very fast, but it was generally expected that some of the other machines would score in the slow speed tests. But here also the "*Wee Bee I*" proved able to hold her own, for during the first set of low-speed tests Piercey actually flew her at 40.67 m.p.h., nearly 1 m.p.h. slower than the next-best performance on that day. Later in the week this speed was further reduced to 39.66 m.p.h. gaining for the Beardmore 347.52 marks for speed range.

In the take-off and pull-up competitions the "*Wee Bee I*" did very well, its best take-off being one of 235 yards, while it pulled up in 124 yards.

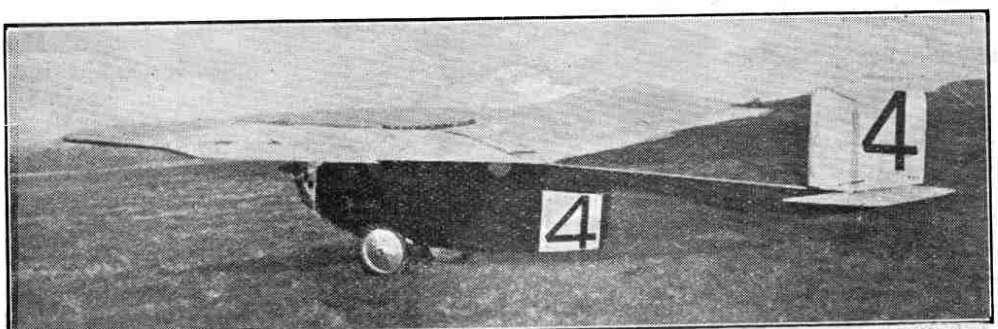


Photo courtesy] ["*Flight*"

The "Wee Bee I" getting its tail up at the start of a test

Engine Trouble at 80 m.p.h.

During the Lympne week many competitors experienced engine trouble, and in this respect the "*Wee Bee I*" had no better luck than many of the others. In fact she had very hard luck, for when Piercey was within two miles of the finish of a high-speed test, which would have placed him far beyond the reach of any rival, he experienced trouble of so serious a nature that he had to land.

About the middle of the week, while Piercey was cruising around the course in order to put in his ten hours' flying, he noticed that his engine revs. began to drop. Upon examination, it was found that a small oil spray pipe in the top of the crank case had become choked. In consequence, the big-ends were not being lubricated and indeed one big-end had heated up considerably. As it was not permitted to change such parts in the engine, except at the penalty of having to start the trials all over again, the pilot decided to "nurse" the engine during the remainder of the competition.

For several days there did not appear to be any likelihood of "*Wee Bee's*" leading position being threatened, but on the last day of the competition there seemed to be a chance of another competitor lifting the prize. This tempted Piercey to go out again in order to do another high-speed test, for he knew that the 70.11 m.p.h. he had already registered did not represent anything like the actual top-speed of "*Wee Bee I*," which is in the neighbourhood of 87 m.p.h. That this was the case was shown by the fact that the first five laps were covered at a speed of nearly 80 m.p.h., as were also the first four laps of the second set of five. On

(*Continued on page* 131)

Dick's visit to MECCANOLAND

Where dwell the Happy Boys

MOST people by now have heard of the wonderful new country where nearly all the inhabitants are boys—millions of them; the land where all is sunshine and joy; where no strife or dissension comes to mar the happy hours; where harmony and good-fellowship reign supreme.

A Wonderful New Country

All the inhabitants of this sunny realm are happy and joyous, crowding the fleeting hours with pleasure and fun. The young ones are enjoying themselves amongst miniature Bridges, Wagons, Windmills, Trucks and Towers—exquisite engineering models, which they have built and set to work mechanically. The older ones are building and playing with larger structures, Giant Cranes, Draglines, ingenious Looms for real weaving, Clocks that keep time, Automobiles with real gears, and hundreds of other models, all equally interesting and fascinating. The more thoughtful and serious boys are busily engaged in inventing and creating new and ingenious models and movements.

This happy country is called Meccanoland, and boys from every part of the world live there. Meccano language is the universal boy-language, and all the inhabitants understand and speak it. They have their own magazine, which deals with topics that Meccano boys love to read about; they have their own Guilds and Clubs; and they spend happy hours in friendly rivalry, each striving to build better and invent more than any of the others.

"Are you ready, Dad? Now watch—I'm going to show you something!"

The Land of Happy Boys

Some boys have lived in Meccanoland for more than twenty years, and the longer they live there the happier they are. Every day more boys are crowding into the country, eager to learn of its wonders. The moment they arrive they feel at home, and they take their places and set to work with a will. They know that in Meccanoland they will have the time of their lives; that they will have more fun than they have ever had before. Meccano fun is healthy boys' fun—fun that makes them glad to be alive; fun that strengthens their characters, sets their brains working, and teaches them something that will make them into successful men.

The sun never sets on Meccanoland, where there is always life and joy. The gates are never closed, and the only passport you require to enter this wonderful land is a Meccano Outfit. Get your passports to-day, boys, and don't stay another minute in the cold dreary world outside.

A short time ago a bright eager boy heard about Meccano and Meccanoland, and he told his father about them. His father was so interested that he called at the Meccanoland Home Office to investigate, and what they told him there so impressed him that he set it all down. You will find it in this article, and when you have read it through you will agree that you have never read anything so absorbing.

The Spell of a Wonderful Toy

"My word, Dad, it's great!" cried Dick, as he came running into my room with a parcel under his arm.

"What is great?" I asked, looking up from my paper.

"Why, Alan's Meccanograph. He has got . . . ."

"Alan's what did you say? What is a Meccanograph?"

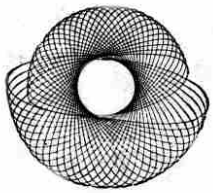
"Well, I'm trying to tell you. Last Christmas, Alan got a Meccano Outfit—the engineering toy that you see advertised in all the papers. He built a most topping lot of models—a big Bridge, a Crane, a Motor Chassis, and I don't know how many more besides. Then he wanted some more parts to make bigger models. His father wouldn't hear of it at first, but said that if Alan would make a really clever model with the parts he already had, he'd buy him the parts he wanted."

"Did he do it?" I asked, becoming interested.

"Rather! Why, he made the Meccanograph, and he's lent it to me. Here it is!"

Dick placed his parcel on the table, took off the wrappings and disclosed a neat mechanical contrivance, with a little crank at one end and a wooden platform at the other.

"Lend me your fountain pen, Dad," said Dick. I did so, and he fixed it into the machine so that the



point rested on a piece of paper, which he pinned on the little platform.

"Are you ready, Dad? . . . Now watch—I'm going to show you something."

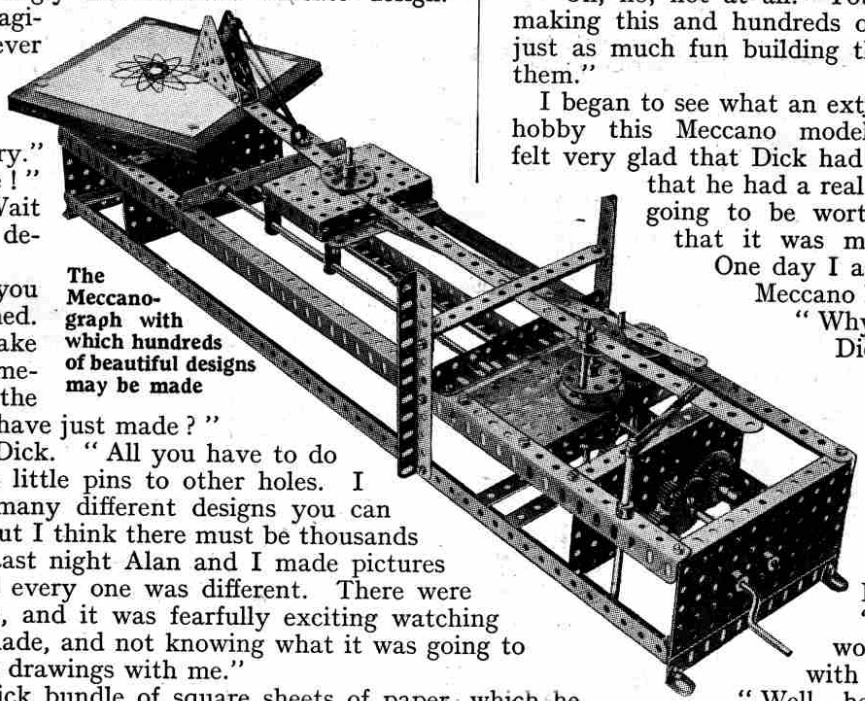
The Wonderful Meccanograph

He turned the crank, and the pen immediately began to trace an exceedingly intricate and delicate design. It was the most magical thing I had ever seen.

"How do you work it, Dick?" I asked. "Let me try."

"Wait a minute!" answered Dick. "Wait till I change the design."

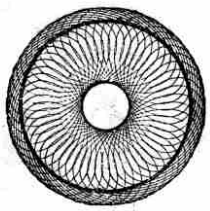
"What do you mean?" I exclaimed. "Can you really make the pen draw something else besides the lovely design you have just made?"



The Meccanograph with which hundreds of beautiful designs may be made

"Yes," replied Dick. "All you have to do is to change these little pins to other holes. I don't know how many different designs you can make altogether, but I think there must be thousands and thousands. Last night Alan and I made pictures for two hours and every one was different. There were some real beauties, and it was fearfully exciting watching the design being made, and not knowing what it was going to be. I brought the drawings with me."

