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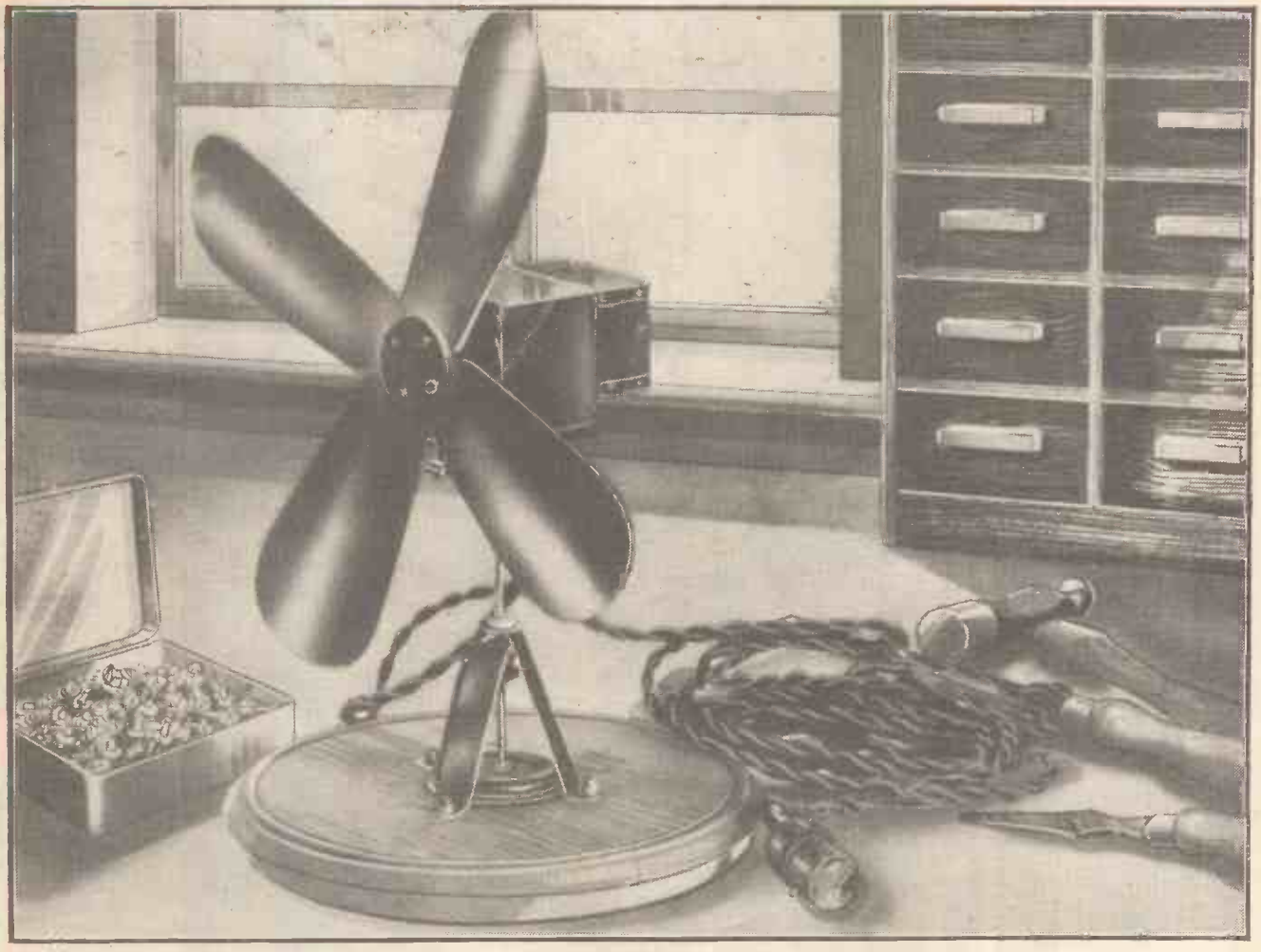
PRACTICAL MECHANICS

9D.

EDITOR : F. J. CAMM

MAY 1949



AN OSCILLATING ELECTRIC FAN FOR THE HOME OR WORKSHOP (See page 232)

PRINCIPAL CONTENTS

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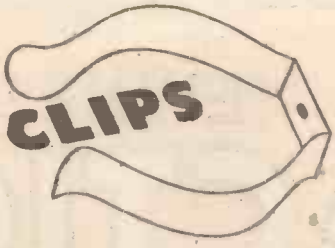

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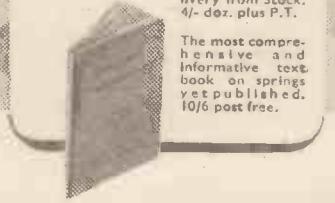

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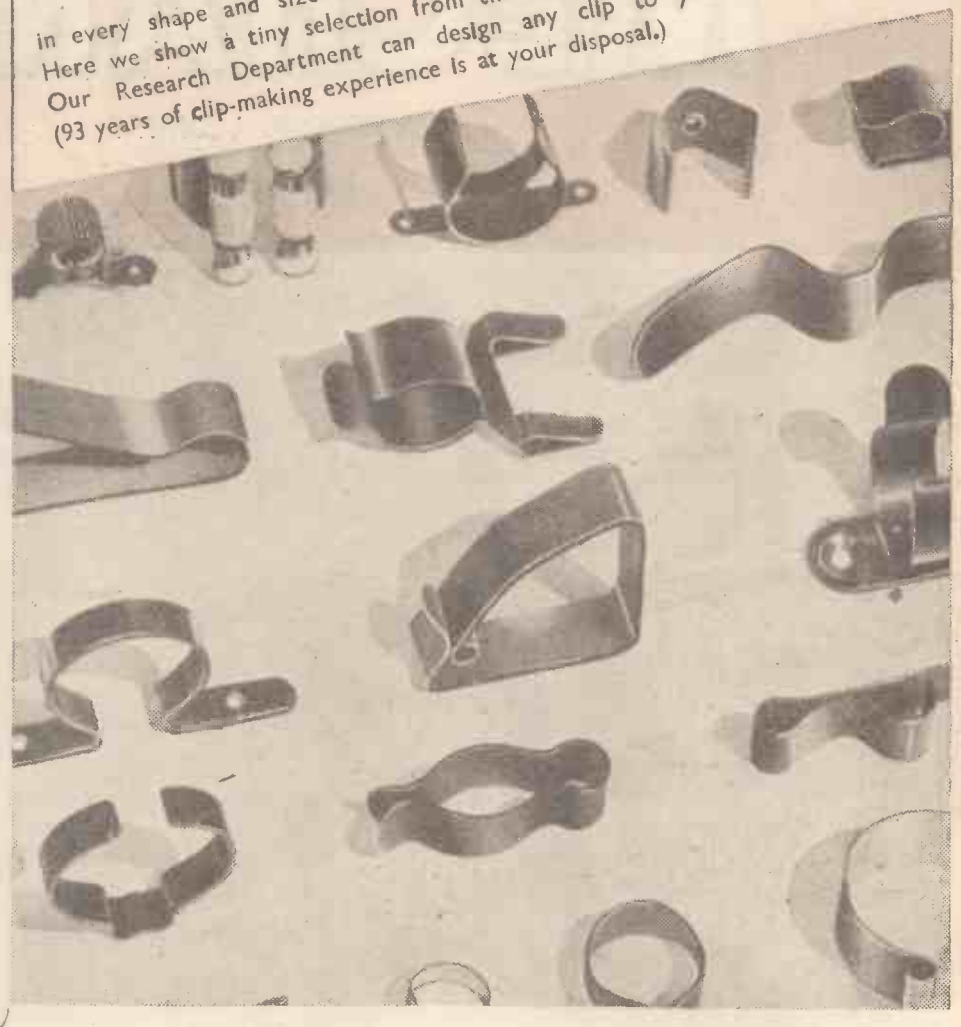

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor: F. J. CAMM

VOL. XVI MAY, 1949 No. 187

FAIR COMMENT

By THE EDITOR

Model Engine Developments

IN the early days of model aeronautics in this country, when the controlling body was the Kite and Model Aeroplane Association, the only source of power we had was the twisted skein of elastic, first used by the Frenchman Penaud in 1871. The disadvantage of this form of motor power was that the power was not constant, being greatest when fully wound and gradually diminishing to zero towards the end of the flight. Thus it was impossible so to adjust the model that it remained stable throughout its flight. When the centre of thrust passed through, as it should do, the centres of pressure and gravity, the model would be over-elevated at the commencement of its flight, and to correct this, and to allow for the initial burst of thrust, models were under-elevated. Hence, at the end of the flight, they had a very steep gliding angle. Downthrust was not used then.

Miniature petrol engines were not produced until the early part of the present century, and one of the very first was the Bonn-Mayer, which was a Vee-twin engine of 30 c.c. This necessitated a very large and heavy model, and in spite of the fact that D. Stanger made the first record for an engine model with a flight of 51 seconds, a record which stood for many years until it was beaten by Col. Bowden, that form of power did not catch on. A few years later I designed a 15 c.c. horizontally opposed twin-cylinder two-stroke petrol engine with flywheel magneto. Then, in America, several firms commenced to produce engines of 10 c.c., 6 c.c., 3 c.c. and 2 c.c., and American aero-modellers deserted elastic for this new power unit.

It was thought that 2 c.c. was the ultimate, until some years ago I produced a highly successful design for a 1 c.c. engine for which we sell blue prints. The Americans invaded the English market with their engines, and petrol models became extremely popular. Many thousands of these engines, including the Brown Junior, the Baby Cyclone, the Gwin, the Ohlsson and the Dennymite, were sold in this country; *some are still on sale and most are still in use.*

This country followed the lead of America and developed a large number of miniature petrol engines of from 1 c.c. to 15 c.c., with the result that the importation of engines from America practically ceased; apart from the question of import restrictions, English aero-modellers were able to purchase from English manufacturers.

The difficulty has always been the ignition system, which often weighs more than the engine. Such engines were temperamental and running on a mixture of petrol and oil—petroil—they needed a nicety of carburetter adjustment which was often outside the ability of amateurs. Carburetters were of the surface type.

The Swiss were the first to produce miniature diesels, and that marked an important step in model aircraft progress. These engines eliminated the need for starting accumulators, change-over switches and dry batteries, as well as that most troublesome unit, the midget ignition coil. The miniature diesel engine was a complete prime-mover in itself, depending upon self-ignition due to compression and dispensing entirely with all electrical equipment. These engines run on a mixture of ether and lubricating oil, and they are remarkably reliable and easy to adjust.

This country commenced from that point to produce miniature diesels, and just as it was thought that finality had been reached the Americans commenced to produce the new glow-plug ignition engines, which have certainly taken America by storm and practically killed the manufacture of petrol engines and diesels. We shall shortly be producing the glow-plug engines in quantity.

In the meantime one or two firms are marketing CO_2 engines, operated, of course, by carbon-dioxide. There is nothing new in this; it is indeed older than any other form of power unit and was first marketed by Fieux in France in 1908. I still have one of these engines which operated from a Prana sparklet bulb, as used in soda syphons. The duration of run, of course, is only a few seconds. They had a vogue for about two years. An effort was made to revise this type of engine in 1932 when the Japanese took one of my designs for such an engine, as published in the columns of *Aeronautics*, and exported a fair number of these engines to this country.

Now a few of such engines are being offered on the English market as if they are something new! I draw attention to these facts because a reader of my new book, *The Model Aeroplane Handbook*, objects that it does not deal with CO_2 engines! For his information, and that of other readers who may be similarly misguided, may I point out that there is no difference between a CO_2 engine and a compressed-air engine. There is a complete chapter in my book on compressed-air engines, and these may be operated equally well by steam, by compressed air, by carbon-dioxide or by dry ice. When my book went to press many of the new engines had not made their appearance, and diesels were just beginning to become popular. These latter are, of course, dealt with.

The glow-plug engine is similar to the diesel in that it does not carry electrical equipment, but in many other respects it resembles the diesel, although it uses a somewhat higher compression ratio. To start it, however, compression alone is insufficient. A tiny plug is fitted into the cylinder head and an accumulator is needed for starting. A lead is taken from one accumulator terminal to the plug and another to "earth," which is any part of the engine. This heats the plug up and is sufficient to ignite the initial charge. As soon as the engine starts, compression is sufficient to keep the engine going.

All miniature petrol engines are secured to their bearers by means of flanges on the crankcase. Provided therefore that the power of the engine is as specified it matters not whether the engine is a diesel, a petrol or a glow-plug.

Concessions to Inventors

THE Inland Revenue have recently announced a decision which will be of great interest to inventors. It is that reasonable awards for suggestion schemes are not liable to income tax unless the suggestions are part of the employees' regular duties. Most works have a suggestions box into which employees are encouraged to drop suggestions for improved methods of production, economy in the use of materials, or for improved devices. Those suggestions which are adopted bring a small financial reward to their creators.

Plutonium

THE announcement that we are producing plutonium in this country is one of great importance to science. It is being produced at the Atomic Research Department at Harwell. Hitherto, plutonium has been listed as one of the missing elements according to Mendeleef's periodic law. Plutonium is made from uranium, and the interesting question arises: if uranium is an element, that is, something which is indivisible, how is it possible to make another element from it?

Prize Essay

THE Council of the Royal Society of Arts has awarded the prize of £50, offered last year under the Thomas Gray Memorial Trust for an essay on "The Applications of Radar to Navigation," to Captain J. Klinkert, F.R.Met.S., Assoc.I.N.A., Extra Master, at present serving as assistant lecturer at the Sir John Cass Nautical School, London.

In recognition of the high standard of the essay placed second by the assessors, the Council has also awarded a special prize of £10, in addition to that originally offered, to Mr. Digby Jones, chief officer in the service of Messrs. Alfred Holt & Co., Liverpool.

An Oscillating Electric Fan

Constructional Details of a Useful Appliance for the Home Workshop

By F. G. RAYER

The completed electric fan with connecting flex and plug.

THOUGH this fan was constructed for use in a small workshop from a 32-volt supply it can equally well be adapted for use with other voltages available from either batteries or mains. The method of construction does, in fact, lend itself readily to modification, especially in the size of the finished unit.

The motor should be obtained first because the dimensions of some of the other parts will depend upon this. Many different types of motor are now readily available, as an examination of advertisements in PRACTICAL MECHANICS will show. A type should be chosen which is suitable for the supply to be used; in addition it should be quiet running, and not consume excessive current. There is no need whatever for a large motor, one about 2in. by 2in. by 3in., including spindle, being powerful enough.

Fan Blades

To simplify balancing four are used, and Fig. 1 shows the dimensions. Aluminium sheet 18 or 20 S.W.G. is satisfactory, and all the blades should be cut exactly the same size. The edges should be filed smooth and then rounded slightly. Each blade should then be bent in a gentle curve for the whole of its length to increase rigidity.

Two discs of 18 S.W.G. brass 1¼in. diameter should now be centrally drilled so that they are a push fit on the motor axle. Four holes are now drilled through these discs and through the narrow ends of the blades so that the latter can be mounted between the discs by means of four 4 B.A. bolts. The 90 deg. angles of the blade-ends should be brought closely together so that all the blades

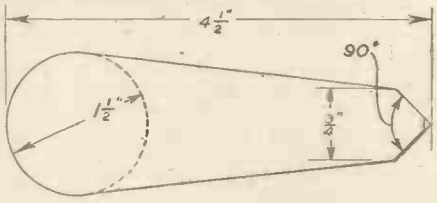


Fig. 1. — Dimensions of fan blade.

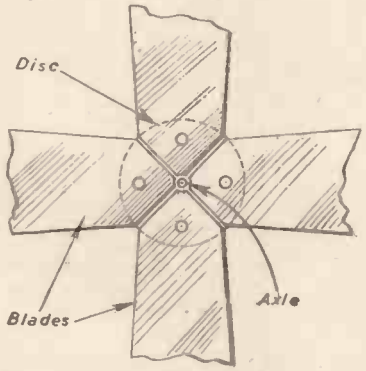


Fig. 3.—Method of securing inner ends of blades.

are secure, as shown in Fig. 3, which shows the fitment before the top disc is placed on, the blades being sandwiched between the discs. The completed fan is fixed to the spindle by soldering.

The motor should then be held in the hand and momentarily connected to see which way it runs. The four blades are then bent about ¼in. forward on the trailing edges so that the air-stream created is forward.

It will be found that a fair degree of twist will give more silent running as speed is reduced. The twist should be slightly more near the spindle because the periphery speed of the blades is higher.

Stand

This is made on the simplest lines and is shown in Fig. 4. The base should be at least 3in. square, and a 5in. length of 3/16th or ¼in. diameter rod supports the motor.