He opened a thick bundle of square sheets of paper, which he handed over to me. On each was a different kind of Meccanograph design. In some the boys had used coloured inks, and had filled in parts of the design with water colours, giving a most fascinating effect. I gave up all thoughts of reading my paper, and spent the evening turning the crank and watching the pen go through its magical performance. I forgot all about going to the club, and Dick and I had the jolliest evening—the first of many such evenings we were destined to spend with Meccano.



"Where do you buy such a machine?" I asked Dick.

"You don't buy it at all," Dick replied. "You just buy a Meccano Outfit, and make it up for yourself.

"That's a drawback, isn't it?"

"Oh, no, not at all. You get full instructions for making this and hundreds of other models, and it is just as much fun building them as it is playing with them."

I began to see what an extraordinary and instructive hobby this Meccano model-building must be, and felt very glad that Dick had run across it. I soon saw that he had a real mechanical bent that was going to be worth something to him, and that it was my duty to encourage it. One day I asked him: "Who started Meccano? Who's the inventor?"

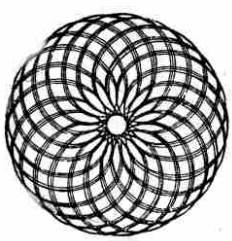
"Why, Frank Hornby, Dad," Dick quickly replied. "Every boy knows about him. He says he has a million boy friends!"

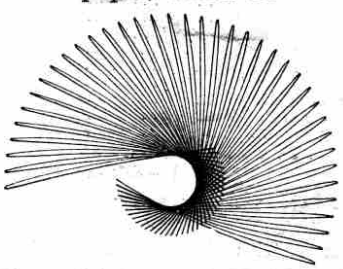
"I shouldn't wonder if he has," I said. "Suppose we look him up some day and cross-examine him?"

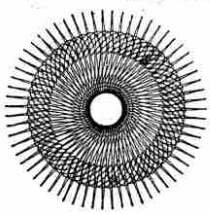
Dick's eyes glistened. "Why! Do you think he would see us?" he said, with doubt in his voice.

"Well, he's human like the rest of us, I suppose," I replied. "Anyhow, we will take a chance of his seeing us."

(To be continued)







We illustrate on this page five of the many beautiful designs that may be made by the Meccanograph. Hundreds of similar designs, each differing in pattern and detail, may be made with this wonderful model by a simple adjustment of the mechanism. Any design may be repeated at any time by reverting to a similar adjustment. In one of our future issues we shall give full details for constructing this splendid Meccano model.—EDITOR.

The Conquest of the Air—

(Continued from page 129)

the last lap, however, and when within about two miles of home, the big-end that had heated up when the oil pipe choked earlier in the week, gave way altogether and Piercey had to land.

Notwithstanding this hard luck, "*Wee Bee I*" remained the winner of the competition, with a total of 588.52 marks to its credit. How close Piercey came to an even greater achievement is clear from the statement that had the engine lasted only another one minute and forty-five seconds his figure would have been increased to something like 780 marks.

A High Tribute

The Lympne tests have proved that "*Wee Bee I*" is extraordinarily efficient aerodynamically, and in this respect Lieut. Col. W. A. Bristow, the aeronautical consulting engineer who kept the records of the competition, said: "no more efficient aeroplane than the Beardmore has ever left the earth."

The minimum thrust required at the propeller is only just over 5 h.p., so that the machine has a power-reserve of something like 17 h.p., a far greater percentage than is attained even in the most efficient modern commercial aeroplane. This extremely high power-reserve means that "*Wee Bee I*" has a good climb, and if necessary would be able to rise out of quite a small field. High power-reserve also means that the machine will not normally be flown at more than about one-half of the engine power, with consequent increase in reliability and greatly prolonged life of the engine. Machines less efficiently designed require nearly the whole of their available power for horizontal flight, and consequently their engines will not last nearly so long, nor will there be so much power in reserve for climbing.

It may also be mentioned that "*Wee Bee I*" possesses an excellent gliding angle (1 in 16.8), which enables the machine to glide to a suitable landing place, in case of engine stoppage. A less efficient machine would have to make a forced landing in the first available field.

Next month we shall give a detailed description of the construction of the "*Wee Bee I*" and also a special interview with the pilot, who will describe how the machine behaved during the Lympne tests.

Competition Corner

"What I should like to be, and why"

Essay Competition

Every week we receive letters from boys all over the world regarding their future careers. In many cases our readers are asking for advice as to the prospects of and methods of entering certain occupations, and in other cases they tell us which occupation they have chosen and their reasons for making this particular choice. We think it would be of interest to a large number of our readers to know which careers other readers are choosing, and their reasons for the choice. Therefore we have decided to announce this month an Essay Contest on the subject: "WHAT I SHOULD LIKE TO BE, AND WHY."

We hope to receive a large number of entries for this contest, and we feel sure that it will prove of interest to those boys who are nearing the end of their school days and are approaching the time when the choice of a career must be made. The winning essays will be published in the "*M.M.*"

The competition will be divided into two sections (A) for those of 16 years and over and (B) for those under 16. Four prizes will be awarded—Meccano goods to the value of £1/1/0 and 10/6 for the first and second in each section, respectively.

Essays must not exceed 1,000 words in length and must be written legibly and on one side of the paper only, with the competitor's name, address, and age *on the back of each sheet.* This contest will be decided entirely on the merits of the essays, and bad writers—provided, of course, that their writing can be read!—will not be penalised in any way as compared with good writers.

Closing date 30th April (Overseas: 31st July).

13th Photo Competition

Our Photographic Competitions continue to produce, month by month, a large number of entries of quite surprising quality, and a still more interesting fact is that the general level of excellence is undoubtedly higher now than it was a few months ago. We hope that the photographic page that will commence in next month's issue will encourage many more of our readers to take up this fascinating hobby and to enter regularly for our Photographic Contests.

Following our custom of choosing subjects that are within the reach of practically every reader, we announce this month as the subject of our Thirteenth Contest: "A TRAIN STANDING IN OR STARTING FROM A RAILWAY STATION." In this competition the size of the station and the nature of the locomotive and train will not be taken into consideration, so that a reader who has access only to a small country station will have an equal chance with a reader living near a large terminal station.

This contest will be divided into two sections (A) competitors under 14 years of age and (B) competitors of 14 years and over. Every entrant must write his name, address and age on the back of each photograph submitted, and must also state by whom the photograph was developed and printed. In the event of a tie for a prize, photographs that have been developed and printed by the competitor himself will receive preference. Envelopes containing entries should be marked "Photo Contest" in the top left-hand corner.

Four prizes are offered—Photographic goods to the value of 10/6 and 5/–, to be chosen by the winners, as first and second prizes respectively, in each section.

Closing date 30th April (Overseas: 31st July).

Competition Closing Dates:

Twelfth Photo	**31st March.**
Fourth Drawing	**31st March.**
Thirteenth Photo	**30th April.**
Essay	**30th April.**
OVERSEAS:	
"Sharp Eyes"	**30th April.**
Bargain Hunt	**30th April.**
Eleventh Photo	**31st May.**
Cycling Hints	**31st May.**
Second Drawing	**30th April.**
"My Favourite Railway" Essay	**31st May.**
Third Drawing Contest	**31st May.**
Twelfth Photo	**30th June.**
"Suggestions"	**31st May.**
Fourth Drawing	**30th June.**
Thirteenth Photo	**31st July.**
Essay	**31st July.**

Fourth Drawing Competition

The entries for our Third Drawing Competition have been very satisfactory as regards numbers, but less so as regards the quality of the drawings submitted. Apparently very few competitors have as good a knowledge of the details of an electric car as they have of a locomotive. We believe that Drawing Competitions of this character provide one of the best methods of developing quick and accurate observation, and therefore we are announcing this month our Fourth Drawing Competition, the subject of which is: "A PETROL MOTOR BUS OR MOTOR LORRY." Drawings may be made either in pencil or ink, but colours are not to be used.

The contest will be divided into class (A) for those of 16 years and over, and class (B) for those under 16. There will be four prizes. Drawing or painting materials (or Meccano products if preferred) to be selected by the winners, to the value of 10/6 and 5/– respectively for the first and second in each section.

Closing date 31st March (Overseas: 30th June).

Results

Cycling "Hints" Contest

As this was the first competition of its kind announced in the "*M.M.*" we naturally thought it would be popular, but we did not anticipate that the entries would be so numerous. Apparently our readers are still as keen as ever on cycling, and it is evident that they take great pride in their machines and that they are thoroughly up-to-date in their methods.

Four prizes were offered in this contest and the prize winners are as follows:—

FIRST PRIZE (pair of cycle tubes treated with "Fibermetic" puncture seal), W. Pearson, Aston, Birmingham. SECOND PRIZE (Veeder Cyclometer), W. Needham, Oldham. CONSOLATION PRIZES (Puncture sealing solution for two cycle tyres), H. Kelly, Droylsden, Manchester, and R. Woodcock, Wickersley, nr. Rotherham.

We hope to publish some of the winning hints in an early issue of the "*M.M.*"

Second Drawing Contest

The First Drawing Contest held at the beginning of last year was a great success, but this Second Contest has exceeded all expectations. Most of the entries received showed not only an excellent knowledge of locomotive construction but also real artistic ability. All entries were examined with the utmost care, and after a great deal of consideration we decided that the drawings submitted by R. W. Tippetts (Acocks Green, Birmingham), and F. Edgar (Blaydon-on-Tyne), were the best in Class A and were of equal merit. We therefore decided to award to each of these competitors a prize of Meccano Products to the value of £1/1/0. In Class B the first prize (Meccano Products to the value of £1/1/0) was won by P. Duxbury, of Margate, and the second prize (Meccano goods value 10/6) to E. Mitchell, of Chester.

"Sharp Eyes" Contest

This competition has been received with the greatest enthusiasm and entries from boys and girls of all ages have literally poured in from all over the United Kingdom. This big response entailed an enormous amount of work, as we make a point of carefully examining each individual entry. It was surprising what remarkably sharp eyes most of the competitors had—even a mistake in the smallest detail being readily detected, proving that the drawing must have been scrutinised with the greatest care. A large number of readers submitted entries showing well over one hundred errors, but in every case the total was reduced by the judges owing to mistakes being shown that were not really genuine errors. Some competitors went so far as to try and penetrate the picture and see the mistakes on the other side!

After carefully going through every mistake found in each entry and in accordance with the rules governing this contest, the prizes have been awarded as follows:—

FIRST PRIZE (Hornby No. 2 Goods Set), W. Mitchell, Exeter, Devon.

SECOND PRIZE (Hornby No. 1 Goods Set), C. F. Floyd, Knowle, Bristol.

THIRD PRIZE (Meccano No. 1 Radio Receiver or Double Headphones), E. Jones, Park Row, Nottingham.

Cross Word Contest

During the month of January entries for this competition were showered upon us in sack-loads until it became quite a problem to know where to store them! It has been a most difficult proposition sorting out these Puzzles and judging the winners. Most of the competitors solved our puzzle correctly, but the most important part with which we had to deal was the puzzles invented by the competitors themselves. Some of these were certainly very ingenious and the dictionaries must have been subjected to some very hard work!

Three prizes were offered in this contest, and finally these were awarded as follows:—

FIRST PRIZE (Meccano Goods value £2/2/0), G. S. Marsh, Blackpool.

SECOND PRIZE (Meccano Goods value £1/1/0), V. R. Neville, Blackpool.

THIRD PRIZE (Meccano Goods value 10/6), E. A. Horne, Muswell Hill, London.

In addition a consolation prize of a Meccano Writing Pad has been awarded to A. Russell, of Abbeyhill, Edinburgh.

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. S. Rogan (Madras).—We are pleased to learn that you have been so successful in your examinations, and that you now intend to continue your studies in this country. If you will write to the Secretaries of either of the colleges you mention they will give you full information. Thanks for the puzzles, which we hope to use.

S. P. Langridge (Oporto).—We are always glad to hear from British boys who live abroad, and we have read your account of conditions in Oporto with great interest. We send more and more Meccano to Portugal each year, and soon you should experience no difficulty in obtaining all accessory parts locally. We are pleased that you enjoy the "*M.M.*" so much.

C. C. McCallum (Anchineruine).—Your article on the Meccanograph will receive consideration later, but at the present time there is so much that we *must* put in the "*M.M.*" and really so little space available in spite of the increased number of pages. The new Hornby electric trains are in preparation, and the Meccano factory is well ahead with the work. We shall be able to make an interesting announcement on this subject very shortly.

J. A. Saddler (Adelaide).—We are gratified that you and so many other overseas readers take such an interest in our railway articles. These will be continued and will, we hope, form a permanent feature of the "*M.M.*" Any Meccano user can tell the year when his Manual was published, by referring to the number at the left hand bottom corner of the cover. If the number is 23 it indicates that the Manual was printed in 1923, 24 denotes 1924, and so on.

L. Stanley (Kingsbridge).—It will evidently be necessary for you to wait a little longer for your No. 2 Tank Loco, but it will come later, never fear, if you wish hard enough! Thanks for your good wishes and congratulations.

E. Breton (Chiswick).—Most parents are only too glad to encourage their boys to play with Meccano, and we rarely come across an instance where its use is discouraged. One very highly-placed man in this country told us recently that he always gave his boys a big Meccano Outfit when they were young, as he considered that the Meccano training would be worth £10,000 to them when they grew up.

W. H. Hope (Ellesmere Port).—"The members of our Meccano Club consider the "*M.M.*" to be one of the seven wonders of the world, and we wonder when it is going to stop growing." It may stop growing in size some day, but it will never cease to grow better in quality, W.H. We are sorry to hear of the damage to your wrist, and we hope you are quite alright again now.

R. Shaw (Calcutta).—We shall be very glad indeed to receive a photograph of yourself standing by your best Meccano model, and we may be able to publish it if suitable.

F. D. Cowley (Hale).—We have received many hundreds of congratulations on the recent improvements to the "*M.M.*" but none more cordially worded or more acceptable than your own. The number of literary pages has now been permanently increased.

J. A. Dean (Stretford).—Many thanks for your letter and permission to make use of same, of which we hope to avail ourselves. Your son is bright beyond the average, and we are interested in his doings and sayings. He is fortunate in having a father to encourage him in his natural bent!

K. Russ (Dongarra, W.A.)—Thanks for your interesting local news. No doubt Geraldton will be a leading port in due time. Major Brearly is evidently a progressive man and is anxious to place your air service on a sound footing. Your hay wagon, drawn by five horses, is on a bigger scale than anything we have seen in this country.

L. Trenberth (Redruth).—We congratulate you on the progress of your Club. It shows considerable enterprise on the part of all your officials and members that you have been able to establish a Library and a Museum, and run a Savings Club.

F. B. Treath (Young, N.S.W.)—We were sorry to hear about your cold, but no doubt you are alright again now, and riding around the country on your pony. Your snapshot is not a good one, and we should like to see something better.

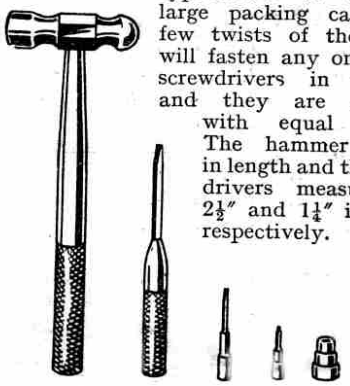
OUR BUSY INVENTORS

RECENT INTERESTING PATENTS

Every day new inventions and ingenious labour-saving devices are being brought into existence, and from time to time the most interesting of these inventions are described and illustrated in these columns. Readers are invited to send particulars (accompanied, if possible, with photographs or rough sketches) of any interesting inventions or devices that may come to their notice. Payment at our usual rates will be made for any contributions used.

Three Tools in One

A hammer with three screwdrivers in its handle is the invention of an American engineer. The screwdrivers are made of specially strengthened steel and will fit any size of screw ordinarily encountered, from the tiny screws used on portable typewriters to those in large packing cases. A few twists of the handle will fasten any one of the screwdrivers in the bit and they are detached with equal facility. The hammer is $7\frac{1}{2}''$ in length and the screwdrivers measure $5\frac{1}{2}''$, $2\frac{1}{2}''$ and $1\frac{1}{4}''$ in length respectively.



Two Pianos in One

Those of us who have listened to the broadcast of the Savoy Orpheans from the London station have often admired the piano effects, especially when we have been favoured with a pianoforte solo. The explanation of the increased musical tone and possibilities is afforded by the fact that the piano used has a double keyboard. It is claimed to be the only piano of its type in existence, although other pianos on the same lines are now being manufactured for American dance orchestras. The double-keyboard piano is particularly serviceable for jazz orchestras where an ordinary piano is not sufficiently powerful. The piano used by the Savoy Orchestra may be played as an ordinary piano when desired, but the movement of a lever converts it into a double piano, by which any note struck also strikes a corresponding note an octave higher.

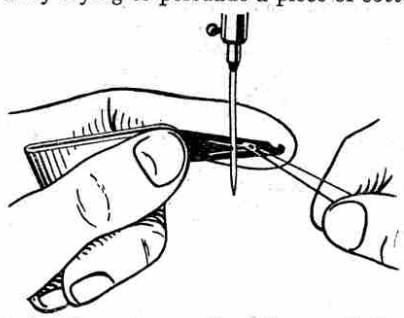
Piano with Short Keys

Another form of piano with a double keyboard has recently been invented by Dr. Moritz Stoehr, of New York, inventor of the Musical Typewriter, a device for transposing and recording music. Dr. Stoehr could see no reason why the keys of the piano should be as long as they are in the standard type. He noticed, too, that musicians do not strike the keys near the edge, but most of them use only a small part of the key near the black notes. In his piano, therefore, he has reduced the size of the keys and this has enabled him to introduce a second keyboard in the form of a step, the second keyboard being a step higher than the first. This allows of two pianos being embodied in the one frame, but those who have seen the inside of a piano will understand that there has been some considerable difficulty in arranging the notes and wires of the second piano without disturbing those of the first.

We know that with Meccano any mechanical movement is possible, but we hope our readers will not be tempted to endeavour to emulate the inventor by experimenting on the family piano!

For Bachelors Only

Having doubtless wasted many hours vainly trying to persuade a piece of cotton



to go through an absurdly small hole, an inventor has recently patented a needle-threader. The device has two thin steel blades with hook-like points, the larger one being for use with darning or sewing-machine needles. In operation the blade is inserted in the eye of the needle to be threaded and the thread is passed over the hook and pulled through the eye of the needle as the point is withdrawn. Needles of various sizes may be threaded quickly with the device, which should certainly prove a great boon to bachelors, although it will probably not be allowed in "threading-the-needle" races at your school sports!