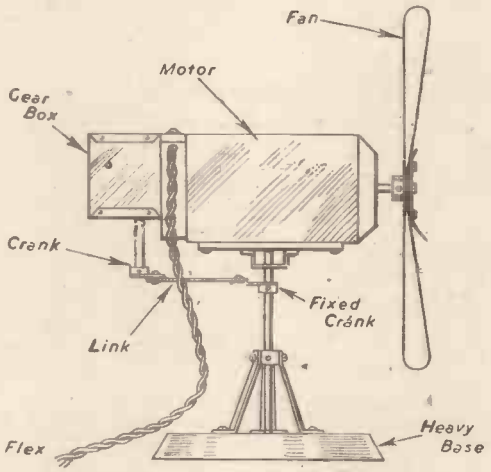


Fig. 4.—Side view of the fan showing the rocker mechanism.

Stays help to hold this firm, and it is secured so that it cannot rotate. There is no point in mounting the motor higher than necessary.

A bearing bent up from 18 S.W.G. metal is bolted to the motor base-plate (see Fig. 5). The size of the latter will depend upon the motor. If the motor has no fixing holes a

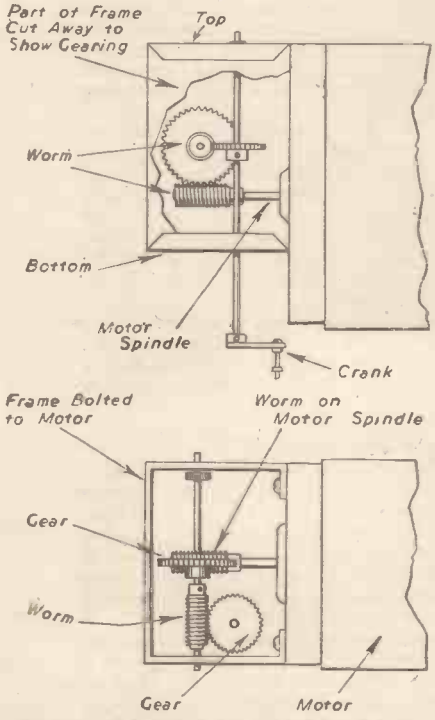


Fig. 2.—Side view and plan of gear box.

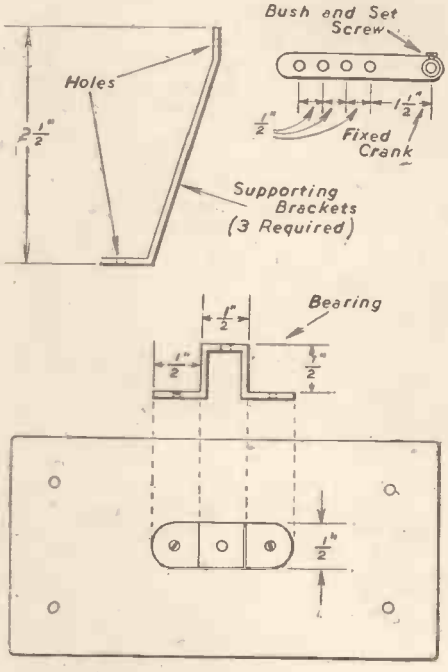


Fig. 5. — Details of brackets, crank and base-plate.

metal strap should be cut to pass completely round it, and if the motor has a round body the base-plate should be curved to correspond so that a proper fit is obtained.

The bearing should be placed centrally so that the motor and fan will balance. Excessive wobble should not be allowed, and the base must be heavy enough to prevent the back-thrust of the fan toppling the whole unit over.

Rocking Mechanism

A double set of worm gearing is necessary for this (see Fig. 2), and the necessary parts may be bought new or taken from a broken speedometer or other mechanism. The total ratio is not particularly critical, but should be in the neighbourhood of 500 or 1,000 : 1. (The ratio of one gear should be multiplied by the ratio of the other to find the total ratio. *E.g.* two gears with 30 teeth would provide a total ratio of 900 : 1.) If it should be found that the fan oscillates too rapidly then the gear ratio must be increased, or the speed of the motor reduced by increasing the angle of the blades.

A framework is made to bolt to the motor and the size of this, together with position of holes, must depend upon the actual parts used. Bearings for the vertical shaft are provided by the top and bottom of the gear box, secured by small bolts (6 B.A.) tapped into a small flange and the edges of the larger frame.

Make sure the gears run smoothly and apply grease to the bearings and worms before fixing the top of the gear box on.

The crank fixed to the bottom of the vertical shaft should have a throw of about 1½in. A link goes from this to the fixed crank (see Fig. 4), and by pivoting this link in any of the four holes provided (Fig. 5) the degree of oscillation of the fan can be adjusted. The link can be ½in. wide, cut from 20 S.W.G. metal. A length of about 2½in. should do, unless the motor is large, but no difficulty should arise in determining the actual length necessary once the motor is fitted up.

When everything is satisfactory all the nuts and bolts in the fan and gear-box should be painted with a penetrating, quick-drying varnish to seal them against working loose. The fan should be placed on a shelf. If on the bench it is best to bend up a guard from ½in. wire-netting.

No switch is included because the fan is brought into use by inserting a plug connected to the twin flex into a supply point. A switch could be fixed to the base or wired up anywhere, as convenient.

Making Blueprints

How to Use Ferro-prussiate Paper for the Reproduction of Drawings

By J. BOYLAN

OF the several methods of copying drawings, charts and plans, ranging from the "Hectograph" to the more modern Photostat, the blueprint process, using ferro-prussiate paper, still excels in giving an unlimited number of true, well-defined, and lasting reproductions from one master tracing. Expensive apparatus is available to carry out the printing, but excellent results are possible at little cost, using the minimum of equipment.

The process itself is similar to that of printing photographs from transparent negatives; a sheet of sensitivised blueprint paper is screened by a tracing drawn on transparent paper or cloth, exposed to the light for a predetermined time and finally fixed. The action of the light on the treated surface of the paper causes a chemical change, with a resultant change of colour when treated with water. Before exposure the active side of the paper is a very light shade of green, and when processed the unscreened paper turns blue, while that shaded by lines on the tracing remains white. An application of intensifier will produce a deeper shade of blue.

The intensifier in powder form and the blueprint paper, supplied in rolls from 30in. by 20yds., are obtainable through any drawing office suppliers, and the material cost per print, 2ft. by 2½ft., is about 3½d.

Printing Frame

The essential piece of equipment is a frame of suitable size recommended to be 32in. by 26in., to take the full width of the paper; the front of the frame is of glass or Perspex, to which the tracing is fastened on the inside; a hinged panel with rubber or felt packing can be closed to hold the blueprint paper against the tracing and glass (Fig. 1). A light, even pressure over the full area is necessary; any tendency for gaps to form between the tracing and the paper will cause blurred prints, and should be corrected.

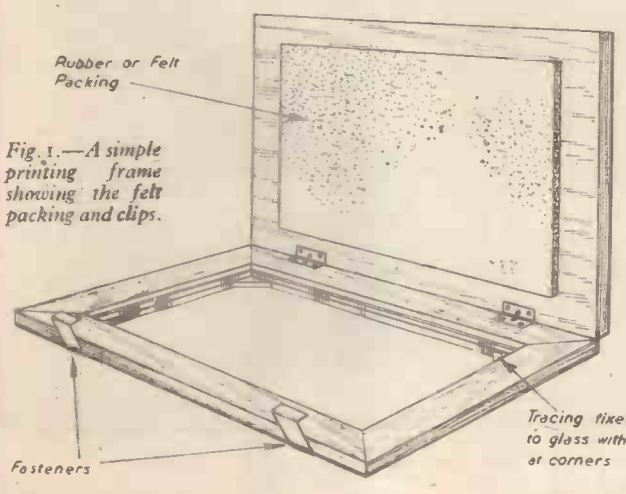


Fig. 1.—A simple printing frame showing the felt packing and clips.

A picture frame modified with a hinged back, packing and fasteners, is perfectly satisfactory for the job.

A bath to take the print and to hold about 4in. of water, and a clean sheet of plywood or other material to back the wet prints while they are sponged down with the intensifier solution, are the remaining items of equipment required. For ease of stowage when not in use, the bath should be of a size to accommodate the printing frame.

The drawing required is copied, or drawn direct on to the tracing cloth or paper with black drawing ink; a light dusting of french chalk will overcome the apparent greasiness of the tracing cloth. The overall size of the tracing is made larger than the required finished size of the blueprint, which can be indicated by corner marks to facilitate trimming after processing. The frame must be clean and dry, and the tracing mounted on the inside, using a small piece of adhesive tape at each corner of the extra border.

The blueprint paper should be handled in subdued light, and if it is intended to keep some of the paper on one side for future use it is best to cut the roll up in a darkened room, using faint red light. The sheets of cut paper should be put in bundles of five or six, each bundle being carefully wrapped in brown paper and stored away from the light until required for use. Scraps of paper should be kept to provide for exposure tests.

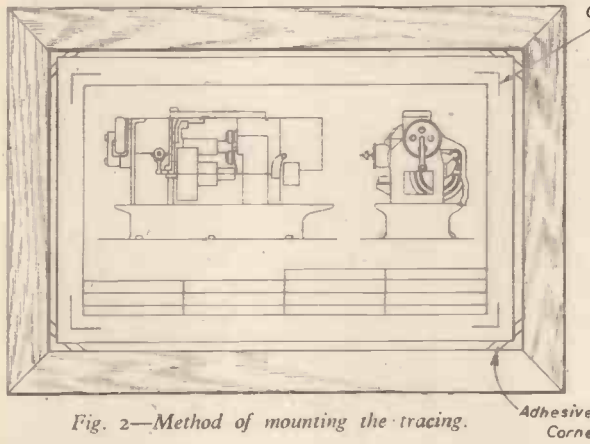


Fig. 2—Method of mounting the tracing.

The instructions for mixing the intensifier are given on the outside of the carton.

Daylight Printing

Daylight printing requires a bright, sunny day, and it is necessary to find the correct exposure time for prevailing conditions and different speeds of paper. A strip of unexposed paper is placed between the pages of a book, leaving a small portion exposed to the sunlight; every five seconds the strip should be pulled out about ½in. from the book. After a minute the strip of paper is removed from the direct light and washed in clean, cold water. It will be found that there is a time giving the maximum intensity of colour, and this is given by multiplying the number of zones from the first to the maximum by five seconds. If no fading occurs up to one minute a further test is necessary, using a longer interval until fading occurs. A further allowance of 15 per cent. is added for the tracing paper. For extra rapid paper the best time for daylight printing varies between 20 and 30 seconds.

The frame is now loaded with the blueprint paper, ensuring that it is correctly positioned in relation to the tracing (Fig. 2), and then exposed to the direct rays of the sun for the required time.

Washing and Intensifying

At the end of the exposure the frame is removed from the light and the exposed print removed and washed in water; the print will show up immediately and can be taken from the bath and spread on the board, while the intensifier is applied with a small sponge or soft swab; an even covering of the solution is necessary.

The intensifier solution can be left on for about 3 minutes, after which the print is thoroughly washed in water and pinned up to dry at room temperature. The prints now require trimming and are then ready for use.

Wind Tunnels—3

Further Technical and Operational Details

By H. E. HUTTER, A.M.I.E.E.

(*Continued from page 141, February issue*)

A LARGE proportion of the work done on model testing is a determination of aerodynamic characteristics of complete 'planes and parts thereof. Under these conditions lift and drag can be readily determined, but the behaviour of the machine under the resultant forces imposed by its own power plant cannot be determined. A method of doing this is to incorporate in the 'plane a power plant of suitable type, and for this purpose the electric motor is the most popular.

The model naturally has to be an exact scale model and should this for example be 1/10th full size the propeller will also be 1/10th the diameter of the actual propeller. Therefore its speed must be 10 times the normal speed, in order to maintain the model propeller tip speed the same value as the full scale unit. Should the proposed propeller speed be 900 r.p.m. then the model will have to run at 9,000 r.p.m. with a power requirement inversely as the square of the model size.

The design of a motor of this type is very specialised and invariably is of the high-frequency type. The main difficulty is the extreme limitation of space which usually occurs. As an example, utilising the 1/10th scale, and assuming a nacelle frontal diameter is to be 40in., then the model will be a mere 4in. Further, assuming that an 1,800 h.p. engine is to be installed, the problem is to produce an 18 h.p. motor with a diameter of 4in. Cooling methods effect serious limitations, as the employment of air cooling would mean its discharge as a jet and consequent effect on the accuracy; water cooling is thus usually employed. Some very interesting models have been made with speeds as high as 80,000 r.p.m. for 1/10th h.p. with a body 1¾in. diameter rising as high as 3,000 h.p. at 2,400 r.p.m. with a diameter of 29in.

Supply of power to the models is by means of variable frequency alternators or frequency converters, and a typical range of frequency would be from 60 to 450 cycles, and the provision of several sets enables a number of models to be run at the same time under different conditions. Aerodynamic considerations demand an accurate knowledge of the power delivered by these motors, and for this purpose measurement of the electrical input is taken as a basis, the motors being calibrated on a dynamometer, and the watt meter being calibrated accordingly.

The supporting of the models inside of the tunnel is done in a number of different ways greatly depending on the choice of the tunnel operators. The two fundamental features of any system are the provision of means of supporting the model and the measuring of the forces and moments acting on this model. The support of wing sections and similar components can be satisfactorily done by using a ring supporting system. This consists of a large ring completely around the working section with two face plates for model support on the horizontal centre line and two on the vertical centre line. Fig. 14 shows the application to a wing section supported from a single position, and Fig. 15 wing and nacelle supported from two positions.

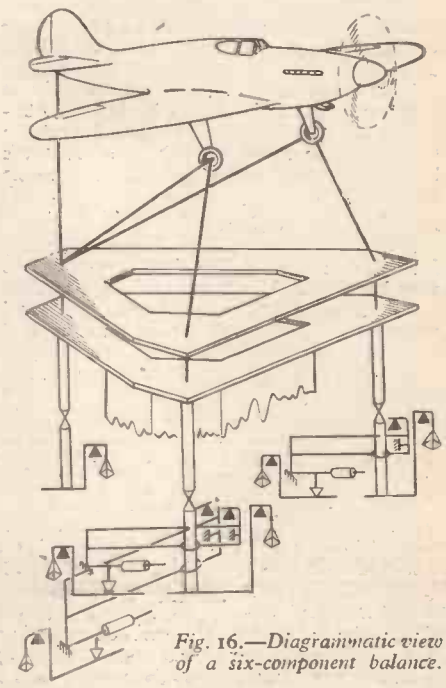


Fig. 16.—Diagrammatic view of a six-component balance.

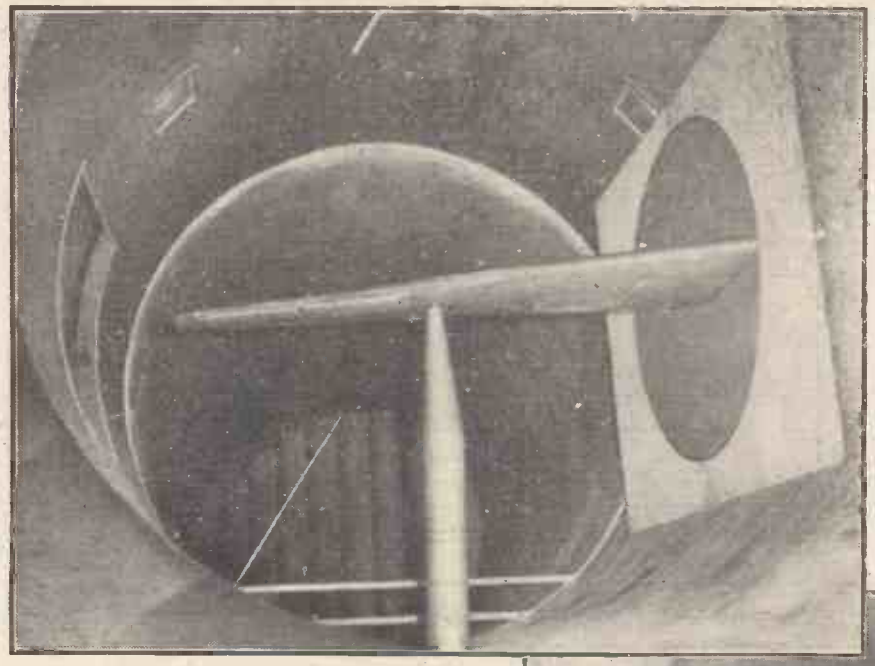


Fig. 14.—Model of a wing section in a wind tunnel.