A Miniature Calendar

A perpetual calendar that fits into the back of a watch has been invented to help people to remember the date and day of the week. It may also be worn as a watch-charm or trinket, and consists of three discs, showing the month, day and date. These discs are mounted on a spindle behind the main disc, in which there is an opening to show the particulars for the day, the disc being revolved by spur-gears.

Stamps for Sale

(*See also page* 136).

Gratis—10 Togoland
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including used and unused, all different. To applicants for my famous approval sheets of ½d. stamps. Enclose 1½d. postage.

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FREE! FREE!

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In order to circulate our Price List and old Pre-War Approval Sheets from which we are clearing stamps at half price we will send the **Mint Packet Free** and **Post Free** to all applicants (abroad 2½d).

SPECIAL OFFER.—Complete mint set of 39 diff. scarce 1923 **German Provisionals** from 5,000 m. on 40 m. to 1,000,000,000 m. on 100 m. (usual price 2/-) offered for **6d.** post free. Collections and Loose Stamps bought. Highest prices paid.

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Fill those Blank Spaces in your Album with good stamps. Quality not quantity counts. My new Price List of Modern Mint Colonials is now ready, containing dates of issue, watermarks, colours, and all particulars, and will be sent to any collector interested on receipt of 1½d. stamp to cover postage.

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30 Sound Colonial and Foreign Stamps, cat. over 6/-, including 2 drachma Byron 1 and 2 Esc. Portugal, U.S., Africa, ½ to 1/-, Palestine, Holland Jubilee various Air Posts, France Pasteur. Postage extra.

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Pictorial Malta, Palestine, Nigeria, Egypt (King Fuad), Gold Coast, 5 Germany on rose paper, 8 Germany, posthorn type, 3 Germany, airpost, making up 100 nice all different.

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He who hesitates may be too late. Only 1 lot allowed each applicant.

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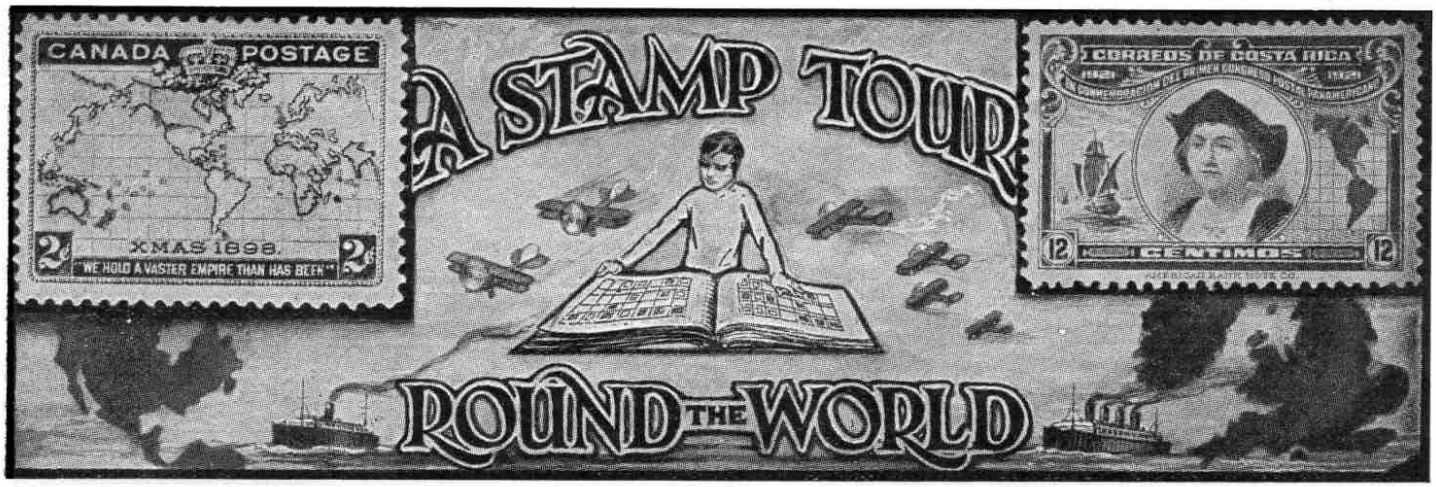


VII. THE ISLANDS OF THE PACIFIC.

WE conclude our aeroplane tour of the South American continent by flying across the Andes to Santiago, the capital of the republic of Chile. Santiago was founded in 1541, and is situated about 1,860 ft. above sea-level on a wide and beautiful plain between the main Andes and the Cuesta del Prado mountains.

To commemorate the holding of the Fifth Pan-American Congress held in this city in 1923, a set of stamps consisting of eight values was issued on 28th April of that year. The one type, which we illustrate, was used for all values and shows a view of the Palace of Santiago with its beautiful grounds. The stamps were printed by two operations, the view being executed by the line-engraved process and the values and borders by lithography. One million copies of the 2c. and 10c. were printed, half a million of the 4c., 20c., 40c., and 1 peso, and one quarter of a million of the 2p., and 5 pesos.

Santiago is about 115 miles east of Valparaiso, to which port we now fly. Here we find our liner, which has sailed down the western coast of the continent and is waiting to take us on board for our tour of the Pacific.

The Cook Islands

Our first call is made at Rarotonga, the chief island of the archipelago known by the general name of Cook Islands. Since 10th June 1901, the islands have been under the control of the governor of New Zealand, although they still issue their own distinctive stamps.

In August 1920 a pictorial series was issued, two values being illustrated here. The same designs were used for two sets, one bearing the name of Rarotonga, the other Aitutaki, which is the name of another island in the group.

The ½d. value shows Captain Cook landing on the islands when he discovered them in 1777. The view shows a portion of the coast with mountains in the distance and palms in the foreground. In the bay is the explorer's ship, and the captain himself is just about to jump ashore from the small boat that has brought him. Several savages, who were at that time man-hunters and cannibals, are seen excitedly awaiting the explorer's approach.

The 1d. shows the wharf at Aitutaki, the 1½d. a handsome portrait of Captain Cook. The 3d. shows a palm tree, probably to remind us that Aitutaki has most luxuriant coco-nut palm groves. The 6d. (illustrated) shows a view of some native huts, with their inhabitants and pets, on the island of Mitiero. The 1/–, the highest value, also illustrated here, shows Avarnua harbour, with its jetty and huts and with the volcanic cones rising in the interior of the islands.

Nauru, our next port, is a small island of the Marshall Group situated very near the Equator. The shores of Ocean Island, one of the group, were shown in the pictorial series of Nauru issued in 1924 and illustrated and described in our January, 1925 issue. The soil of Nauru and Ocean Island is largely composed of phosphate of lime, and owing to the great value of this substance as a plant food, the islands are in themselves probably the richest in the world.

Honolulu, the Stopping Station of the Pacific

We now turn due North-east and sail in that direction for about two thousand miles until we arrive at Honolulu, the capital of the Hawaiian group, a colony of the United States of America. A view of Honolulu is illustrated here, the stamp being one of a series designed by E. W. Holdsworth, of Honolulu, engraved and printed by the American Bank Note Co., New York, and issued between the years 1894 and 1899.

These islands also were discovered by Captain Cook in 1778, the year after he had discovered the Cook Islands. Although he was received with great delight by the natives, who looked upon him as a kind of god, he was killed on the beach of Kealakekua Bay in Hawaii the following year by a native. In spite of this apparent ill-feeling against him, his death occasioned very great distress and, until the natives were converted to Christianity, his tomb was made a place of pilgrimage and the priests received offerings on his behalf.

The Hawaiian islands are very mountainous and here is found Kilauea, the largest active volcano in the world. It was last in eruption in 1922 when great streams of molten lava flowed over the surrounding countryside.

From Honolulu we turn westwards again and begin our long voyage across the second half of the Pacific to Japan. This portion of the Pacific is further north than that containing all the immense groups of islands and so for nearly four thousand miles we journey on without a glimpse of land.

The Beautiful Mountains of Japan

Our goal in Japan consists of a visit to Mount Fuji-yama, the finest of all Japanese mountains. We leave our ship at Yokohama and take the train to Gotemba at the base of the mountain and spend the next day or two in making the easy climb to the summit.

The highest point is 12,395 ft. above sea-level and consists of a huge crater, for Fuji is, of course, a volcano. Although it is now believed to be almost extinct one can never be sure of a mountain in Japan, for the quietest volcano is always liable to burst into a fury of smoke and lava. It is largely due to the great streams of lava that have flowed from the crater of Fuji in past times that it is shaped in such a remarkably graceful curve. This is excellently shown in the Japanese stamps issued in 1922 bearing a view of this mountain.

The series consisted of three values, 4, 8 and 20 sen, and was printed by the Government Printing Bureau, Tokio, on granite paper. The watermark is a series of wavy lines and the perforation 13 by 13½ between the stamps.

From Japan we sail southwards to Formosa to visit Mount Morrison, pictured on the two commemorative stamps issued by Japan in April 1923, to celebrate the first visit of the Imperial family to Formosa. Fuji-yama was Japan's highest mountain

until Formosa was added to her dominions. Mt. Morrison (14,270 ft.) and Mt. Sylvia (12,480 ft.) then took the first and second places, Fuji being the third highest.

Mount Morrison is rather more than half way down the east coast of the island and stands nearly on the Tropic of Cancer. The mountain is one of the few found in Japan that are not volcanic. It is surrounded by many other large mountains and is therefore not a very conspicuous object.