Three-point System

The method most commonly associated with all wind tunnels is the three-point system, in which the scale model is supported by three struts. Two of these are vertical arms attached to points on the wing and the third one is attached near the tail. These struts being supported from the balance system, any force or moment transmitted by the model as a result of the airstream is automatically applied to the weighing system. By

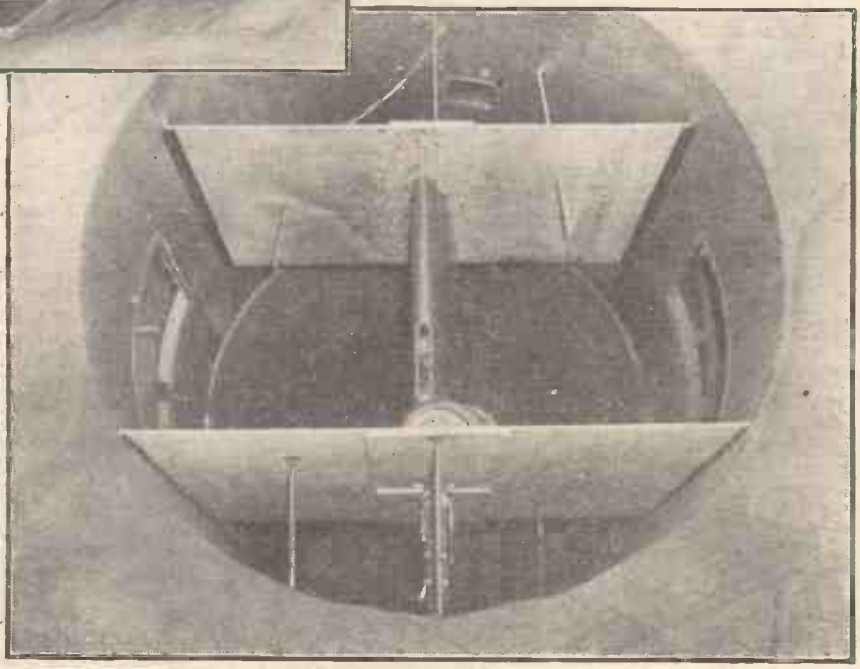


Fig. 15.—A wing and nacelle in a wind tunnel.

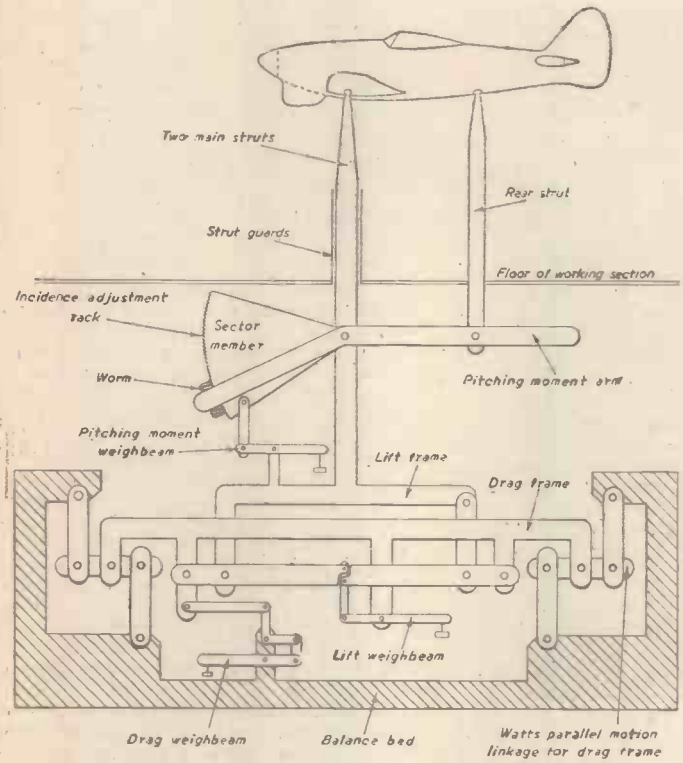


Fig. 17.—Diagrammatic view of the R.A.E. balance.

the provision of remote controls the attitude of the 'plane can be changed whilst actually in the tunnel under test. The total angles of attack of over 100 degs. are usually possible.

A third type is termed a strut support system and in this the tail strut is removed and the main trunnion arms are replaced by two other arms each having a double strut at the top. The model is connected to these systems and by making the rear struts remotely adjustable the model can be adjusted as to angle of attack whilst undergoing test. The angles of attack are much smaller than the previous method, and the model cannot be changed as regards yaw.

The measuring system in all cases is an exceptionally fine piece of work due to the very fine limits of accuracy which are obtainable. Quite frequently lift forces of 5,000lb. and moments of the order of 15,000 lb./in. are measured to an accuracy of ½ per cent. of the load or 1/10th of 1 per cent. of range, whichever is the greater.

When supports are used for the model it is necessary to determine the tare drag of them and the effect of the supporting system on the airflow around the model, and for this purpose a so-called image system is employed. This consists simply of an inverted frame supported from the working section ceiling on which are attached main and tail strut wind shields, which are an inverted duplicate of those already in use for the model. It will be noted that the actual control struts are provided with wind shields serving no purpose in the measurement but serving to reduce the airflow disturbance, and it is these wind shields only which are employed in the image.

A wide variety of balances have been worked out, as can be expected from consideration of the number of types of tunnels which have been mentioned. In the case of an Eiffel tunnel unit the whole of the equipment will be mounted inside the test chamber and not subject to pressure differences. A diagrammatic view to show the principle of such a six-component balance is shown in Fig. 16.

Installing the Balance

In the case of return flow tunnels, there are two methods of installing the balance. It can either be mounted inside of the tunnel shell, when it will be entirely free of ground or tunnel foundations, or, on the other hand, the expansion or contraction of the tunnel caused by pressure air temperature changes causes considerable difficulty in maintaining the unit exactly level inside. When the conditions inside are of varying density all the controls of every type must be brought through the shell and the pressure tight against these varying conditions. The balance may also be anchored externally to the tunnel with a view to eliminating any troubles due to external vibration. A typical foundation block for this purpose would weigh nearly 100 tons and be set in a pit of springs, provision being made for individual adjustment to them for lifting and statically levelling the unit. The mounting of the balance with the model in the airstream has

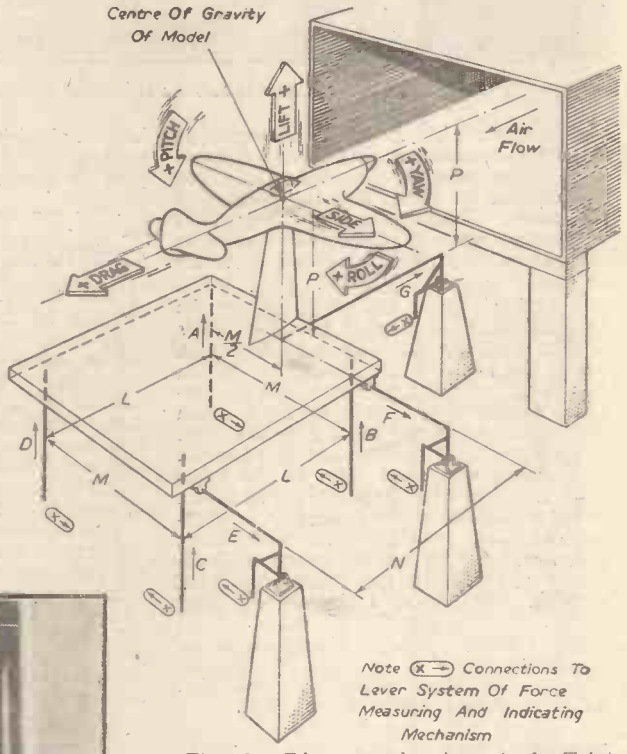


Fig. 18.—Diagrammatic view of the Toledo balance.

the effect of providing an overturning moment to this block, despite its great weight, and means have to be provided to limit all possible motion. Normally a limit of about 5/100th of an inch would be fixed and further movement mechanically restrained. Means are provided to adjust the natural frequency of the block so that no trouble can be caused this way.

It has already been mentioned that a six-component balance is employed and these components are lift, drag, cross-wind force, pitching moment, rolling moment and yawing moment; and all can be measured by means of direct readings without any calculation.

An elementary diagram of the principle employed in the R.A.E. high-speed tunnel balance is shown in Fig. 17, and the balance consists of a framework mounted in a suitable manner so that all vertical and horizontal forces applied to this framework

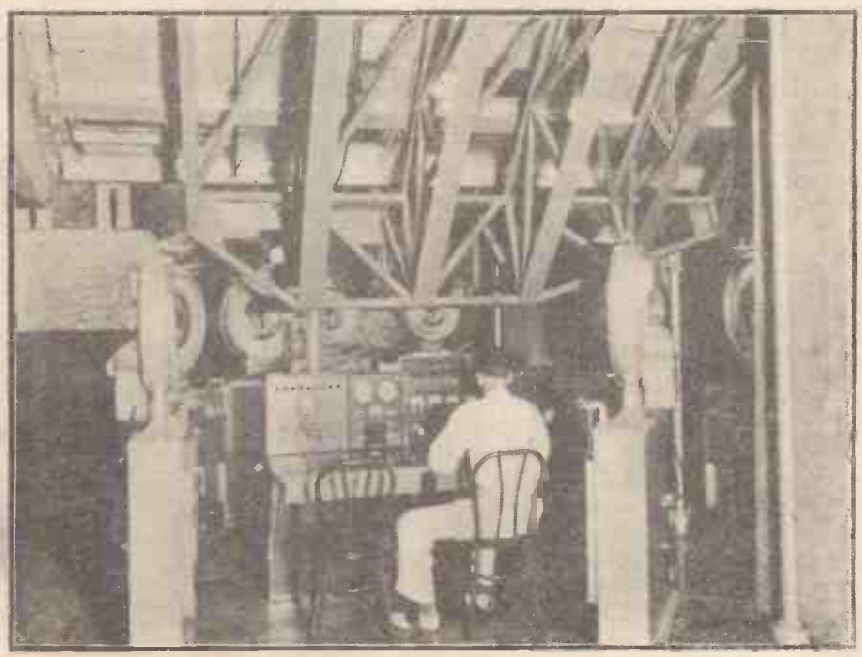


Fig. 19.—Balance control room of the 12ft. tunnel.

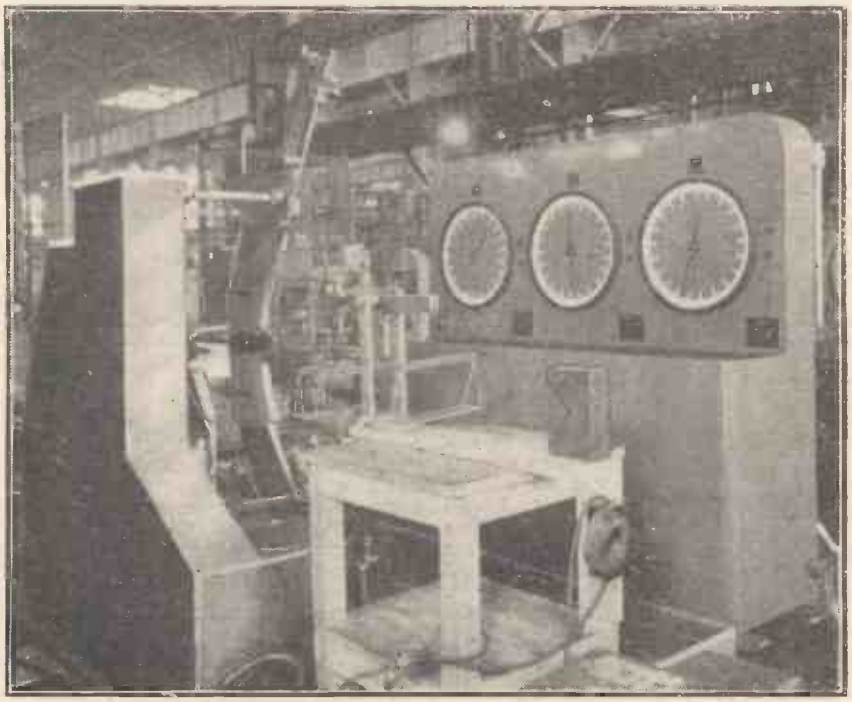


Fig. 20.—Hydraulic balance unit under construction.

can be measured. Actual measurement of forces and moments are measured by means of weighing arms, the rider weight of which is controlled by means of a motor-operated lead screw. Each motor is provided with a Selsyn transmitter to give a direct reading in the control-room of the position in which the actual balance is situated.

A further type of balance employing the more conventional type of weighing means is that made by the Toledo Company, in which the model is mounted on a floating framework coupled together so that the tendency of the 'plane to react in any direction affects the lever system which gives the direct indication of the measurement to be made. In common with other types all the forces and movements which regularly act on such a model are measured simultaneously. Varying conditions possible in an aerodynamic experiment call for a scale measuring loads lifting as well as the usual downward pressure. In Fig. 18 a diagrammatic view is shown of the lever system employed. A point to notice is that there are none of the usual knife edges or pivots on the floating sections, which are suspended from their guides by means of flexible steel tapes.

Method of Weighing

The method of weighing is to employ double pendulums which move into such a position that they automatically counterbalance the load on the scale platform. The final connection links to the indicating heads are illustrated in Fig. 19.

A method widely employed in a number of the largest tunnels employs a hydraulic measuring system which replaces all the balances of the beam type which are otherwise used. The main element of this balance consists of a hydraulic unit of the cylinder and piston type, the piston being coupled to the strut or other measuring unit; any force exerted on this strut is balanced by a hydraulic pressure set up in the cylinder and any pressure change is transmitted to the indicating unit. Due to the elimination of all mechanical parts there is practically no inertia and limitation of the piston stroke for full movement is always less than 1/100th of an inch.

The peculiar nature of the loads on a balance of this type means that plus or minus readings will be required and for this purpose the piston is pre-loaded by means of a special spring unit; automatic means are also provided to counteract changes in volume through temperature. The piston unit being complete in itself, connections to the balance supports will be by struts in place of the movement parts used in balance systems. The maximum movement of any strut is only the same as that of the piston, so that a very rigid unit can be built up. The use of these pistons in different positions on the balance enables all the forces and moments to be individually measured.

The moments and other forces are indicated on dials, one for each load, and Fig. 20 shows a part of the weighting cabinet and the balance under construction. The hydraulic pressure set up by the movement of a piston operates a Bourdon tube which tends to displace a pivoted load plate. Any movement of this load plate is counteracted by means of an air-operated servo, the air entering through a simple jet orifice system, the servo balancing the hydraulic pressure already set up by a direct pull through a spring system which returns this load plate to its neutral position. The addition or subtraction of different loads can be arranged by grouping the different Bourdon tubes so that their final effort is exerted on the single load plate. The spring system employed for all the different elements is designed to have a linear characteristic between the deflection and the force acting on it, and it is the extension of this spring which finally controls the dial pointer by means of a rack and pinion, thus finally indicating the reading set up by the act of the wind loads on the hydraulic piston.

Cathode-ray Equipment for Locating Thunderstorms

THE location of a thunderstorm area can now be fixed with a high degree of accuracy up to a range of 1,500 miles by the use of special cathode-ray direction-finding apparatus known as "Sferics" sets, made by the Plessey Co., Ltd, Ilford, Essex, to the design developed by The National Physical Laboratory for the Meteorological Office. Sets have been installed at four specially selected sites controlled by the British Meteorological Service.

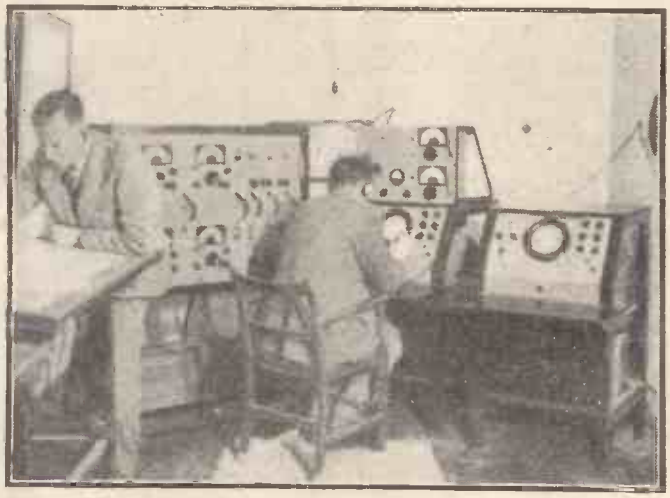
The apparatus at each station is accommodated in two huts, one of which houses the cathode-ray direction-finding (C.R.D.F.) equipment, consisting of power supplies, signal amplifiers and display unit. The other contains the aerial system, which comprises four multi-turn loops, six feet high, two of which are placed in a N-S line and two in the E-W line.

A compass scale is superimposed on the face of the C.R. tube for recording the direction of the impulse received from a lightning flash occurring in a storm area. Impulses received from a N-S or E-W direction would be picked up by the N-S or E-W aerials respectively, causing a bright line to appear momentarily on the face of the cathode-ray tube along the corresponding diameter of the scale. Signals from any other direction will give a line on the tube in an intermediate position.

The receivers operate on a frequency of about 12.5 kc./sec., equivalent to a wavelength of 24,000 metres, this being the frequency at which maximum energy is radiated by lightning discharges. Another reason for using this low frequency is the freedom from interference by commercial W/T stations.

The four observation stations are located at Dunstable, Bedfordshire; Camborne, Cornwall; Leuchars, Fifeshire; and Irvinestown, Northern Ireland. Dunstable is the control station of the four and is also, of course, the central forecasting station and communication centre of the Meteorological Office.

Observations are made simultaneously from the four stations 12 times daily, between 7 a.m. and 10 p.m. and the results are plotted at Dunstable on a special chart of gnomonic projection.



Equipment installed in the plotting room at the Meteorological Office, Dunstable, Beds.

Lens Calculations Made Easy

With the Aid of a Mechanical Model

By J. A. STORER, B.Sc.

THERE seems to be a common notion that lens calculations are difficult. They are, if you do them the hard, old way. But there is an easy way, too. It was first introduced and used by practical men. For a long time the theorists looked down on it as a rule of thumb, unfit for advanced work, but it is a mistake to despise the instinctive reasoning of the practical man; it may contain a touch of genius, and if a practical rule works well, there must be a theoretical reason for it. The "easy way" is no exception to this. It has now an unshakable mathematical basis to support it, and it is used with advantage for the most advanced work taught in the majority of the grammar schools of this country.

The first step is to understand in a practical way what lenses actually do. It is quite easy to make a mechanical model to illustrate this. The writer made one about 15 years ago and exhibited it at the Science Masters' Conference a year or so later.

The Mechanical Lens

(1) *The working drawing.*

Take a sheet of foolscap paper, place it horizontally, and rule a line the full length along the middle. In the centre of the line draw a section of a converging lens about 3in. high (Fig. 1). The horizontal line is the "*principal axis*" of the lens. On it mark the two "*focal points*," F, F, each 2½in. from the centre of the lens. On one side of the lens draw four evenly-spaced rays, parallel to the principal axis (say, .6in. and 1.2in. above and below). On the other side of the lens

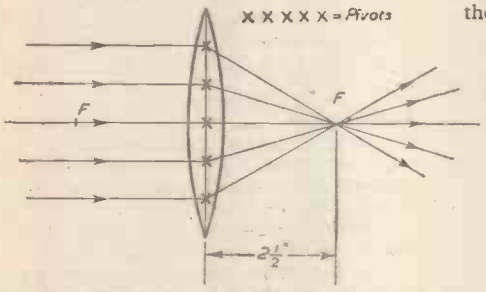


Fig. 1.—Working drawing for the lens model.

make all these rays pass through the focal point F, as shown.

(2) *The rays*

Each of the four bent rays must now be copied in some rigid material. Each must have a hole for a pivot at the point of bending. A fifth, perfectly straight ray may also be pivoted at the optical centre of the lens. Various methods will suggest themselves to readers. Perhaps the best is to make each strip out of two pieces of tin 1/10in. wide and 9in. or 10in. long. They should be joined at the required angle with a touch of solder. The result will be a ray 18in. or 20in. long, bent through a fixed angle and pivoted at the point of bending. Strips of thin tough card joined with paste might be used instead, although they would require to be about twice as wide to give sufficient mechanical strength. A piece of stiff wire is also satisfactory if it is turned through a complete circle at the point of bending, to allow for pivoting.

(3) *The Base Board*

The original drawing, placed on a board with five pins as pivots, may be used, or something more elaborate and permanent may be made up. The essential thing is to have the representation of the lens, its principal axis and the two focal points. In any case, a model of some sort will greatly help in understanding what follows.

How a Lens Works

It can be proved theoretically that, with certain limitations, to be mentioned later, a ray of light on passing through a lens is bent or deviated through a definite and fixed angle. The size of this *angle of deviation* depends on the power of the lens and the distance the pivot of the ray is from the centre of the lens. The original direction of the ray does not affect the amount of bending. We have made the

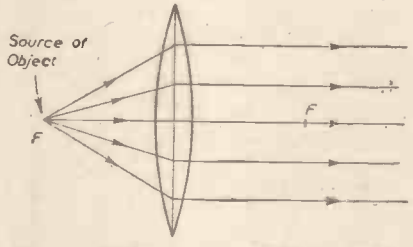
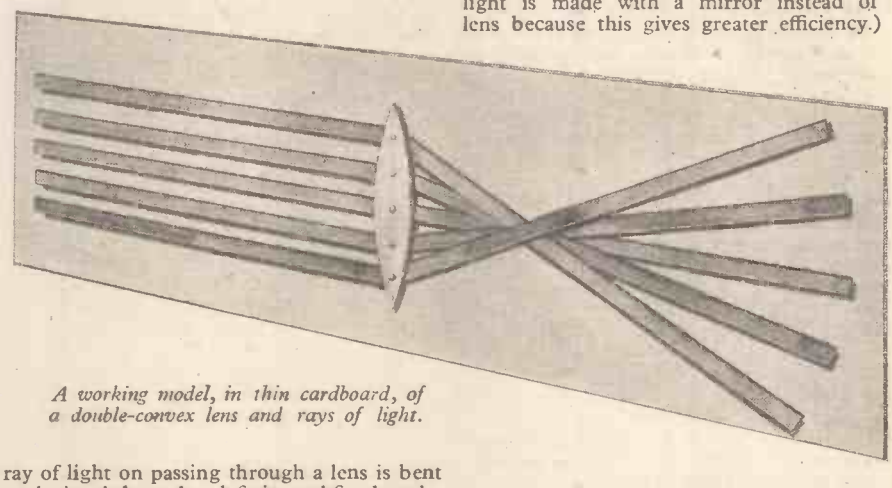


Fig. 2.—Diagram of searchlight beam.

rays of our model so that they will obey this theoretical law.

If we set up our model as in Fig. 1 it will represent a parallel beam of light from a distant source falling on a converging lens. This is what we used to do as schoolboys when we used a lens as a burning glass. The lens pulls the rays inwards so that they all pass through one point, the *principal focus*, F. A *real image* of the distant object is formed at that point. It is called "real" because the light really goes there and the image can therefore be caught on a screen. (The distinction between *real images* and *virtual images* is important; there will be more about this subject later.) Note here what is meant by the power of a lens; the greater the power, the nearer the focal point is to it.

Now let us bring our source of light nearer to the lens. The real image moves farther away. This can be seen by manipulating the rays of the model and bringing the object nearer and nearer to the lens. The image moves steadily farther and farther away until the source is at the previously unused focal point; the "image" rays are then parallel and the image is "at infinity"—(=a very great distance away). A flashlight bulb and a lens arranged like this (Fig. 2) provide us with a model searchlight. (An army searchlight is made with a mirror instead of a lens because this gives greater efficiency.)



A working model, in thin cardboard, of a double-convex lens and rays of light.

It is very fascinating to arrange the rays of the model and to see how the image moves up and down the principal axis according to the position of the object or vice versa.

See also how the one set of rays opens out as the other narrows down, the interplay of convergence and divergence. (Readers will possibly know the word "*vergence*," which is used to cover both.) As one vergence increases, the other decreases. An object and its related image are said to be at *conjugate focii* (Fig. 3). (Conjugate=yoked together.)

Lens Calculations. Power

Lens calculations are concerned with:

(a) The vergence of (the light from) the object, or the power of the object.

(b) The vergence of (the light to) the image, or the power of the image.

(c) The alteration of vergence caused by the lens.

(1) The power of a lens is equal to the vergence that it can give to a parallel beam, or give to cause a parallel beam. (Figs. 1 and 2.)

A parallel beam has neither convergence nor divergence.

Look again at Fig. 1. The object has no vergence. The vergence of the image= the power of the lens.

In Fig. 2, the image has no vergence and the vergence of the object=the power of the lens.

In Fig. 3, object and image together share the total power or vergence of the lens.

(2) The power of a lens=the sum (algebraic)

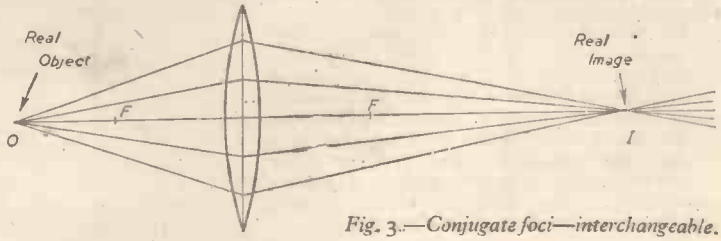


Fig. 3.—Conjugate foci—interchangeable.

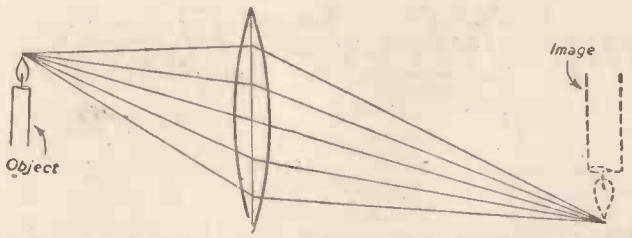


Fig. 4.—Larger object. Fixing one point on the image.

of the powers of object and image. Many opticians dispense with the word "vergence" and use the word "power" in all cases.

Lens Calculations. Signs

At first sight one would think it necessary to distinguish between convergence and divergence; in fact, this distinction is made under the old system. Under the new system distinction is not made, for the following reasons. On our model, or if you look at Fig. 3, you could choose either end and say it was the object while the other would be the image. If they are not marked and if the direction of the light is not marked, nobody can say which end is convergence and which divergence. Object and real image are interchangeable. It is well worth while to duplicate the working of the model with experiments, using a reading glass or other converging lens, a small electric light as object, and a post-card as screen on which to catch the image. You can then satisfy yourself that object and real image can actually be interchanged. These real things, object and image, are given the same sign, and are called positive. Converging lenses have a *real focal point* and are also positive.

(3) The powers of converging lenses, of real objects and of real images are all positive.

This system is often called the "Real-is-Positive" system.

As long as we use only converging lenses (which are thicker in the middle than at the edges), and keep object and image outside the *focal points*, the objects and images will all be real, so there will be no minus signs. The *virtual image* with its minus sign comes later.

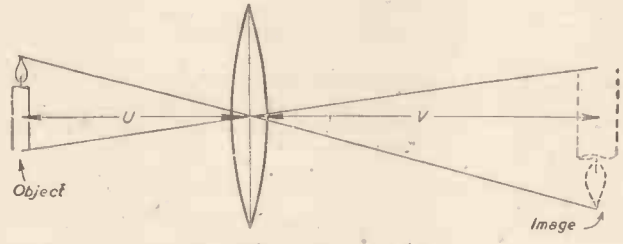


Fig. 6.—Similar triangles.

The Diopter, the Unit of Power

The *power* or *vergence* of a lens is its ability to concentrate a parallel beam of light to a *real focus* (or to spread it out as from a *virtual focus*). *Power* is expressed in *Diopters*. As we have already seen, the greater the power, the shorter the focal distance. Hence, to calculate power, we must divide by the focal length. "Divide what by the focal length"? you will ask. The opticians have chosen the metre, so:

The power of a lens, in diopters, is calculated by dividing the focal length (in metres) into one metre.

Of course, you may, if you like, change both measurements into centimetres (1 metre = 100 cms.), or inches (1 metre = 40in. (39.4 to be more accurate). You get the same result each time. For example: Calculate the power of a lens which has a focal length of 5 cms. (5 cms. = 0.05 metres = 2in.).

$$\text{Power} = \frac{1 \text{ metre}}{.05 \text{ metre}} = 20 \text{ diopters}$$

$$\text{Power} = \frac{100 \text{ cms.}}{5 \text{ cms.}} = 20 \text{ diopters}$$

$$\text{Power} = \frac{40\text{in.}}{2\text{in.}} = 20 \text{ diopters}$$

The *vergence* for object and image is calculated in exactly the same way.

To find the distance of the focal point, object or image, when you know the power, simply divide the diopters into 1 metre (or its equivalent in cms. or ins.).

Example:

Calculate the focal length of a lens which has a power of 20 diopters.

$$\text{Focal length} = \frac{1 \text{ metre}}{20 \text{ diop.}} = 0.05 \text{ m.} \qquad \text{Focal length} = \frac{100 \text{ cms.}}{20 \text{ diop.}} = 5 \text{ cms.} \qquad \text{Focal length} = \frac{40\text{in.}}{20 \text{ diop.}} = 2\text{in.}$$

First Calculations

(1) (a) What is the power of our model lens?

Power = 40in./2½in. = 16 *Diopters. Ans.*

(b) If the object is 8in. from the lens, where is the image?

Power of the object = 40in./8in. = 5 diopters.

Power of the image = 16 − 5 = 11 diopters.

Distance of image = 40in./11 diopters = 3.6 *inches. Ans.*

You can make up plenty more and test your answers on the model. (Of course, you cannot expect to do very exact work on a model.)

(2) An object 8in. from a reading lens gives a real image 4in. from the lens on the other side. What is the power of the glass, and what is its focal length?

(a) Power of the object = 40in./8in. = 5 diopters.

Power of the image = 40in./4in. 10 diopters.

Power of lens = the total = 15 *diopters. Ans.*

(b) Focal length = 40in./15 diopters = 2.67 *inches. Ans.*

(3) Examination of my spectacles.

(a) They are thicker in the middle than at the edges; hold them at arm's length and look across the room, or if that fails across the road, things appear upside down; both tests proclaim them to be converging. (Real images are upside down.)

(b) Hold at arm's length, look through one lens and rotate this lens on its principal axis, like a cart wheel—a fence across the road shows the same relative thickness of upright and horizontal all the time; the glasses are simple lenses and there is no correction for astigmatism.

(c) The trees across the road form a real image on the wall when the spectacles are 45 cms. from it. Both lenses act at this distance,

Power of the object = 1 metre/25 metres = .04 (may be "neglected").

Power of the image = 100 cms./45 cms. = 2.2 diopters.

Power of the lens = 2.2 *diopters.*

(d) I have a stronger pair with a focal length (as found in c) of approximately 30 cms.

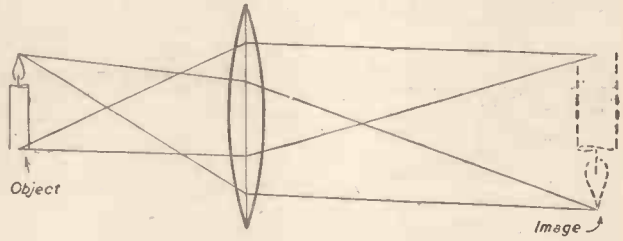


Fig. 5.—Image of top and bottom point of object.

Power of stronger pair = 100 cms. 30 cms. = 3.3 *diopters.*

(e) If I wear them both together, the total power of the two lenses in contact = 2.2 + 3.3 = 5.5 *diopters.*

All this is fairly straightforward. It all turns on rules 1 and 2. You have to work in *powers* or *vergences*; but you can only measure *distances.* Hence turn the distances into diopters, do the addition or subtraction, and then turn the diopters back into a distance if necessary.

Magnification

So far we have only discussed point objects and images on the principal axis. Now let us take a bigger object and find some points on the image by means of our rays (Fig. 4). Still keep outside the focal point so that everything will be real and positive.

After all, we are only finding sample points by means of sample rays. Two rays are enough to fix the position of a point, so let us remove the straight ray from our model and find the image of the top of the object with one pair of the rays we have left, and the bottom with the other pair (Fig. 5). You can find out a lot of things about images this way. Some of them provide a very considerable headache for the makers of camera lenses.

Magnification is the size of the image ÷ the size of the object, even when the image is smaller than the object as in a photograph and the magnification is a fraction (such as 1/9). Let us take a straightforward object and its image, as in Fig. 5, and remove the rays. Now bring that neglected straight ray into action, joining first the top of the object

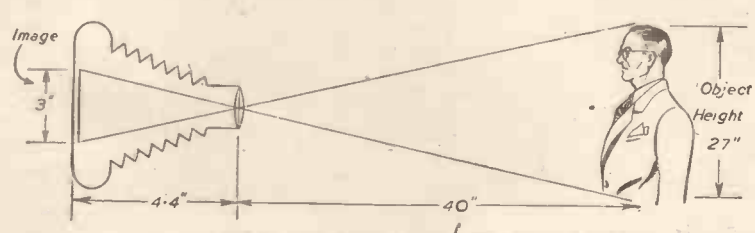


Fig. 7.—Taking a portrait. How the image is formed.

to the top of the image and then bottom to bottom (Fig. 6). We get two triangles of exactly the same shape. These similar triangles have a valuable and very practical characteristic: take any two measurements (sides, heights or any similarly drawn line), either both from the same triangle or one from each, and divide one into the other; now take the corresponding two measurements and divide them in a similar way, and you get the same answer from each division. Test this in as many ways as you like, but what interests us is that:

$$\frac{\text{Size of image}}{\text{Size of object}} = \frac{\text{image distance (v)}}{\text{Object distance (u)}}$$

or, of course,

$$\frac{\text{Size of image}}{\text{Image distance}} = \frac{\text{Size of object}}{\text{Object distance.}}$$

Examples on Magnification

(1) My camera has a focal length of 4in. The film is 2½in. by 3¼in. What will be the magnification if I photograph somebody at a distance of 3ft. 4in., and how much will I get in?

The first step is to calculate the image distance; then we can work out the magnification.

Power of the lens, 40in./4in. = 10 diopters.