NEXT MONTH:—

The East Indies and New Zealand.

How to find Plate Numbers

"Plate numbers" appear to be a mystery to many young collectors. Perhaps this is because now-a-days plate numbers usually appear on the margin of each sheet of stamps instead of on the stamp itself, and after all, not many people are lucky enough to obtain at the Post Office a stamp with a margin in which the plate number appears. Even fewer people buy a whole sheet of stamps at a time, so plate numbers are not often seen or enquired about, except by those collectors who specialise in them.

Between 1858 and 1880 plate numbers appeared on every British stamp, as well as on the sheet margins, with the one exception of the 1d. red with letters in the bottom corners only, which stamps had no plate numbers. Our present English stamps have no plate numbers, but instead have control letters and numbers in the margin of each sheet.

Portion of the stamp below, greatly enlarged to show plate number

On British and British Colonial stamps, the plate number shows the order in which the printing plates for those particular stamps were made. Sometimes only one batch of impressions would be taken from a plate, but at others two or even three printings would be made before a new plate was considered necessary.

Plate numbers appearing on the stamps themselves are peculiar to the stamps of Great Britain. The 1d. reds of Queen Victoria's reign are the most famous of these numbered stamps. In their case the numbers are found in the vertical columns of net-work at each side of the Queen's head.

The numbers may be seen with the naked eye, and a sharp-eyed person will generally be able to read them. In some cases, however—and more especially in those where the cancellation mark on the stamp comes over or near the number—a magnifying glass will be found necessary to identify the number. Our two illustrations will show exactly how these plate numbers are placed.

The numbers run from 71 to 225, but 75, 126, and 128 are non-existent. Plate number 77 is by far the rarest, only seven or eight copies being known. There is one in the Tapling collection in the British Museum, but there must have been several issued, for at least one sheet of 240 stamps would be printed. Any stamp collector has the chance of being the lucky finder of a Plate 77, and such a discovery would benefit the finder to the extent of some hundreds of pounds! Now, you "Sharp-Eyed" Meccano boys, get busy.

Collecting plate numbers is one of the interesting sides of stamp collecting, and it is exciting work searching for special numbers to fill the blanks. The 1d. reds are fairly common, and as they may be purchased at about 1/- per 100 it is not a very expensive matter to complete a set with the exception of one or two rarities.

STAMPS FOR SALE

(*See also page* 134)

Readers frequently write to me asking if I can recommend books that are both of interest and of use. In this column I hope to review books that I consider specially appeal to Meccano boys. I do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

Practical Electrician's Pocket Book, 1925
by H. T. Crewe
(Rentell, 3/- net).

The 27th annual issue of this welcome work of reference comes to us with the assurance that it has been most carefully revised and that many sections have been re-written. These include the chapters on Measuring Instruments, Railway Signalling Apparatus, Wiring Systems, and Wireless. There is also a new chapter on the Time Switches that are now being installed in increasing numbers all over the country. Other alterations have been made here and there where necessary to maintain the reputation for accuracy that this pocket book has held for many years. We are pleased to note that the Metropolitan Electricity Undertakings are now arranged in alphabetical order—a decided improvement. We have no doubt this new edition will meet with the cordial appreciation that it fully merits.

"The Book of the Wireless Valve"
(The Mullard Radio Valve Co. Ltd., price 1/6).

A particularly interesting little book on the wireless valve comes from the Mullard Radio Valve Co. Ltd. Commencing with a brief history of the invention of the valve the book passes on to explain in simple language exactly what the valve does, and wherein lies its great value for wireless. Later chapters deal with valves for all kinds of purposes, either reception or transmission, and point out the particular features that make each type valuable for its own particular work. Some interesting details of the low temperature valves are also included. In short, this little book covers practically every feature of the modern wireless valve, and its value is greatly enhanced by a large number of clearly-drawn diagrams and some interesting photographs showing various stages in the manufacture of valves.

"Photography and its Mysteries," and
"Electrical Amusements and Experiments."
By Charles R. Gibson, F.R.S.E.

(Seeley Service & Co. Ltd., London. 5/- net each).

Mr. C. R. Gibson's activities as a writer on popular science show no signs of slackening, and in his two latest books, "Photography and its Mysteries" and "Electrical Amusements and Experiments," he fully maintains his standard of accuracy and interest. In the first-named volume the history of photography is briefly traced and its mechanism explained, and the remainder of the book is devoted to some of the more remarkable uses to which photography has been applied. We are shown how it aids the police, and how it is used for making pictures through the microscope and the telescope

In "Electrical Amusements and Experiments" Mr. Gibson leaves the beaten track and shows how electricity can be utilised for an almost endless number of interesting and amusing experiments and illusions, and how by its aid we may accomplish remarkable conjuring tricks that will surprise and mystify our friends. The various sections of the book are well illustrated by diagrams and photographs.

"The Schoolboy's Annual."
(B.O.P. Office. Price 3/6 net).

It would be difficult to find a better collection of sea yarns for boys than those gathered together this year in the "Schoolboy's Annual." There is the real sea flavour about these tales, and once a boy has started to read this Annual it will be difficult to tear him away from it. The illustrations are numerous and good, and the volume is an ideal gift for any boy who loves the sea.

The Meccano Idea—(*cont. from page* 115)

All the necessary pipes for water, gas or electricity are sent from the works with the plates, and during erection are simply joined by screwed unions. The house is provided with a complete hot water system, supplied from the kitchen range, or if there happens to be no fire in the range, hot water is supplied to the sink and bathroom by a copper, heated by a gas ring.

These ALL-steel houses will not be monotonous in appearance, as all the units are interchangeable and may be arranged to suit any design within the limits of the 3 ft. 6 in. space.

The Meccano house is a fitting name for such a well-designed structure, and its invention should go far towards helping to solve the acute housing problem.

The Tragedy of the Matterhorn

An Adventure in the Alps

The Matterhorn, or Mont Cervin as it is sometimes called, is an Alpine peak 14,781 ft. in height, and situated a little to the south-west of Zermatt. Although considered unconquerable, this peak was ascended by a band of intrepid climbers on 14th July, 1865, with the tragic results detailed in this article. It is interesting to know that by means of ropes, chains, and ladders, the ascent of the Matterhorn is now comparatively easy from either side, while huts at short distances provide shelter in case of need.

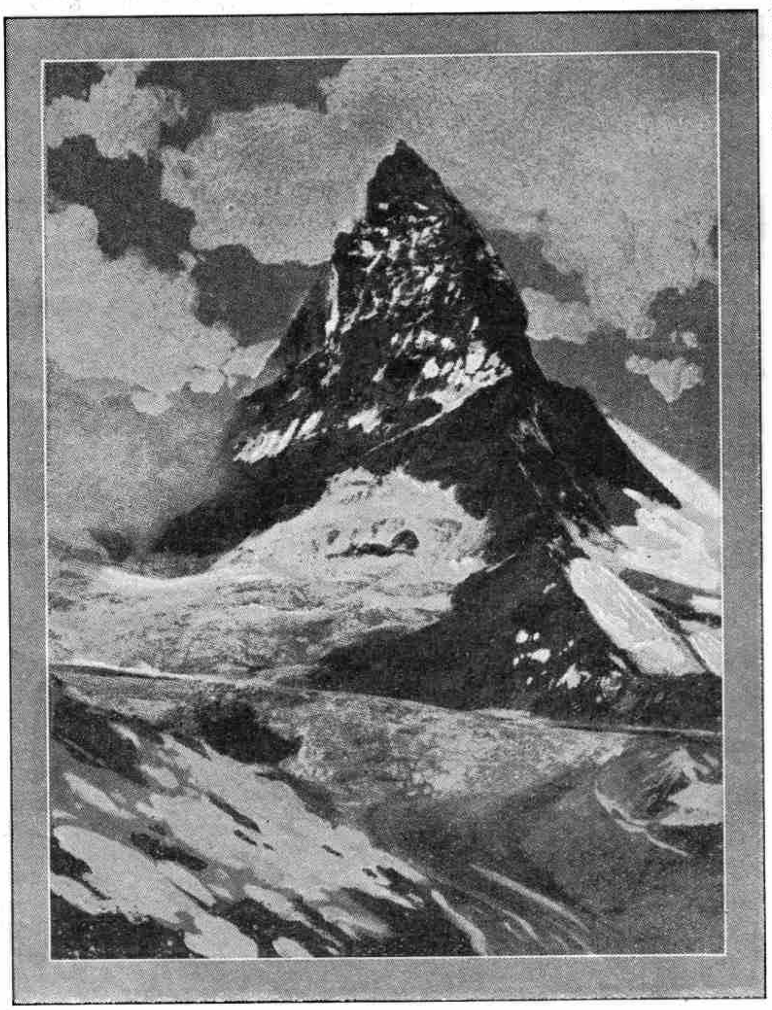
ONE evening, some months ago, whilst reading my paper I saw a name that recalled to my memory one of the most exciting episodes in one of the most interesting books I have ever read. The name was Peter Taugwalder, and the newspaper announced that he had just died at the age of 81 in the mountain village of Zermatt, Switzerland.

To Conquer the Matterhorn

As a boy, I read Whymper's wonderful book "*Scrambles Amongst the Alps*," and it left a most vivid impression on my mind. Edward Whymper was an Alpine climber of repute, and his greatest ambition was to climb to the tops of mountains that had hitherto defied the attempts of other explorers. Although he had many conquests of that kind to his credit, his ascent of the Matterhorn is undoubtedly the feat that marked him as one of the world's most successful climbers.