Power of the object, 40in./40in. = 1 diopter.

Power of the image (by subtraction) = 9 diopters.

Image distance = 40in./9 diopters = 4.4 ins.

$$\text{Magnification} = \frac{\text{Image}}{\text{Object}} = \frac{\text{Image distance}}{\text{Object distance}} = \frac{4.4\text{in.}}{40\text{in.}} = \frac{1}{9} \text{ full size.}$$

A head and shoulders 27in. in height will go in nicely in the vertical position (Fig. 7).

(2) I am buying an optical lantern to use in a hall 30ft. long. What must be the focal length of the projection lens if I want a picture on the screen about 6ft. square. The object is a slide with a picture size of 3in. square (Fig. 8).

The image is so far from the lens that the object will be practically at the focal distance. It will not help to be too particular because projection lenses are not made to fractional sizes.

$$\frac{\text{Object distance}}{\text{Size of object}} = \frac{\text{Image distance}}{\text{Size of image}}$$

$$\frac{\text{Object distance (in.)}}{3\text{in.}} = \frac{30 \times 12\text{in.}}{6 \times 12\text{in.}}$$

∴ Object distance and focal length = 15in.

Power of projection lens = 40in./15in. = 2.66 *diopters.*

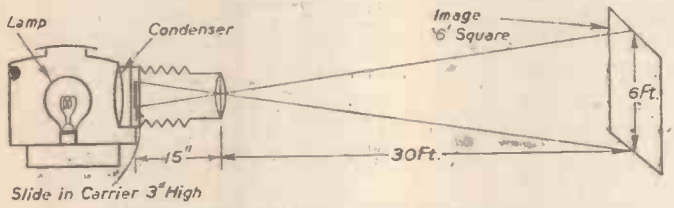


Fig. 8.—Characteristics of an optical lantern.

Virtual Images and the Minus Sign

So far we have not been concerned with signs. Everything has been Real and Positive. Now let us turn to our model again and push our object nearer to the lens than the focal point (Fig. 9). The rays are diverging at a pretty considerable angle when they reach the lens. It pulls them in a lot, but it cannot stop them diverging. It cannot cause them to converge together and form a real image. It has not sufficient power. All the outgoing rays seem to be diverging from the point marked "I."

If this is repeated as an experiment, using a lens and a small bulb or other object, and one looks through the lens from anywhere on the line A B, the light will appear to come from the image "I" because the eye cannot make allowance for any bending of rays of light. The image is *virtual.*

When light *converges* on an image, that image is real and we say that its *vergence* is *positive.* Here we have light *diverging from* an image; this is surely the wrong way round, and the image isn't really there anyhow, it is only virtual. Could anything be more natural than to say that its *vergence* is *negative*? Well we do, and everything works out correctly.

Example:

Let the object be 2in. from our model lens. The image distance turns out to be 10in.

Power of the lens (we have done this already) = 16 diopters.

Power of the object, 40in./2in. = 20 diopters.

(This is more than the power of the lens, as we saw above.)

Power of the virtual image −(40in./10in.) = −4 diopters.

Total = Power of the lens = 16 diopters.

We have been using the lens as a simple magnifying glass, but there is no need to bother about signs when working out the magnification.

$$\text{Magnification} = \frac{\text{Image}}{\text{Object}} = \frac{\text{Image distance}}{\text{Object distance}}$$

$$= \frac{10\text{in.}}{2\text{in.}} = 5 \text{ times as large.}$$

The "Easy Way" depends on distinguishing between real and virtual images. Here is a summary of the main points:

Real

(1) All the light really goes there.

(2) The image is really there, and can be caught on a screen or seen suspended in space.

(3) The light *converges* to the image.

(4) The image is inverted.

(5) Examples are: cinematograph pictures, pictures thrown by the optical lantern or epidiascope, the photographic image.

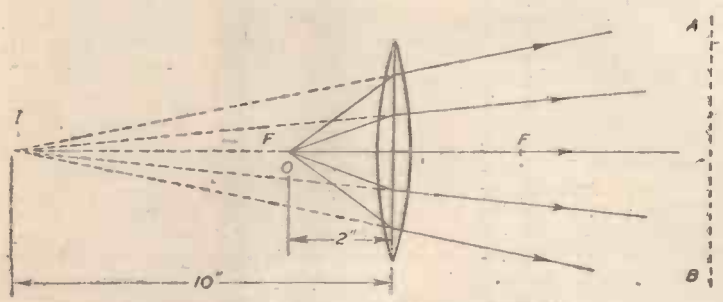


Fig. 9.—Virtual image—simple magnifying glass.

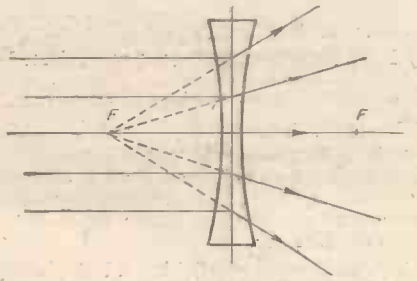


Fig. 10.—Diverging lens—virtual focus.

Virtual

(1) Light does not go there.

(2) The image only seems to be there, and it cannot be caught on a screen.

(3) The light *diverges from* the image.

(4) The image is the right way up.

(5) Examples are: converging lens used as a magnifying glass, all ordinary images with a diverging lens, the normal use of spectacles, all images in a plane mirror.

Example: Spectacles for Long Sight

What power of glasses would be required by a man who cannot focus an object nearer than 30in. and who wishes to read a book held 10in. from the eye?

The object is to be at 10in. and a virtual image is required at 30in.

Power of the object = 40in./10in. = 4 diopters.

Power of the virtual image = −(40in./30in.) = −1⅓ diopters.

Power of the lens (algebraic sum) = (+) 2⅔ diopters (positive . . converging).

$$\text{Focal length} = 40\text{in.}/\frac{8}{3} = \frac{40 \times 3}{8} = 15\text{in.}$$

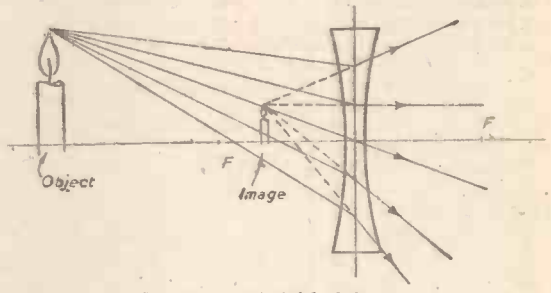


Fig. 11.—Diminished image.

Diverging Lens

Take the rays off the model and turn them over. They are now bent outwards and represent the action of a diverging lens. Fig. 10 shows how a parallel beam is made to diverge as from a virtual focal point (F). The power (and with it the focal length) of a diverging lens is obviously negative.

Fig. 11 shows an object as seen through a diverging lens, with one point on its virtual (and diminished) image.

Example: Spectacles for Short Sight

A man cannot see clearly beyond 4ft. and he wishes to see distant objects. What is the power (and the focal length) of the glasses he requires?

The object is very distant, and a virtual image is required at 48in.

Power of the object = 40in./ a very large number. May be neglected.

Power of the virtual image −(40in./48in.) = −5/6 diopters.

∴ Power of the lens $= -5/6$ diopters. Negative. ∴ the lens is diverging.

Focal length $= 40\text{in.}/(-5/6) = -40\text{in.} \times 6/5 = -48$ *inches.*

Spherical Mirrors

Spherical mirrors act just like lenses except that the light comes back instead of going through. It is not quite so easy to make a mechanical model to illustrate their action, but it can be done.

Fig. 12 shows a parallel beam brought to a focus by a converging mirror.

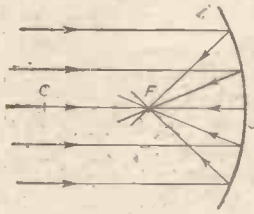


Fig. 12.—Diagram showing the focal point of a converging mirror.

Fig. 13 shows the effect of a diverging mirror on a parallel beam. The driving mirror of a car is usually of this type as it gives a diminished image and therefore a wider field of view. Note that there is only one focal point, but there is an additional important point, the centre of curvature,

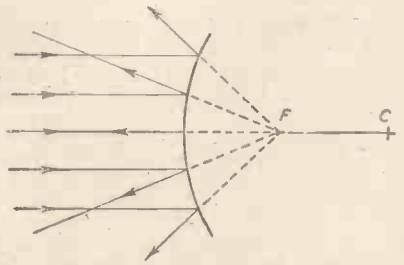


Fig. 13.—Showing the effect of a diverging mirror on a parallel beam.

"C," twice the focal distance away. The calculations are done in exactly the same way as for lenses.

Imperfections of Lenses

Earlier in this article it was mentioned that lenses have limitations. The two chief are: (1) the lens must be thin; (2) the rays must not make a large angle with the principal axis. The result is that (1) a thick lens will not normally give a sharp image, and (2) the outer parts of a picture thrown by a lens may be out of focus. You may have noticed that the image made by our model was curved, so that the edges would be out of focus. If we want a powerful effect and also a clear image we must use several thin lenses instead of one thick one; we must use only the rays near the principal axis; and also, it is better to use only the centre of the lens. This last is, of course, the chief reason for the stop in a camera lens.

Because they disregard these limitations, our rays are not suitable for the accurate determination of the positions and sizes of images; their use is to give a clear general understanding of what takes place.

Another trouble is the rainbow fringe which may be seen sometimes round the image made by a simple lens. This is cured by fitting a weaker lens of opposite sign, made of a different sort of glass, and specially calculated to suit it. You will find that the object glass (lens nearest the object) of a good telescope is corrected in this way. It is important not to disturb the arrangement.

An Automatic Dark-room Clock

A Useful Appliance for the Amateur Photographer.

By F. G. RAYER

DEVELOPMENT by time and temperature is probably now the most-used method. With panchromatic materials it is essential because even a dark-room safety-light will fog such negatives. This makes a simple method of knowing when development is completed very useful, and the addition described here (which may be added to almost any clock) saves all trouble in calculating how many minutes will elapse, or trying to read the time by a dim light.

Part of the clock dial is calibrated "backwards" in minute intervals and an extra hand is used in conjunction with these markings. When this hand reaches zero a contact is made and a buzzer sounds. Accordingly the procedure is as follows:

Take the temperature of the developing solution and from the usual table determine how many minutes are required for development. Set the extra hand to indicate this figure and put the plate or film in the solution. When the buzzer sounds remove the negative as development is complete.

The arrangement will not interfere with the normal working of the clock.

Constructional Details

A thin brass contact is mounted so that its end comes opposite "12" on the dial, as shown in Fig. 1. If the dial is of metal this contact must be insulated with washers of fibre or similar material.

A stout piece of steel or iron wire with the longer end filed smooth and a blob of solder on the shorter end is suitable for the extra hand. This hand is mounted so that it turns because of slight friction between it and the minute hand; it can be turned in any direction without moving the minute hand from its position. Fig. 2 shows the best method of arranging this. The spring-washer does not need to be strong.

If the axle of the minute hand does not project sufficiently (at least $\frac{1}{8}$in. is required) then it may be lengthened by soldering a very small bolt head-downwards on the central boss of the minute hand. The extra hand can then be fixed to the shank of this bolt.

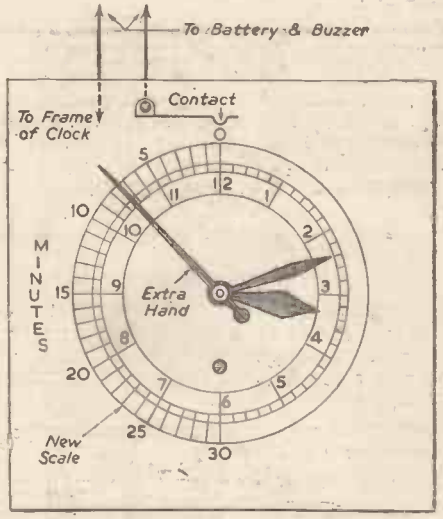


Fig. 1.—The clock face showing the marking out of the new dial.

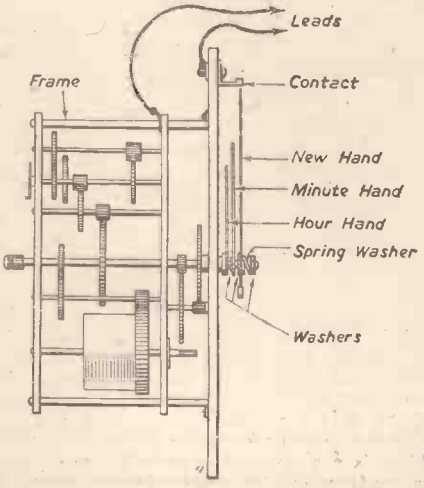


Fig. 2.—Side view of the clock mechanism showing the additional hand and washers.

Electrical Circuit

When it reaches the upright position the extra hand makes light contact with the brass strip. The electrical circuit is as follows: Clock frame to battery; battery to buzzer; buzzer to contact strip. A switch may be inserted in one battery lead to prevent the buzzer sounding for several seconds each time the extra hand passes the "12" o'clock point.

Chlorine and Corrosion

ACCORDING to a report just issued by the Department of Scientific and Industrial Research, many towns during the recent war, which had not previously done so, began adding chlorine to domestic water supplies. This was done mainly as a safeguard in case water mains were fractured by bombing, but generally the use of chlorine was continued when the war ended to protect the purity of the supplies during distribution. Many water engineers, however, considered that chlorine was causing increased corrosion of brass fittings such as ball valves. Tests, using hard waters and soft waters, have now been made at several waterworks by the laboratory in collaboration with the department's chemical research laboratory and the British Non-Ferrous Metals Research Association. Chlorinated and unchlorinated water was passed through fittings of different kinds, including ball valves which were arranged to flush automatically; the number of flushes was usually between 40,000 and 50,000 in each series of tests. Chlorine, in the concentrations used in waterworks practice, had no decisive effect on fittings made of cast brass but did increase corrosion in valves made of hot-pressed brass.

The Cleaning and Restoration of Oil Paintings

Practical Methods and "Trade" Secrets Revealed

By J. F. STIRLING

(*Concluded from page 213, April issue*)

A final "spotting" of a picture with fresh paint before the surface varnish coat is applied.

BEFORE varnishing a picture set it at a safe distance in front of a fire for a few hours so that the canvas is gently warmed throughout. If this is not done the canvas may contain traces of moisture which will work their way through the varnish skin and cause it to "bloom" badly.

Apply the varnish with a soft brush or, better still, with the tip of the finger. Try to get a perfectly even film of varnish on the picture, and do not get the film too thick. If there are any particular rough areas on the picture surface, these should be subsequently revarnished.

The varnish layer will dry within a week and harden within a month. After that time it is advisable to rub a little high-grade wax polish over the varnish surface. This not only gives extra protection to the picture, but it takes away that high gloss which the varnish sometimes gives and which, to many people, is unpleasant. The wax film keeps the air away from the varnish, and forms an additional precaution against its gradual yellowing. The wax film will, of course, in time attract and hold atmospheric dust and dirt, thereby becoming discoloured, but it is very readily removed by wiping over the picture surface with a cloth charged with white spirit, and such a picture is equally readily re-waxed.

Only a hard wax mixture is to be recommended. The following is excellent for the purpose:

Carnauba wax (prime yellow)	2 parts.
Beeswax	1 part.
Paraffin or ceresin wax ...	2 parts.

(Melt together gently. Then add about 4 parts white spirit, or just sufficient of the latter to enable the wax mixture to remain slightly soft when cold.)

Keep Water Away

When cleaning a picture it is not advisable to apply water or even a damp cloth to its surface. Most particularly, soap and water should not be used, for any such solution penetrates down through the minute cracks on the picture surface to the ground beneath the picture, where, attacking the glue or other binding medium, it may loosen whole areas of the picture and cause them to scale or flake away.

Often enough, an old painting may have developed "blisters" in areas, these being caused by lack of adhesion of the paint layer to the ground or of the ground to the support. When occurring in backgrounds it may be easier gently to remove these blisters or scales and to retouch in with fresh paint, but, usually, it is better to re-cement the blistered areas to the ground or the support.

This can be done by pricking the blister with a needle and by introducing on the needle-end a quantity of glue solution under the blister, subsequently allowing the area to dry under light pressure. Professional restorers often use a hypodermic syringe for this purpose, but the careful application of a common pin or needle will suffice for the same use.