The day of his victory over the Matterhorn was one of mingled triumph and tragedy. No human being had ever before set foot on the summit of this great mountain monarch, indeed, it was considered that the peak was inaccessible. Many attempts had previously been made, but all had to be abandoned owing to cold, choosing the wrong route, or to the dreadful blizzards that sweep this great peak at almost every season of the year.

In July 1865, after most careful preparation and the closest study to ascertain the best route, Edward Whymper, accompanied by Charles Hudson, Mr. Hadow, Lord Francis Douglas, and three experienced guides, Michel Croz, Peter Taugwalder, senior, and Peter Taugwalder, junior, started out to attack the mountain from the eastern side. It was a perilous ascent, and more than once it seemed as though Nature would again beat them. Finally, however, they gained the summit and planted their flag of victory on the highest peak, where it was seen by thousands of watching peasants in the far-away valleys below.



The Matterhorn (14,781 ft.)

A Terrible Tragedy

The joy of the climbers was intensified when they caught sight of a rival party from Italy who had started out a day or two before from Breuil on the southern side. The Italians were some thousand or more feet below the Britishers, and in his book Whymper tells us that as soon as they saw the British, the Italians turned back disgusted at having lost the race.

After a short rest, Whymper and his party started the descent in high spirits. They were all roped together, and Michel Croz, a sturdy guide of great experience, took the lead. After him came the others in the following order—Hadow, Hudson, Douglas, Taugwalder, senior, Taugwalder, junior and last of all Whymper. A little below the summit they came to a shoulder of the mountain that is doubtless the most difficult point on the eastern face. Here the party proceeded with the utmost care. Michel Croz made the first few steps downwards, and turning round, took hold of each of Hadow's feet and having guided them to a safe foothold, turned to continue his own descent. At this moment a disaster happened that changed triumph to tragedy and threw a gloom over Switzerland that found a mournful echo in our own country.

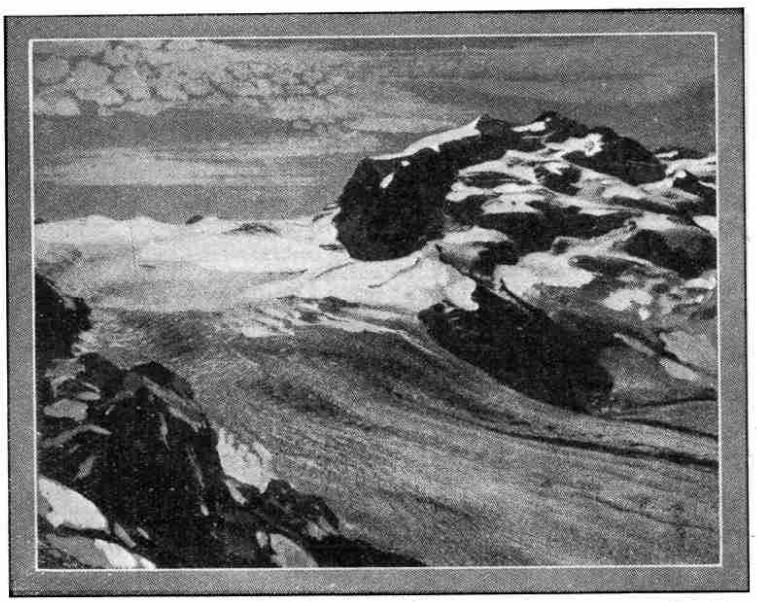
Just how the accident happened will never be revealed, but evidently Hadow slipped and fell with his entire weight on Croz. Hudson and Douglas were unable to withstand the sudden and unexpected strain on the rope, and commenced to fall also. Croz gave a warning cry, and Whymper and the two

Taugwalders, grasping the situation at once, braced themselves for the shock. There was a sickening jerk on the rope. Unhappily it failed to withstand the strain, and broke between Douglas and the elder Taugwalder. The memory of the next few seconds must have scored itself on the hearts and brains of Whymper and his two remaining companions for the rest of their lives. They saw their four comrades sliding down the mountain side at a fearful speed with arms and legs outstretched in a vain endeavour to seize something to save themselves. They fell from abyss to abyss, finding their final resting place on the great Matterhorn glacier, four thousand feet below. What can have been the feelings of Whymper and his two companions at this tragic moment! We can imagine their grief, loneliness, and terror at the awfulness and suddenness of the event.

The Search Party

For half an hour Whymper and his two companions remained where they were, not able to move a step. The two Taugwalders were utterly unnerved and cried like children, calling out "We are lost! We are lost!" At last the elder guide summoned up sufficient courage to change his position a little, enabling him to fix a rope to a rock. They all then descended to the shelf below and stood together. Shortly afterwards they continued the descent, and Whymper tells us that he thought every movement of the next two hours would be their last. The two guides were almost in a state of collapse, and were afraid to proceed, each from time to time exclaiming "I cannot," as they came to the more difficult points.

The party spent the next night on the mountains, and at daybreak resumed their sorrowful journey. On their arrival at Zermatt they aroused the village, and a search party of 20 men was formed to ascend to the glacier. There the party found the bodies of Croz, Hadow and Hudson, which a few days later were buried in the little churchyard in Zermatt. The body of Lord Francis Douglas was never found, and to this day it lies somewhere on the side of the giant Matterhorn buried in eternal snow.



The Monte Rosa

This is a glacier mass lying between Switzerland and Italy and near to Zermatt. It has ten peaks, of which Dufourspitze (15,217 ft. in height) was first climbed in 1855, one of the climbers being Mr. Hudson mentioned in the accompanying article.

The Story of Copper—(*cont. from page* 143)

probably has a great future. All round are evidences that mines in this region were worked by the people of some of the great empires of the dim past. It has been prophesied that the copper mines of Central Africa will ultimately outrival those of the United States in regard to richness of ore and lower cost of production.

British copper production has sunk to negligible proportions, the meagre output coming mostly from Cornwall and Wales. A century or so ago very large quantities of copper were produced in Anglesey, in the neighbourhood of Amlwch, but to-day all mining activity has vanished. The following striking description of the conditions existing in this district when mining operations were in full swing is given by an observer who visited the Parys mine in 1799:—

Mining in Anglesey 100 Years Ago

"This vast natural accumulation of mineral, which measures a mile in length and half a mile over, rises to the south-east of the town (Amlwch), about two miles from it. Its appearance is waste, wild, and barren in the extreme; not a vestige of green is seen on its parched and scarified surface, all vegetation being prevented by the sulphurous fumes which arise from the roasting heaps and smelting-houses and extend their destructive effects for miles round. . . . The bowels of the mountain are literally torn out, and the mighty ruin is subjected to the eye.

"Standing on the edge of the excavation, the spectator beholds an awful range of huge caverns, profound hollows, stupendous arches, gloomy passages, and enormous masses of rock. Amid this striking scenery the miners are engaged in their curious but perilous occupations; some sticking to the sides of the rock, or seated on the narrow ledges of precipices, which gape beneath them to the depth of two or three hundred feet, tearing the ore from the mountain, and breaking it into smaller masses; others boring the rock in order to blast it, whilst a third party are literally hanging over the abyss below them, drawing up and lowering down the ore-buckets, supported only by a frame of woodwork, which quivers like an aspen leaf with the operation carrying on upon it.

"Ever and anon we heard loud explosions rattling through 'the dark profound,' occasioned by the discharge of the gunpowder, and in separating the ore from the mountain. The reports varied, increased, and multiplied amongst the passages and caverns of the abyss, and, united with the scene of rocky ruin below us, excited the idea of the final consummation of all things."

Evidence of this feverish activity is still to be seen, but the mines are silent for ever.

Next month we shall describe the various processes through which the different classes and grades of copper ore are passed in order to obtain the pure metal.

Lives of Famous Engineers—

(*Continued from page* 120)

He was particularly fond of children, and on the occasion of the meeting of the British Association at Plymouth in 1841, certain worthy scientists who called upon him were astounded to find him lying on the floor playing hide-and-seek with a friend's children! His thoughtfulness for others was unfailing, and many of his inventions arose from the desire to lessen the fatigue and labour experienced by those employed on some particular work. He was a firm believer in hard work as being more important than inspiration, and a favourite phrase of his was: "It is very easy to invent a machine, but it is not easy to make it work."

NEXT MONTH:—

I. K. BRUNEL'S EARLY ACHIEVEMENTS

Giant Block-Setting Cranes—(*Continued from page* 113).

by a method that is interesting. Strictly speaking they were not "dove-tailed" in the manner used in the building of a lighthouse. Instead they were keyed together by cutting semi-circular grooves in their faces, it being arranged that these grooves came opposite to each other in pairs. When the blocks were in position, bags of concrete were placed in these grooves. The action of the water at once caused the concrete to solidify, so that each block had really two concrete pillars holding it in position.

In building a breakwater the engineers are very largely at the mercy of the weather, for naturally no work can be done when the seas are running high. On the other hand, when the water is calm work continues whenever possible during both night and day. At Dover, even on the best days it was only possible to work three hours on each tide owing to the strong currents. Notwithstanding this, in one particular month over 600 blocks were laid, showing a progress of over 75 ft. One of the points that had to be carefully watched was the organisation of the block-making yards. In bad weather they had to be kept free from congestion by unused blocks and in good weather, when the work on the breakwater was being pushed forward with all possible speed, it was necessary to ensure that they were sufficiently well-staffed to be able to cope with the increased demands made upon them and so not delay the work.