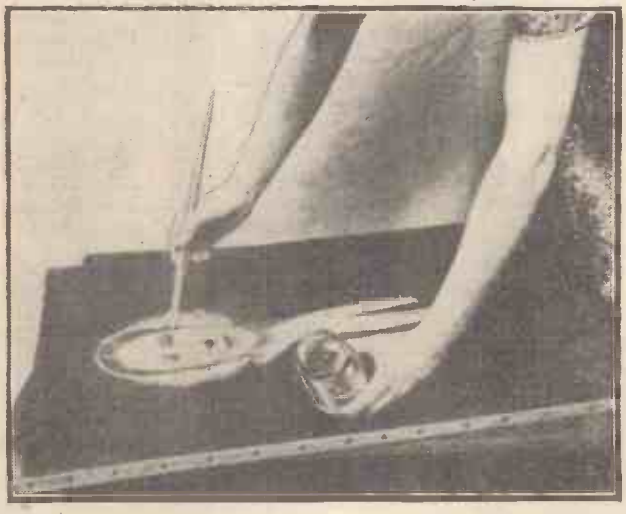
An old picture may often be holed in places. In such instances, if the canvas is otherwise sound, the picture should be laid face downwards on a perfectly smooth surface, such as, for example, a marble wash-stand slab. With a needle carefully tease out the fibres around the edges of the hole or tear in the canvas and draw them together. Then moisten them with a little glue solution. Place a wax paper over them together with a light weight to keep them in position. Let the glue set over night.

In the interim prepare a piece of strong, thin linen fabric. Cut it with a serrated edge so that it does not form a hard outline. Then, after the glued fibres of the canvas have set in position, re-glue the area lightly, and, also, the prepared linen backing. Bring the latter into contact with the canvas and press it down firmly. Again, allow it to dry overnight. In this manner, after a little judicious touching-up on the punctured surface of the picture, the local repair will be almost invisible.

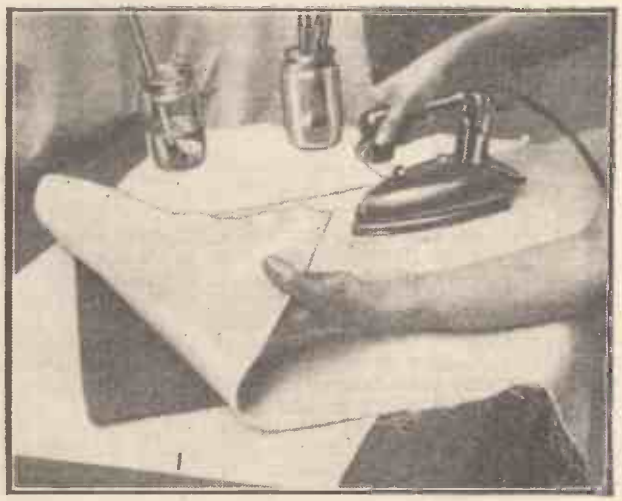
Remounting and Relining

Very often the canvas support of a picture which is old and which has not been attended to may be in a completely fragile and even rotten condition. Such a canvas punctures almost at a touch. In these circumstances it must either be remounted or relined.

The mounting of a canvas is simple enough, the only requirement in this instance being to cut the canvas away from its wooden frame or "stretcher" and to cement it with glue to a suitable non-warping plywood board.



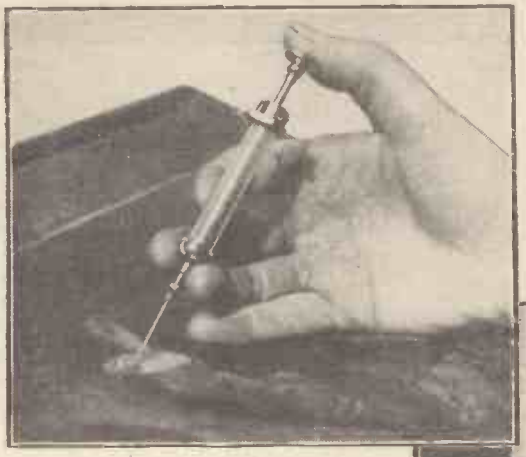
Revarnishing a restored and renovated picture. Here we see a brush being used, but the finger tip may be employed equally as well and, perhaps, better for the purpose.



Relining a canvas—new canvas material being cemented over the old canvas in the manner described in this article.

This method, however, has never been in favour with picture restorers. It gives additional weight to the picture and, often, it depreciates its commercial value.

The orthodox process is the "relining" of the canvas. This, in brief, consists of cementing an entirely new canvas back on the rear of the old canvas, so that the picture is completely reinforced by the new back. Good strong linen or sailcloth may be used for the purpose; even high-quality hessian sacking may be employed, but, for a valuable picture, it is always best to use only the prepared canvas which is obtainable from dealers in artists' materials.



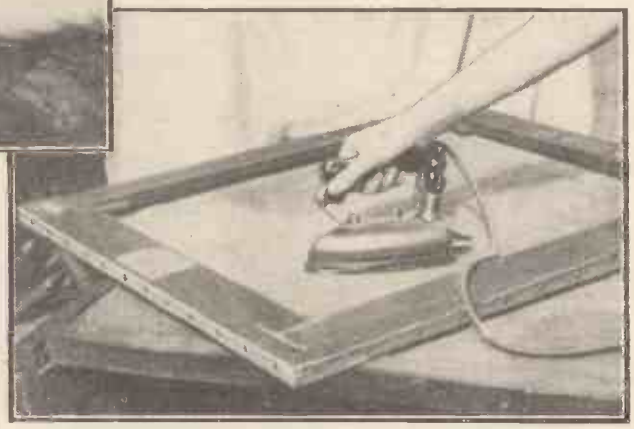
By means of a hypodermic syringe, small amounts of glue can be injected below the surface of a blister in an important part of a picture, thus cementing it firmly to the canvas. An ordinary needle may also, with care, be used for the same purpose.

Lay the picture face downwards on a smooth slab as before. Scrape away as many of the irregularities of the old canvas back as possible and spread a light layer of the adhesive over it. Then cut the new canvas so that it overlaps the old one an inch or two all round. Spread a layer of the adhesive on this. Then bring the new canvas in firm contact with the old one, and place them under firm and even pressure overnight. If the old stretcher is wormed or rotten it should be replaced with a new one.

The reinforced or "relined" canvas is now firmly nailed to the stretcher and any overlapping edges of the new lining are trimmed away.

For an adhesive for relining purposes glue has been used for a long time, but it is now coming into disfavour owing to its bad reaction to moisture, and to its tendency to attract mould growths. In place of it an adhesive consisting of equal parts beeswax and pale resin, melted together with a small quantity of Venice turpentine, has been recommended.

The rear of an old or new canvas must never be wetted. This would cause unequal expansion and contraction of the canvas, and possibly fracture. Never, also, apply any oil or any similar material to the rear canvas. Oils tend to oxidise, particularly linseed and other drying oils, and, in oxidising, they also tend to bring about an oxidsation of the canvas material itself, thereby causing it to deteriorate and, in bad cases, actually to powder.



With firm pressure and very little heat, a reinforcing patch on a canvas back is ironed into position before being left overnight to dry.

It is a good plan, however, to brush over the rear canvas with a molten mixture of paraffin wax or ceresin wax 4 parts, white spirit 1 part. This puts a barrier layer of an absolutely inert and unoxidisable wax over the rear of the canvas, which effectively removes it from contact with atmospheric impurities. The only objection to this is that the wax, being soft, attracts dirt. No other type of wax, however, should be used for the purpose, not even the hard wax used for putting over the final varnish of the picture.

If the picture does not lie taut on its stretcher, much can be done to improve matters by hammering in more tightly the wooden corner wedges of the stretcher. It is also a further aid to insert into the stretcher a "cross backing" in the manner shown in one of the accompanying illustrations.

Panel Paintings

Pictures painted on wooden panels are, in general, treated in the same manner as are those done on the more usual canvas. If the wooden support has warped, a lot may be done to bring it back to a respectable degree of flatness by glueing criss-cross battens on its rear surface. The rear of the wooden panel should be waxed to prevent it from mould and insect attack. The wooden back should not be painted over with protective paint, since this lowers the commercial value of the picture.

Small pictures may be conveniently framed under glass, but the larger ones should be framed "open," that is to say, without glazing. A large sheet of glass not only imparts additional weight to the picture and strain on its frame and hangings, but, in cold weather, it tends to condense moisture on the inner side of the glass. It is best, therefore, in private houses, to leave the picture open to the air on both sides and to rely on the wax film barriers on both sides of the picture to guard it from atmospheric deterioration. The frame should have two small corks glued to its lower end at opposite sides in order to keep the picture out of actual contact with the wall. It is also a good thing to dust a little D.D.T. powder over the bottom stretcher of the picture in order to deal with straying insects and especially spiders.

Test Instrumentation of Brabazon I

THE installation of test instruments in the Brabazon I is now nearing completion, and, because of the aircraft's size and operational rôle, the extent of test and instrumentation and laboratory facilities is considerable to ensure that the utmost value shall be obtained from every hour of flight and ground test. More than half of the fuselage interior will, in fact, be occupied by 1,000 instrument dials and oscillographs.

To save time in checking performances, completing and refining design, and, ultimately, to accelerate production of the Mark II aircraft, all instrument indications will be recorded photographically or plotted automatically for analysis in the flight research laboratory.

As a general rule, instruments used for test purposes are of the synchronous electrical type, each having a transmitter containing an element sensitive to the quantity to be measured and means of electrically repeating the indications of these elements to the dials located in the fuselage. So that each group of dials shall tell the complete story of some function or aspect of performance without the need for cross reference, instrument dials are grouped in 12 panels.

Photographic Recordings

For the photographic recordings two types of camera are being employed. For those panels where readings will remain approximately constant as one condition of flight is held, the periodicity of photographic record will vary from one photograph every 10 minutes to one every other second. For this purpose a negative size 5in. x 5in.—sufficient to accommodate 170 dials—is used. Where the rate of change of dial indication will be higher, as for instance response of the aircraft to control movements, the periodicity of record may be as high as 4 per second. For this purpose specially-built 35 mm. cinematograph cameras are used, the negative of which can accommodate over 60 dials.

Control of the 12 cameras is from a master station on the flight deck, where the chief test engineer will be stationed, but test engineers observing the dials can at any time override the master control should they notice any trend or condition which, in their opinion, should be recorded. Normally, however, all cameras will take photographs at the same instant to obtain a full record of all performance under the selected condition of test.

Mirror galvanometer oscillographs, two in number and each capable of recording 15 quantities simultaneously, will record low-frequency vibrations of up to 60 cycles per second—such as those caused by aerodynamic forces—and steady strains in the structure. High-frequency vibrations, up to 1,000 cycles per second—as those caused by engine forces—will be recorded by cathode-ray oscillographs which can handle four measuring points at a time.

In addition to the instrumentation described, three lamp recorders, each containing 120 lamps, will carry out a continuous watch on the operation of various emergency devices. Should any one of the lamps light up, it will produce a line on a slowly-moving film and thus record exactly the timing and duration of the associated operation.

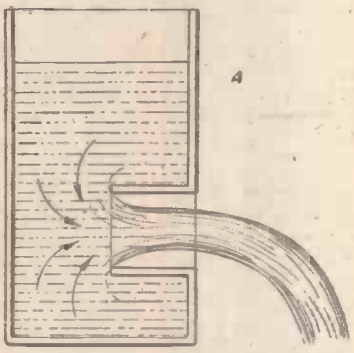
Finally, to cover the inevitable special cases which will arise during the Brabazon tests, a number of portable and self-recording types of instruments have been provided. These, in conjunction with two double-beam cathode-ray oscillographs, will enable any flight phenomena to be observed.

The Elements of Mechanics and Mechanisms—19

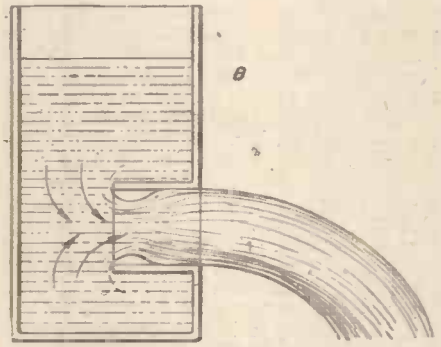
Drowned Orifices—Borda's Mouthpiece—Triple Discharge

By F. J. CAMM

SO far we have considered orifices discharging liquids into the atmosphere, but all orifices do not discharge in this way. In some cases they are submerged, as when a pipe discharges a liquid from one tank into another tank containing a liquid. These are known as drowned orifices. In these cases the rate of discharge is considerably reduced. The discharge of a liquid from a vessel can be considerably increased by fitting an external mouthpiece to the outer side of the orifice. This may consist of a short length of pipe, which is secured to the outside of the orifice. When the liquid stream issues through the orifice it will at first contract (*vena contracta*), but will immediately expand and fill the pipe. In such a case, the coefficient of discharge can be as much as 0.85.



A re-entrant or Borda's mouthpiece.



A "running free"; B "running full."

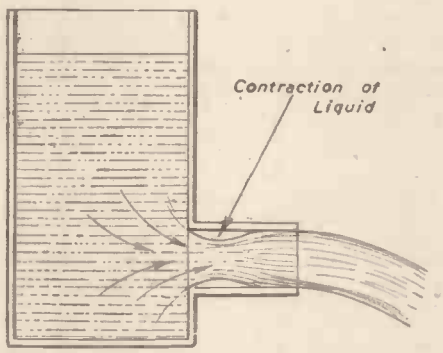
Convergent Mouthpiece

With a convergent mouthpiece the coefficient of discharge can be increased to 0.975, which closely approaches its theoretical or calculated rate of discharge.

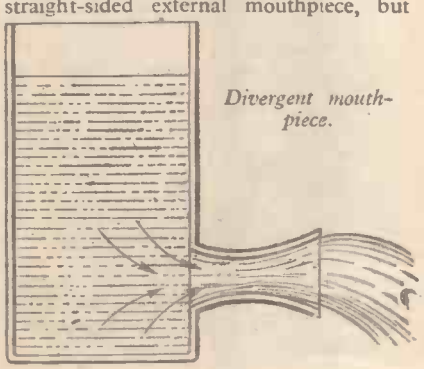
It is also possible to have a divergent mouthpiece which is made convergent up to the *vena contracta*, after which it diverges or opens up. As the degree of divergence increases, the velocity of flow at the *vena contracta* also increases. This, of course, is only true up to a certain critical point beyond which the liquid would issue in a series of gulps.

Borda's Mouthpiece

The re-entrant or Borda's type of mouthpiece is in reality an inverted pattern of the straight-sided external mouthpiece, but it is fitted so that it projects backwards into the tank from the orifices. With this type the issuing jet of water, after its initial contraction and subsequent expansion and divergence, will not touch the sides of the mouthpiece tube, and the issuing jet is said to be running free.



Illustrating the principle of the "external mouthpiece" fitted to an orifice. Note the contraction of the liquid in the mouthpiece.



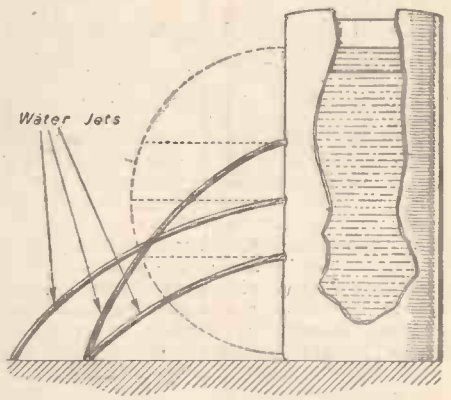
Divergent mouthpiece.

Triple Discharge Vessel

Now consider the case of a water vessel having three orifices of equal size and situated at varying distances from the base of the vessel. Obviously liquid would not issue from them at identical rates. Their rate of discharge, in fact, would be proportional to the square root of their respective depths below the surface of the liquid: the lower the orifice the greater the rate of discharge. In other words, if the lowest orifice is four times as deep below the surface as the uppermost one, it will discharge twice the amount of liquid in unit time.

Pump Action

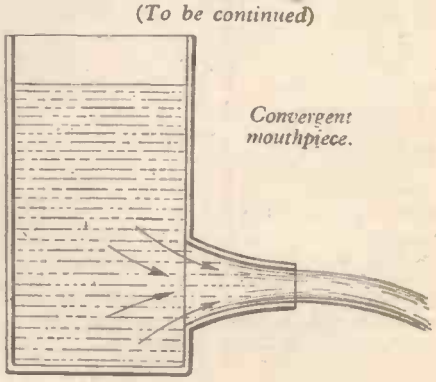
A pump is a device for the mechanical displacement of liquids or gases or for imparting energy to such fluids. Pressure pumps, generally known as force pumps, impart energy to the fluid and give it an artificial head. Suction pumps, which raise the water or other liquid by suction, only operate efficiently when the height to which the liquid is to be raised is not great. They are low-lift devices. The maximum height to which fluid can be raised by means of a suction pump is theoretically equal to the height of the water barometer—about 34ft. In practice, of course, it will raise water no more than from 25ft. to 30ft. This loss of efficiency is due to mechanical defects, and also to the fact that water under the influence of a partial vacuum created by suction exudes its dissolved gases. Pumps are usually of two types—centrifugal and reciprocating. In the latter type, a piston or plunger moves up and down in a barrel or cylinder, so creating a vacuum or a positive pressure in the cylinder. Such pumps are single acting, when the water acts on one side only of the piston or plunger, and in this case the water is sucked into the cylinder by the outward stroke of the piston and forced out of it on the inward piston stroke. It is possible to calculate the volume of liquid which will be delivered by a reciprocating plunger pump. This is merely the volume displaced by the plunger at each stroke multiplied by the number of delivery strokes of the plunger in unit time. The volume per stroke will be equal to the area of the plunger head multiplied by the stroke.



Showing the paths taken by water jets issuing from similar orifices placed one above the other in the side of a vessel.

The actual discharge is nearly always less than this, and the difference between actual and theoretical rates of discharge is known as the slip, which is usually expressed as a percentage of the calculated rate.

(To be continued)



Convergent mouthpiece.

Stained and Painted

The Necessary Operations from the Designing

Fig. 1.—A sketch (in water-colour) for a memorial window.

THE designing of a painted window, or even of a small ornamental panel to hang in the window of an ordinary room, calls for a thorough knowledge of all the operations which go to the making of it. It is to a great extent upon the artistry put into the preliminary design that the beauty of the final work depends.

The Sketch

This design is made in pencil on hot-pressed water-colour paper, with all the folds of drapery, the outlines and shading of heads, hands and details of accessories, carefully rendered.

All lead lines are drawn in and it is then fully coloured in water-colours with some of the shadows accentuated with colour.

Although it is, of course, possible to modify portions of the colour scheme when the glass is being selected for cutting it is advisable to determine the whole of the colours, right from the start, and especially so if the design is that for a window to go in a church, because the sketch will have to be submitted to the Diocesan Advisory Board or other church authority. Fig. 1 shows a sketch, the subject being St. George.

Having completed the colouring, fill in the lead lines with black, using a fine sable brush, but do not make the lines too intensely black because they may have to be washed up if alterations are called for.

Taking Templates

On the return of the sketch after final approval it becomes necessary to take templates of the exact size and shape of the heads of the lights—the heads are the arched, and frequently ornamental, tops of the window openings. Templates are cut from paper—usually by the most reliable of the firm's glaziers, but individual artists prefer to do it themselves, using ordinary strong brown or white paper. The cutting is done with a pair of scissors, after the paper has been pressed into the angle next to the stone.

It is best, after the paper has been held in position, to cut away all the superfluous parts which it is known will not be required, leaving, say half an inch or perhaps a little more. Then lay it in place again and with a pencil or a thumbnail get a sharp bend in the angle. Cut carefully on the line of this bend. Now mark on the paper on each side the exact points where the springing of the arch occurs. Usually there is a saddlebar on the springing line, in which case the matter is easy, for the paper can be allowed to overlap the bar and a rubbing taken with the pencil along the centre of the bar. Cut the paper along this line. Next, with a long rule or steel tape, measure from the centre of the bar down to the sill of the window. This will give the right dimensions of the rectangular part of the light. Take measurements also either from the sill or the top bar for the positions of each and all of the other bars. Make sure that the sides of the light are parallel from top to bottom and square with the top bar and the sill.

The head template may be tried in the next light in order to see if it will fit. In the case of new stonework the heads may be all exactly alike, but in old churches it is usually necessary to cut a template for each head. The papers should then be marked "A," "B," and "C," or, preferably, "left," "centre," and "right,' so that no mistake can be made later in making the cutlines.

The Cartoon

The next work for the artist will be the making of the cartoon. This is an exactly full-size shaded drawing of one of the lights as shown by heavy lines in Fig. 1. Some artists use black or sepia wash, as does the writer, whilst others use chalks; others again, and these are perhaps in the majority, work in charcoal. Both chalk and charcoal, especially the latter, are easily smudged, and so it becomes necessary to spray them with a spirit-and-gum fixative. The primary object of the cartoon is to provide something from which to copy when painting the glass; that is to say, when tracing the drawing, taking out the highlights, the half-tones and painting in the deepest shadows. The lead lines should be carefuly painted in, and in doing this it will be as well to decide upon what widths of lead shall be used, for they will not all be the same. In a normal size window with lights of 18 inches to about 24 inches they vary between one quarter-inch and half-inch, whilst the edging lead, which enters the groove in the stone for rather more than half its width, may be half-inch or five-eighths of an inch wide.

The Cutline

The cartoon completed it is laid upon the table and over it is placed a sheet of tracing cloth, or paper, large enough to cover the cartoon. The cloth is, of course, the more durable of the two materials, but it is very expensive, and for a single job the writer considers that in these days tracing paper is good enough, if care is taken when glass is laid and cut upon it, for it is upon this paper that the cutting is done.

On the cutline the lead lines drawn in the cartoon are traced over with a fairly fine brush and solid black water-colour or "process black"; the centre of each lead only being traced with a line having a uniform width of rather more than one-sixteenth of an inch or a little less than one-twelfth. It matters not what the overall widths of the leads may be; all the lines traced must be the same.

Cutting the Glass

The cutting of glass is a simple operation to those who have had an infinite amount of practice, but even to the novice it is not difficult, provided the shapes are not too complicated. The beginner in stained glass work should therefore aim so far as possible, when making his designs, at simple forms for each piece of glass so as to make the cutting easy, avoiding small-radius curves and long slender strips, especially those of the latter which come to a point at one end.

In the writer's large book, "The Art and Craft of Stained Glass" (Pitman), a whole chapter was devoted to cutting, and it is suggested that the present reader should refer to this work, say at a public library, for full details of difficult cutting, grozing and such other operations which would occupy too much space to describe here. It must suffice to say that few glaziers of church windows now use the diamond. The standard tool is the wheel cutter, which is cheap, less liable to be damaged by misuse, can be resharpened and thrown away when really worn out.

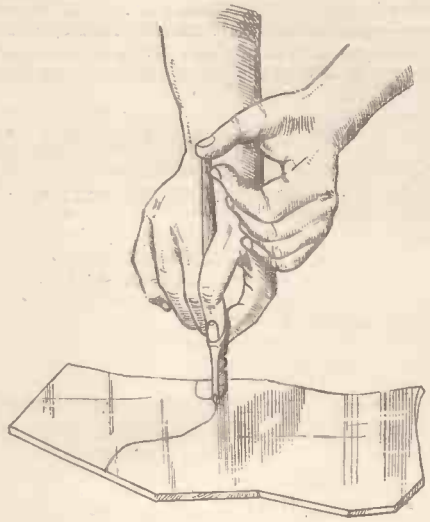


Fig. 2.—Making a forward cut.

In a general way, when making a cut the wheel handle is held by the thumb and between the first and second fingers of the right hand. The wheel is pressed on to the part of the glass farthest from the body, not very heavily, and drawn towards the operator. That is the normal way of cutting, but when the line to be followed is curved, bending to right and left, the writer makes a practice of pushing the tool forward, away from the body. The part of the cutter just above the wheel is gripped in the usual way but held nearly vertical to the glass; then the left thumb is pressed downwards on the top of the handle and so, as the wheel travels, it is possible without any obstruction to see

Glass Windows

to the Finished Windows.

By E. W. TWINING

exactly the course to be followed. The idea is sketched in Fig. 2.

A skilled glass-worker would complete such a fracture, as the cut shown, with his hands alone, but a beginner is well advised to carry the operation further by rapping from underneath with the back of the cutter, as depicted in Fig. 3, letting the raps commence at one end of the cut and continue until a bright streak appears in the thickness of the glass. The movements of the cutter should be by the second finger only, with the wrist held rigid. Follow this up with another rap at the end of the streak ; then another, until the brightness appears right along the cut, after which a little persuasion and perhaps another rap will cause the glass to become two pieces. Along all newly fractured edges of glass draw a file—for the safety of the hands.

Dark glasses, such as "antique" ruby, are not so easy to deal with because the cutline cannot be seen through them ; so either the glass must be laid underneath the cutline or a small piece of tracing paper used to obtain the outline of the piece to be cut. In either case a piece of greasy carbon paper is placed between either the glass and the cutline, or the glass and the tracing, and the drawn outline followed with a hard pencil. This will transfer a greasy line on to the glass. If this line is dusted over with any white powder, such as french chalk, then there is the line on the glass ready for cutting on.

Waxing Up

Having cut all the glass for the window, or for one light of it, make a point of thoroughly cleaning every piece. A clean rag and some wet whiting is advisable. At this stage it may be as well for the beginner to

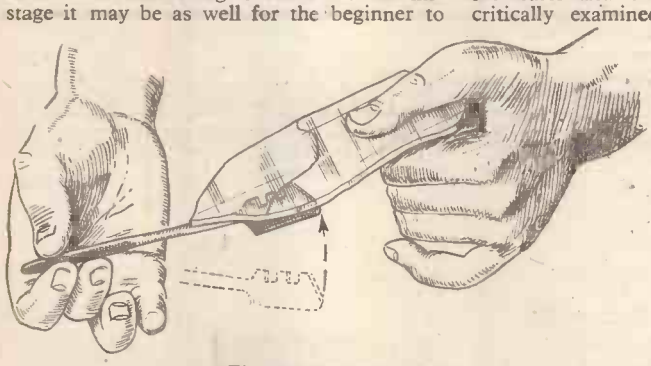


Fig. 3.—Rapping a cut.

"wax up" all his glass. A sheet of quarter-inch plate or other thick pure white glass large enough to take the light, or portion of the light, and not too large for the easel is laid down over the cutline. On this is laid every piece of the cut glass for the light, each in its correct position as indicated by the cutline.

Now will be required a quite small iron saucepan, and in it about a quarter of a pound of pure beeswax. This must be melted over a gas ring. With a tool, which can be made of sheet copper, strip iron or a pointed slip of common sheet glass, and having the saucepan in the left hand, the molten wax is taken up—as much as the implement will hold—and allowed to drop between the glasses at every place where three glasses adjoin ; in other words, drop the wax at every point or angle of every glass. Fig. 4 will convey the idea. The small sketches at the top show, on the left, how the wax is conveyed to where it is required, and, on the right, the tool tilted to such an angle as will cause the drop to fall.

As the easel glass will have to be raised to an upright position, and as the wax will have to bear the weight of the stained glass, see that each drop of wax flows on to both the easel glass and the stained glass, and if one drop from the tool is not enough to do this, apply two or three all at the same spot. Be sure the wax is hot enough and the tool also, but care must be taken not to burn the wax. Take it off the gas ring just as it begins to show slight traces of smoke; never go away and leave it on the ring.

For large work, i.e., large pieces of heavy glass, more elaborate waxing tools are required for transferring the wax from the saucepan. The writer uses one shaped like an elongated spoon with a narrow-pointed spout set in a wooden handle. This enables more wax to be carried, and as it is of fairly heavy gauge metal it retains the heat.

The easel glass having been raised, set on the easel and the general colour scheme critically examined, it is, if everything is satisfactory, again laid flat on a table or bench and all the coloured glasses removed. This is best done by cutting through the wax vertically with a knife at every point, then, starting at some point on the outside edge, driving the point of the knife along the surface of the easel glass and letting it strike under a coloured glass near a waxed point ; this will at once loosen and lift it. As each piece is removed the wax remaining on it must be chipped off, the fragments collected and put back in the saucepan for re-use.

Tracing on the Glass

Tracing, the first portion of the work of painting, should now be commenced. Glass-painters' tracing colours, opaque, vitreous enamels, are to be used, a mixture of the purple-brown and the black in equal parts. If the artist has obtained his glass from Messrs. Hetley and Son of Soho Square he can also purchase from them Heaton's colours: "Tracing Red No. 7" and a "Tracing Black." For use take about a heaped teaspoonful of each and mix them together on a square piece of common window glass to serve as a palette. Now add four or five drops of strong gum (ordinary gum arabic dissolved in water), work this into the colour with a palette knife and add water as required until the mixture is of such consistency that it will not run.

Fig. 5.—Scrub, stick and needlework on a head.

Tracing brushes should be of two or three sizes ; they should be long and slender in the hair and should, when wet, come to a fine point. A little experience will soon show which brush is best for the varying thicknesses of the lines to be traced.

Lay the first piece of glass (preferably the head of the figure) down on the cartoon, which must be laid flat down on a table in a good light, the window being preferably in front and a little to the left of the work. Moisten the brush with water and work some of the colour into it. The lines to be traced on the glass will follow, of course, those of the "drawing" in the cartoon, and should vary in thickness, the finest being around the highlights and thickening up towards and bordering the shadows. All lines traced should be perfectly opaque, yet with the minimum of colour. It will be found that going over a line a second time after the first is dry will render the paint thick and lumpy, and there will be trouble in firing ; the heavy parts will crack, flake off, and what is known as "fry."

When all the tracing is done the glasses may be lightly fired in the kiln in order to fix the lines and prevent their being washed up when the next painting is done, namely, the laying of the matts. There are two ways by which this firing of the tracing can be avoided, if desired: one is to matt over the unfired tracing, taking the risk of a line moving, and, if it does, touching up afterwards ; and the other is to mix and use the tracing colour so that it is insoluble in water. The latter is the old-fashioned way—a very sensible way—when fat oil of turpentine, thinned with ordinary distilled turpentine, is used with the colour instead of gum and water.

The first method of working, matting over unfired tracing, is followed by many glass-painters and by all those who work in a broad style with heavy tracing lines and matts which are boldly stippled.

Laying Matts

Now with regard to the laying of matts:

Fig. 6.—Scrubwork on a scroll.

The first thing to do is to wax up all the antique glasses again. Now get another palette glass and on it mix in the same way with gum and water a brown colour—Heaton's "Brown No. 63" is admirable. A large, flat, camel-hair mop will be required, one of about three-quarters of an inch across the ferrule. This is dipped in water to moisten all the hairs and then partly loaded with the brown colour. Try a stroke with it on an odd bit of glass held vertically. The brush must not be so loaded that the colour runs down, nor must the matt so laid be too dark to see light through it. When dry, try it for rubbing off with a dry brush or "scrub."

At this stage we come to a very vital question: What style or technique is the artist going to work in? Are the matts to be stippled or badgered. The writer prefers the smooth-badgered matt, which is perhaps the more difficult to execute. In either case the same tool is used, namely, a badger-hair softener.

In badgering a matt—it must be done immediately after the matt is laid uniformly over a piece of glass—the colour is quickly and very lightly stroked with the tip of the hairs, the badger being used dry and held vertical in relation to the glass. Brush in all directions in order to evenly distribute the colour but finish in only one direction. Fig. 5 illustrates a head that has been worked up from a perfectly laid and badgered matt.

Stippling is more simple and not so difficult to execute; the matt, which must be laid much darker than for badgering, is stabbed with the badger and by this means varying depths of tone can be obtained. The longer the stippling is carried on the lighter becomes the tone. When viewed from a distance the stippled matt lets more light through than does the badgered matt, although the ultimate results are the same. Stippled work calls for less care and less skill in doing the subsequent scrubwork, and often less scrubbing is needed. The artist is recommended to try out a number of matts all on one odd piece of glass, in each case carrying the stippling further than in the matt preceding it. Thus he will find that in the final one most of the paint will be stippled away leaving minute lumps uniformly distributed over where the matt was laid. The writer makes a practice of using both badgered and stippled matt in the same window: badgered for flesh and some drapery and stippled for accessories and borders.

Scrubs and Scrubbed Work

Scrubs are chiefly hog-hair brushes made for picture painting, whilst a few may be of sable, when they have become too worn for water-colour. They are converted for stained glass work by singeing the tips of the hairs in a small gas flame and then gently rubbing away the charred portions on a piece of No. 0 glass-paper.

The working up of the matts, in the glass on the easel, would be too lengthy a matter to be dealt with here, and the writer again refers his readers to his book previously mentioned, where the subject is fully dealt with. A careful study of Fig. 5 and of the portion of the scroll, Fig. 6, will be very helpful.

Sticks and Needles

Beside the scrub pointed wooden sticks and needles are used; the needles are pushed into wooden holders. An example of the use of a stick will be found in the coronet around the head in Fig. 5. As a matter of fact most artists use for sticks the ends of the scrub handles, by pointing them with a penknife. Sticks are chiefly used for taking out broad highlights on the edges of drapery, scrolls and lettering of inscriptions, whilst the needle is for finer lines and the touching up of scrubwork.

After the scrub, stick and needle work is completed the glass is fired, waxed up again and the effect critically examined. It will probably be found that some glasses, particularly those of heads, hands and some parts of draperies, appear too flat and need some deeper shadows put in. They must be gone over again with either a matt or with colour, stippled on just where it is required, and this must be fired.

Firing and Stain

It is surprising the number of times that some pieces of glass have to go through the kiln. The writer frequently finds it necessary to fire the head of a figure four times for the painting and then, once again, for stain.