In the construction of the first pier at Dover (completed in 1871) only 91 ft. was built during the first 12 months but in the new Admiralty Harbour 400 ft. of work was constructed in the same period of time showing how great was the advance in harbour engineering in the meantime. In the new Harbour over 1,920,000 tons of masonry were used and as the blocks averaged about 30 tons in weight, the total number required was about 64,000.

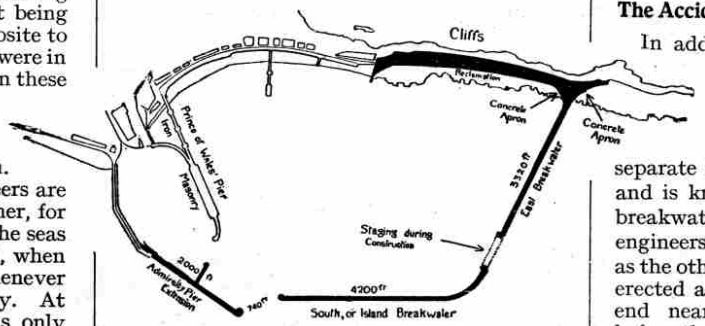


Fig. 2.—The Admiralty Harbour, Dover

The plan shows in solid black the works added recently, as described in the accompanying article

The Harbour works included the excavation of a portion of the cliff and it became necessary to build a retaining wall to protect the exposed chalk. This necessitated over 1,000,000 tons of blocks and masonry, in addition to that required by the breakwater themselves.

The Accident on the Island Breakwater

In addition to the East breakwater and the Admiralty Harbour extension another breakwater had to be constructed to complete the scheme. This breakwater is quite separate from the two former breakwaters and is known as the South-East, or Island, breakwater. In order to save time, the engineers decided to build it at the same time as the other breakwaters. To this end they erected a huge steel frame in the sea at the end nearest to the East breakwater, but before the frame was complete a great storm entirely destroyed it. Six months were required to remove the wreckage, so that instead of gaining time, time was actually lost.

After this disaster, the steel frame idea was abandoned. In its place the trackway used in the construction of the East breakwater was carried on temporary supports across the south-east entrance to the harbour to the Island breakwater. This enabled Goliaths to bring up the blocks for the Island breakwater from the block-setting yards and at the same time allowed the cranes to be withdrawn in bad weather.

(*To be concluded*)

Electricity—(*continued from page* 127)

again as soon as the circuit is broken. A dot is signalled when the lever falls back immediately after the click, and a dash when it makes a slight pause before returning.

Relay introduced by Morse

The strength of an electric current is greatly reduced by the resistance of a long wire, and if two telegraph stations are a very long way apart the current may not have sufficient strength to energise the electro-magnet of the sounder. This difficulty—a very serious one in the early days of the telegraph—was overcome by means of an instrument introduced by Morse and known as a "relay." This instrument consists of a very small electro-magnet that attracts a light bar, the movement of which closes the circuit of a separate battery at the receiving station. The feeble electric current works the relay and thus the strong current in the local circuit comes into play and operates the sounder.

German Electricians Puzzled

The following interesting story regarding the Morse Relay is told in Reid's "*Telegraph in America*":—

"The Morse relay could not be patented in Germany, and therefore could not, with safety, be exposed. In 1848 two young Americans had gone there with Morse machinery, and built a line from Hamburg to Cuxhaven, a distance of ninety miles, for the transmission of marine news. The line worked charmingly, the registers clicked out loud and strong at either end, but the relays were carefully concealed in locked boxes. The German electricians scratched their heads and wondered. Finally, Steinheil was sent forward to reconnoitre. He looked carefully around, and his keen eyes soon detected the locked boxes. He asked to see the locked boxes, but was courteously refused. So he returned and reported that the Yankees kept their secret locked, but that the action was magnificent. And when, at a later date, he did know all, he showed the grand stuff of which he was made. He gave Morse his hand, confessed himself beaten, and the two were friends for ever after."

Recording Messages

By modifying the construction of the sounder this instrument can be made to record the messages it receives. In its simplest form the Morse "inker," as it is called, consists of a small wheel fitted to the free end of the lever of a sounder, with an ink container so placed that the wheel dips into it when the lever is in the normal position. When the electric circuit is closed the lever moves just as in the ordinary sounder, but instead of striking against a stop it presses the inked wheel against a paper tape that is kept slowly and steadily moving forward by means of clockwork. The wheel continues to mark a line along the tape so long as the circuit remains closed, and according to the time during which the sending operator keeps his key pressed down, a long mark or dash or a short mark or dot is produced.

The Passing of a Great Engineer—

(*Continued from next page*)

at the Calcutta Mint. He made yet another important step in his life about this time, when he accepted the position of consulting engineer in India to the Railway Department, and this post he held until his retirement in 1888, at the age of sixty.

It would be impossible to give in these pages even a brief outline of his work during this period in India. That he was a busy man may be gathered from the fact that while he was in India an average of 200 miles of railway was opened each year—the total of one particular year reaching 1,100 miles!

During the Afghan War Molesworth saw much active service, and was nearly captured by the enemy on more than one occasion. In 1882 he was deputed to make an examination of the harbour works at Madras, where he again explored the bottom of the sea in diving dress. During the Burmese War he was ordered, after the capture of Mandalay, to make a survey for a railway from that place to Rangoon, and for the work done on this railway and on the North-West frontier he was awarded the Burma War and Afghan Medals. Finally, it is not surprising to learn that on his retirement he was created a K.C.I.E.

A Last Splendid Act

Returning to England, he settled down at the Manor House, Bexley, but his life thereafter was by no means inactive. His wonderful energy was continually urging him to undertake further work. In 1891 we find him, in compliance with a request made by the British East Africa Company, planning the route of a new railway from the East Coast of Africa to the Victoria Nyanza. Seven years later he was invited by the Foreign Office to visit the line and report on its organisation and progress. He promptly set sail for Africa, and though seventy years of age, carried out his inspection either on foot or on a solid-tyred bicycle!

Even this does not complete the story of his life. On the outbreak of the Great War, Sir Guilford, then in his eighty-sixth year, volunteered for home defence and actually commenced to serve. He was forced to retire, however, on medical orders. Nothing daunted, and urged by his splendid patriotic spirit, he volunteered in the following year as a munition worker, and was employed as a skilled mechanic in the Vickers Works at Crayford. For five months he worked daily from 9 a.m. to 4 p.m., but then his medical advisers again ordered him to retire. Nothing could be more fitting, after a long life of splendid achievement, than this unselfish and whole-hearted service to his country in the hour of her greatest need.

The Passing of a Great Engineer

The Late Sir Guilford Molesworth

THE recent death of Sir Guilford Molesworth has both deprived the world of one of its greatest engineers and terminated a very full and extraordinarily useful life. Guilford Lindsey Molesworth, the fifth son of the Rev. J. E. N. Molesworth, D.D., was born on 3rd May, 1828, and was thus nearly 97 years of age at the time of his death. Though Meccano boys may not be familiar with many details of his life, owing to his great age and to the fact that he retired from active work as long ago as 1888, yet many must have heard of Sir Guilford's well-known work published as "*Molesworth's Pocket Book of Engineering Formulæ.*"

A Famous Book

This became a classic among engineering books of reference, and now consists of 950 pages, although it contained only 220 when first published in 1862. Actually, Sir Guilford started his book many years before that date—in fact he had made a habit all through his life of writing down in a book anything that particularly interested him or appeared unusual. As may be imagined this notebook grew to a great size, and it was then that the idea came to him to print the data he had collected as a book of convenient size, so that it might be circulated and that posterity might benefit from his own experiences.

At the age of sixteen Molesworth was sent to the College of Civil Engineers at Putney. He is credited with saying later that although he left the College feeling perfectly satisfied that he had learnt all there was to know about engineering, he began to find before he had been very long in actual practice that there were *some* things that he did not know, and that as time went on the number of those things increased in a marvellous manner!

"And now," he concluded, "after a long professional career I have achieved a knowledge of my own ignorance, and a conviction that the education of an engineer is never complete."* This remark admirably shows Sir Guilford's attitude to his chosen profession, and may even contain the secret of his success!

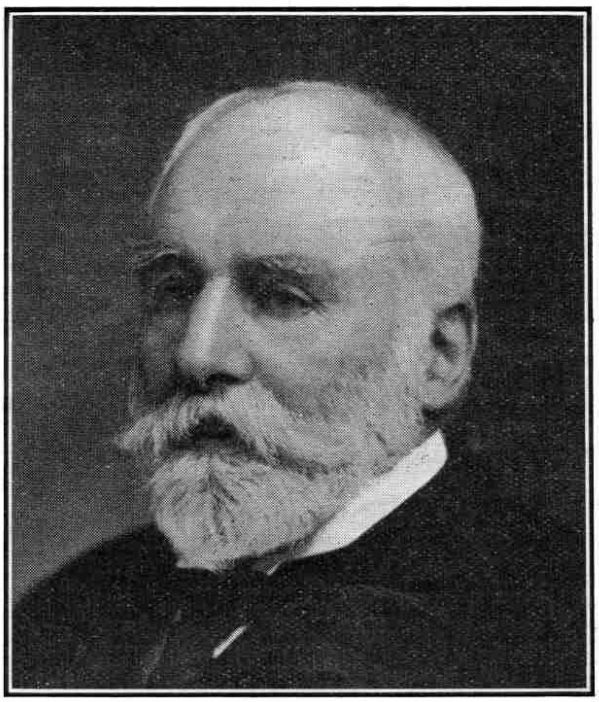
Millwright and Fitter

From the college he was sent as an articled pupil to Mr. R. B. Dockray, the Chief Engineer of the London and Birmingham Railway, and although still quite young was quickly made Assistant Engineer. His father then apprenticed him to Sir William Fairbairn, however, in order that he might gain practical workshop experience, and in Sir William's workshops at Manchester he was employed as a millwright and later as a fitter.

* "*The Life of Sir Guilford L. Molesworth,*" edited by his cousin Miss E. J. Molesworth.

At the age of twenty-one he was sent to Portugal to erect an engine for driving a cotton mill, and returning to England he built a 240 horse-power pumping engine to drain a deep coal mine.

Later, during 1849–50, young Molesworth acted as chief assistant in South Wales to Mr. Doyne, who had known him when he was on the London and Birmingham Railway. From here he was appointed Chief Assistant Engineer on the London, Brighton and South Coast Railway. At the outbreak of the Crimean War he accepted an important post in Woolwich Arsenal, which he held for a short time until going into partnership as a consulting engineer in London.



Courtesy ["*The Engineer*"

The Late Sir Guilford Molesworth

In 1859 his former chief in South Wales, Mr. Doyne, who had since become Chief Engineer to the Ceylon Railway Company, advised his directors to make Molesworth their Mechanical Engineer and Locomotive Superintendent. Molesworth, then only thirty-one, accepted the position and left England that year. In Ceylon a new railway had been proposed between Colombo and Kandy, but Mr. Doyne, dissatisfied with the survey and estimated cost, suggested the employment of a rope incline instead of an adhesion line. He was sent to England to consult Robert Stephenson in the matter, but Stephenson died before he could send in a report. Molesworth, acting as Chief Engineer while Mr. Doyne was away, meanwhile decided to make a survey of the proposed line himself. He found that by using a different route it would be possible to build an adhesion railway at a much less cost than the first estimate. For some time nothing was done however, and in 1861 Molesworth set sail for home. There followed a short period of comparative leisure, but in November 1862, he was recalled unexpectedly to Ceylon, for the Government of that country had decided to construct the Colombo-Kandy line according to his plans.

Molesworth Saves a Train

On his arrival he was told to proceed with the line—which, it may here be mentioned—was eventually completed for practically the amount of his estimate.

It was on this line that an exciting incident occurred that nearly cost his life, and perhaps the lives of many others. The Duc de Brabant, who was afterwards the King of the Belgians, had visited the Governor at Kandy and was returning to Colombo. The train in which he was travelling in company with a number of British officials was driven by Molesworth himself, and since there was no turntable available the engine had to proceed tender first. Whilst running at considerable speed down a steep gradient the engine rounded a curve, and Molesworth's horror may well be imagined when he saw, not far ahead, several large stones laying right across the rails! He realised it was impossible to stop in time, and that if he struck the stones at his present speed the train would most certainly be derailed, for the tender was not provided with a guard such as a locomotive carried. But he immediately seized his only chance, therein revealing his coolness and self-possession. He did not attempt to slacken, but instead opened the regulator to its fullest possible extent. With a roar the engine leaped down the incline at a tremendous speed, and reaching the stones thrust them aside with the force of the impact, and the train passed over safely. Many years later the Royal passenger was told—for the first time—of the narrow escape he had had!

Decimal Coinage for Ceylon

Soon after this, Molesworth was made Director-General of Railways and Director of Public Works in Ceylon, and this post, as may be imagined, entailed a great amount of work in all branches of engineering. Railways, roads, harbours, water-supply and irrigation schemes all claimed his attention. Whilst superintending the removal of rock from the bottom of the harbour at Galle, he made several excursions in diving dress 40 ft. or so below the surface.

A further valuable service he rendered the island was the institution of a decimal coinage in 1871, when he personally designed the first set of coins to be struck

(*Continued on previous page*)

The Story of Metals

II COPPER.

IN last month's issue we gave an outline of the early history of copper and of the value and uses of the metal. We must now turn to the actual mining of the various copper ores.

Vast quantities of copper come from the United States, principally from Montana, Michigan and Arizona. The Montana copper mines came into existence as the result of a rumour in 1880 that gold was to be found in the Butte district. This rumour was immediately followed by the usual rush of prospectors, but very little gold was found. Copper was there in abundance, but the prospectors were not interested in this metal, and as soon as they found that there was no gold they quickly left in disgust to try their luck elsewhere.

A Far-Sighted Irishman

One man alone, an Irishman named Daly, realised the immense value of the copper ore, and when the prospectors began to depart he bought for next to nothing the three biggest copper claims. He was regarded as a lunatic for doing so, but he knew what he was about, and from these three claims were developed three of the greatest copper mines in the world, one of them being the famous "Anaconda" mine.

Daly lost no time in beginning mining operations. He obtained the necessary labour and drove underground galleries in all directions, extracting the ore as it was found. From a small beginning the number of miners employed increased to 10,000 or more, and the quantity of ore produced reached the immense total of some 15,000 tons per day.

Fumes from Smelting Plant

Daly's next step was to provide means for smelting the ore from his mines, and in 1883 he established smelting works at Anaconda, about a mile from Butte. At first this smelter was able to keep pace with the amount of ore produced, but before long another and considerably larger plant had to be set up on a neighbouring hill.

World's Production of Copper in 1923

	Metric Tons*
NORTH AMERICA	
United States	684,540
Mexico	54,920
Canada	36,496
Cuba	10,853
SOUTH AMERICA	
Bolivia	10,654
Chile	203,256
Peru	43,856
EUROPE	
Austria	1,540
Germany	17,000
Norway	8,000
Russia	2,000
Spain and Portugal	51,815
Sweden	4,700
Serbia	6,837
ASIA	
Japan	63,790
Rest of Asia	1,000
AUSTRALASIA	17,946
AFRICA	73,909
OTHER COUNTRIES	7,000
Grand Total	1,300,112

World's Consumption of Copper in 1923

United States, 663,262; France, 117,000; Great Britain, 95,000; Germany, 93,100; Japan, 70,200. Total:—1,210,362 tons.

*A Metric ton = 2,204.6 lb.

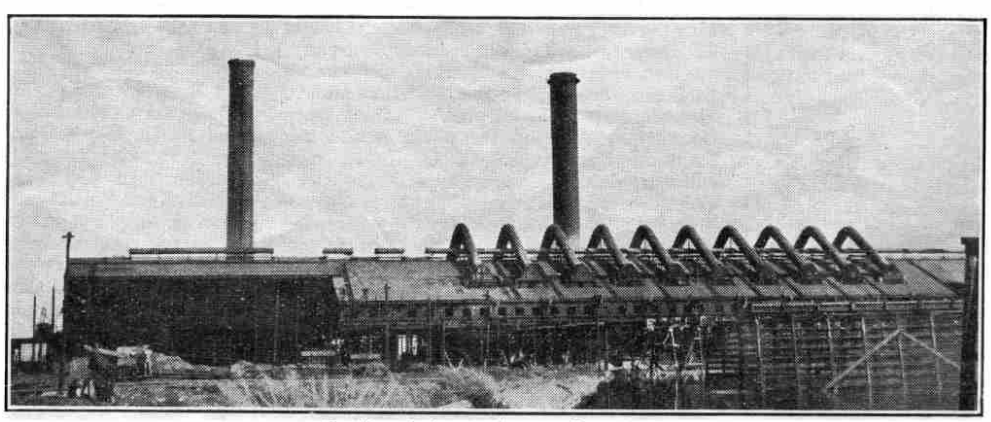
Daly's interests at Butte and Anaconda were subsequently acquired by a Copper Combine for the enormous sum of £10,000,000, and smelting developments proceeded with great rapidity until the plant became the largest of its kind in the world.

This development was not carried out without difficulty. In the process of smelting copper, clouds of fumes are given off which have a most disastrous effect upon the surrounding vegetation. It was not long before the agriculturists of the district began to complain that their crops were being severely damaged and that their cattle also were suffering, and they set up heavy claims for damages. A prolonged legal struggle ensued which cost the copper combine enormous sums of money. The attempt of the farmers to have the smelting operations stopped was unsuccessful, but on the other hand, in spite of all efforts on the part of the combine, it was not found possible to eliminate entirely the nuisance of the fumes.

Mining Low-Grade Ore

Copper mining on a vast scale is also carried out at Bingham in the State of Utah. Bingham was formerly famous for its gold and silver mines. After a time the rich lodes became worked out, and although everybody knew that there was copper in abundance, the ore was of such low grade as to be considered unworkable at a profit. Presently a mining engineer of specially keen intelligence came along and saw that this ore, low grade as it was, could be made to pay if treated on suitable lines, and after buying out the claims of the gold company he commenced work in earnest. A new company was formed and was so successful that in about 15 years from the commencement of operations the shareholders received no less than £5,000,000 in dividends!

The miners cut their way into the hillside on a gigantic scale by means of powerful steam shovels, the whole operation being on the lines of quarrying rather than mining in the ordinary sense of the term.



In the Arizona Copper Country

Our photograph shows the Copper Queen smelter at Doughlas, Arizona, where vast quantities of ore are smelted every year