Now staining is our next process, but it is not this from which the term "stained glass" is derived. Stained glass *is* stained glass before the artist handles it. All the beautiful colours are introduced, in the process of manufacture, by the addition of various metallic oxides, but this does not concern the practical side of the glass-painter's work. The only staining which he will require and have to do himself is the changing of localised portions of a piece of white or other light-coloured glass to yellow; for instance, the hair on a head, a diaper pattern on a robe, the reverse side of a scroll and a dozen other different things. A complete range of yellows is obtainable from palest lemon to deepest orange or red-brown. The exact shade required is got by varying the strength of the stain and, with much more powerful effect, the temperature and period of firing it. Then again, some glasses

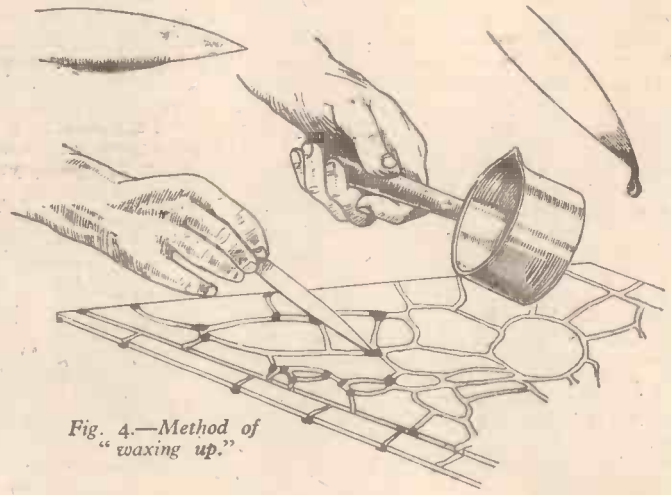


Fig. 4.—Method of "waxing up."

are soft and take the stain at comparatively low temperatures.

The stain used is pure silver, in chloride form, ground between a slab and muller in water until it becomes an impalpable paste. This grinding is a very arduous job, and it is a great saving of labour to buy it from Messrs. Hetley and Son, from whom it is obtainable as Heaton's "Strong No. 1" stain. It is tinted with yellow lake. To use it mix it with water with just a very little gum. It is further thinned with water and painted or allowed to flow on to the back of the glass, opposite to the part to be coloured yellow, using a large tracer or other long-haired brush. In floating on this stain it is well to have the glass quite horizontal, painted side downward, and beneath it a mirror arranged to reflect the light of the window upwards. Transfer the glass to the table and keep it horizontal until the stain is dry.

In firing, the stain must be placed downward on the plaster of the kiln, that is to say, painted side up, just as when the paint was being fired.

(To be concluded)

Letters from Readers

Making an Ellipsograph

SIR,—My attention has been drawn to the article by T. Hadfield entitled "Making an Ellipsograph" appearing in the March issue of PRACTICAL MECHANICS.

The instrument described is certainly an efficient and simple application of the well-known method of drawing an ellipse by means of two pins and a length of string, but it has serious drawbacks from the draughtsman's point of view.

In considering ellipsographs it should be borne in mind that such an instrument will be used chiefly by draughtsmen engaged upon the preparation of pictorial drawings, because with this type of work ellipses virtually replace circles appearing in "flat" orthographic views. An ellipsograph should be to the pictorial draughtsman what a pair of compasses is to the layout draughtsman.

It follows, therefore, that the principle upon which any such instrument is based should lend itself to a practical application that is not only simple and cheap to manufacture but—what is of equal importance—it must be easy and quick to use. Otherwise who will use an instrument in preference to well-known methods of approximation?

The principle upon which Mr. Hadfield's ellipsograph is based does enable a simple instrument to be made, but unfortunately the same thing cannot be said for the method of locating and using it. In order to draw an ellipse of given size, it was stated to be necessary first to mark off to scale the major and minor axes thereof. This means, of course, that the magnitude of both axes must be known or predetermined, whereas so far as pictorial drawing is concerned the length of the major axis only is known; the actual length of the minor axis being relatively unimportant and dependent chiefly upon the type of projection in use.

Following the instructions given for using the ellipsograph it would seem that no less than six successive steps have to be taken before commencing to draw each ellipse. These stages are, viz.:

1. Calculate minor axis (assuming the ellipsograph to be used for pictorial work);
2. Mark out major and minor;
3. Draw arc to cut major axis at X and Y;
4. Adjust instrument as to length of string;
5. Adjust gap between the two outlets of string;
6. Position instrument correctly relative to the terminal points of the axes; and
7. Draw one-half of the figure, incline the instrument and complete the ellipse by drawing the other half.

Imagine going through this procedure fifty times or so during the preparation of a drawing.

I agree with the author's comments on the trammel method of producing ellipses, and it is quite true that the majority of ellipses which the draughtsman has to draw are comparatively small in size—very often smaller than ½in. major axis.

For ink-tracing purposes it should be possible to use a stylographic pen in place of pencil, but I doubt whether the instrument could successfully be used for ink work.

My own ellipsograph which produces approximate ellipses sufficiently accurate for the perspective drawings requires only to be adjusted as to the major axis and takes no longer to draw any specified ellipse than it takes to produce a circle with a pair of compasses. Patent application has been made for this ellipsograph, and arrangements have been negotiated for its manufacture.—W. H. HILLS (Croydon).

Improvement for Cycle Rear Lights

SIR,—On many of the old type cycle lamps two small pieces of green glass were fitted so that you could see if it was still alight. This, I think, was totally unnecessary; but would it not be an excellent idea if fitted to the sides of rear lights.

Many times have I cycled with my head twisted round looking for the red glow and being a danger to the public in general until I carried out this modification. Trusting this may be of interest to other readers.—A. R. JONES (Lowestoft).

A Model Launch

SIR,—As a regular reader of PRACTICAL MECHANICS I thought the enclosed photograph might be of interest to other readers of this journal.

It is a model launch I have just completed from a set of "Modelcraft plans," with minor modifications of my own. It is 23in. long by 6in. beam; powered with a "Revmaster" motor and driven from a 6-volt battery it attains a speed of approximately 4 miles per hour. May I offer congratulations to PRACTICAL MECHANICS which is full of interest and puts technical problems in everyday language—simple enough for the tyro to understand?—A. C. ROSSELL (Coalville).

An electrically-driven model launch made by A. C. Rossell (Coalville)

Anti-fouling Compositions

SIR,—The following comments on an answer to a reader's query in the February issue may be of interest to other readers:

The manufacture of anti-fouling paints by the addition of copper naphthenate solution to paint (nature not specified) is an unusual method to which there are a number of serious objections. Among these are the following:

1. The addition of copper naphthenate to paints made on an oil or varnish basis frequently impairs the drying very seriously.
2. The amount of copper so added is insufficient to prevent fouling, and in any case it has not been established that copper naphthenate alone is an effective poison.
3. Continuous immersion in water needs special types of paint.

For this purpose manufacturers use a specially formulated paint and the fouling resistance is achieved by the incorporation of high percentages of copper and mercury compounds (generally in the form of oxides).

The application of copper naphthenate solution to a wooden hull before painting will certainly protect the wood from decay, but such treatment will confer no anti-fouling properties on subsequent coats of paint. To be effective the latter will have to be treated with the necessary poisons; in other words, a coat of the normal type of anti-fouling composition is necessary.—W. M. MORGAN (Cuffley).

"Fixing Wood-block Flooring"

SIR,—With reference to your reply to the query "Fixing Wood-block Flooring" in the March issue.

A composition which has been used in naval dockyards for many years for the fixing of Corticene cork carpet to steel and other decks is a very suitable solution to the problem.

I found some years ago that pitch tended to become brittle and powder, leaving the wood flooring floating, and I tried the naval composition with such success that the floor so treated is still in perfect state after about 18 years of constant use.

The composition varies a little according to the personal tastes of the user, but is substantially as follows:

Crude resin 75 per cent., tallow 25 per cent., melted together with gentle heat and used hot. This does not dry solid, but on cooling settles down to a fairly hard and very tacky bond with a slight "give."

A mixture similar to the above but using a mixture of beeswax with a proportion of raw linseed, whale, or rape seed oil in the place of tallow is used under conditions where there is some heat, over engine rooms, etc., and in tropical conditions. This latter is the best mixture for wood floors as there is a tendency for tallow to creep and form ugly patches if used too thickly.—A. WRIGHT (Greenford).

Working and Polishing Perspex

SIR,—I have been greatly interested in the articles on Perspex work which have appeared in PRACTICAL MECHANICS from time to time. In the March issue I notice that Mr. J. Arsbit, of Bury, was inquiring about a polish for Perspex, and, having been working Perspex myself for several years, I wondered if the following details would interest readers:

The first point which struck me on reading through the various articles was the fact that cements and cement formulæ published are expensive in comparison to my own methods. The following is my way of making cement: I first purchase a tin of amyl acetate. A point I should like to mention here is this: A friend of mine on going into several shops asked for amyl acetate but was told that it was not stocked. I told him I could get some, and did so at the first shop

I entered. The difference was that I asked for banana oil and was served with it. This brings to light the fact that many materials and liquids are not known by their true chemical names.

However, to revert to the cement making. All that is needed after obtaining the banana oil is a small amount of Perspex filings mixed with it. I have found a very large drop in costs by using this mixture. The speed of drying can be regulated to a certain degree by reducing or increasing the amount of filings mixed in.

The next point is about polishes.

Mr. Arsbit did not mention whether he wanted polish for the worked edges or the surface of the Perspex. If proper care is taken the surface should not need actual polishing apart from an application of Perspex Polish No. 2, which is slightly greasy, and requires a rub over with methylated spirits to take away the greasiness. The protective paper covering must not be removed until all working of the parts is completed.

I work the edges in the following manner: For a clean, straight edge I use a smoothing plane with a very keen edge and a very fine cut. This is followed by using a fine grade of sandpaper until all marks are removed. For polishing I next use Dura-glit, which is well known and easy to obtain. I have also used a fine grade of lapping compound with every success. Finally an application of Perspex Polish No. 2, followed by methylated spirit.

I have not so far found a cheaper substitute for the Perspex Polish No. 2, which imparts the final high glossiness which is not marred by the application of methylated spirit.

Further protection to the surface of the Perspex during the working can be obtained by using very soft material such as velvet between the jaws of the vice.

For working curved edges, etc., needle files of varying types are used in place of the plane, followed by the method already mentioned.—K. A. TRUCKLE (Peasedown).

The Time Element!

SIR,—I always read with interest your "Fair Comment," and in the February issue it is especially attractive and illuminating. I am gratified to note your appreciation of H. G. Wells under whose magic influence I came in 1895 and have read and possess almost all his works except for a few lost by fire, shipwreck and theft.

Assuming that the universe is four dimensional and static, a time element would appear to be unnecessary, although Dunne's ingenious thesis requires a series. I suggest that from the point of view of an observer at infinity all events appear simultaneously because discrepancy in age (time element between events) tends to a constantly diminishing part of the whole and therefore has zero value at infinity. By the way, is it not high time we abandoned the meaningless absurdity of expressing the interval between events in terms of "Time." Presumably by "10,000 years" we mean 2π Rad. 10^4 (S); we certainly do not know, nor can we know, the amount of Time (if any) which has elapsed during our apparent journey round the sun. What seems to be a very general experience that, to put it colloquially, time is flying very fast these days may be due to an acceleration of angular velocity and that therefore the time element is shortening.

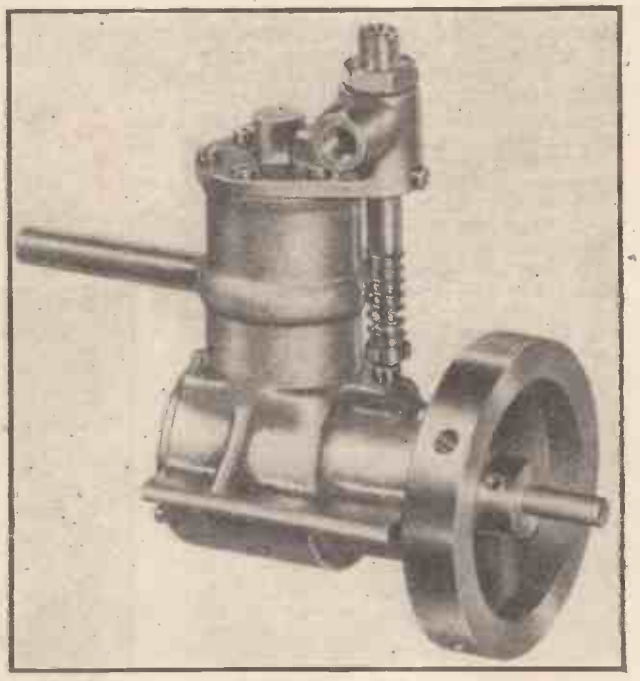
I am aware of serious objections to this suggestion—conservation of angular momentum, radius of orbit and so forth—always supposing that our mathematics are not based on fallacious assumptions.—G. D. NELSON (Fowey).

New Model Uniflow Engine

MESSRS. BASSETT-LOWKE, LTD., of Northampton, have just placed on the market a model Uniflow engine of unique design. The model, which has a single cylinder of 11/16in. bore and $\frac{5}{8}$in. stroke, was recently tested while mounted in a speed-boat hull. The boiler used was $7\frac{3}{4}$in. long and $2\frac{1}{4}$in. diameter, fitted with three $\frac{1}{4}$in. diameter water tubes, and mounted in an aluminium casing. It was fired by a methylated spirit burner having an asbestos wick 6in. long and 3/16in. wide, fed from a container 2in. diameter and 3in. long.

From cold, a working pressure of 90lb. was reached in $7\frac{1}{2}$ minutes, and at this pressure the speed of the engine was 3,600 r.p.m. On raising the pressure to 120lb. per sq. in. the speed increased to 4,100 r.p.m. At the higher pressure the engine worked excellently with considerable torque. The pressure was maintained continuously during the entire run of $18\frac{1}{2}$ minutes with the safety valve blowing the whole time. The steam pipe from the boiler was carried through the casing, a 24in. length being coiled in the flame of the burner to provide superheat and a maximum value of expansion.

The price of the complete, finished engine, as illustrated, is £5 9s. 6d., purchase tax extra if applicable. The complete set of finished machined parts are priced at £4 15s.



The new model Uniflow engine.

The set of castings, materials and ball-races will cost £2 5s. Further particulars of this little engine can be obtained from Bassett-Lowke, Ltd., St. Andrews Street, Northampton.

Books Received

Electricity in the Small Workshop. By Ian Bradley and Norman Hallows. Published by Percival Marshall and Co., Ltd. 60 pages. Price 3s. net.

THIS book deals concisely with the extensive subject of the use of electricity in the small workshop. The first chapter deals with electric power from the mains, small D.C. and A.C. generating sets, and electric motors of various types. Chapter two is devoted to electric lighting requirements, adjustable bench lamps, fluorescent lighting, and installation. Electric heating is dealt with in chapter three, various types of heaters being described. Such subjects as lighting circuits, switches, overloading of motors and fuses, are dealt with in chapter four. The book is illustrated with several line drawings and half-tones.

Railway Hobbies Year Book, 1949. Published by Railway Hobbies, Ltd. 40 pages. Price 9d. net.

MODEL railway enthusiasts will find this book a handy work of reference, including very complete lists of manufacturers and retailers of model railway equipment, lists of books and periodicals for railway enthusiasts, and tables of Model Railway Standards and Gauge Conversion Factors.

Johnsons' Photographic Competition

MESSRS. JOHNSONS of Hendon have recently issued a list of prizewinners in their photographic competition which closed on December 31st, 1948. The interest in these competitions is increasing and this time Messrs. Johnsons had to make selections from over 4,000 prints. Owing to the large number of entries it was necessary to double the number of prizes awarded.

Four first prizes of £5 each were awarded to: Mr. R. Boardman, 9, Linden Avenue, Atherton, Manchester; Mr. H. L. Hancock, 75, Shakespeare Avenue, Wellsway, Bath; Mr. S. Darlington, 35, Alderley Road, Northwich; Mr. M. Callan, 35, Moor Lane East, South Shields.

There were also 6 second prizes of £2 each; 20 third prizes of £1 each, and 41 fourth prizes of 10s. each. In addition, 26 consolation prizes were also awarded.

More and better prizes are being offered in the 1949 competitions, full details being set out in a folder, copies of which can be had free on application to Johnsons of Hendon, Ltd., Hendon Way, Hendon, London, N.W.4.

THE WORLD OF MODELS

Model Making in Germany : Cornish Beam Engines : Scale Model Factory

By "MOTILUS"

Fig. 2.—Herr von Bronsfeld's fascinating model of an imaginary harbour, with varied architectural features and numerous model ships and boats.

MODEL news from Germany is still infrequent, so that I was interested to receive, not long ago, a courteous invitation to a model railway exhibition in Esslingen, Würtemberg, and another to a model railway gathering in Leipzig. Unfortunately, in these earnest and busy times, beset with travel regulations, visas and permits, we cannot just answer the call of adventure, pack a bag and follow our inclination by accepting an invite of this kind, so I was obliged to refuse. I was glad, however, to receive this indication that German model-makers are now able to combine their efforts once more. A hobby always becomes doubly absorbing when we can meet others with interests similar to our own, through model clubs, etc. Even so, model-making in Germany today is largely handicapped by shortage of supplies, and much ingenuity must be exercised by those enthusiasts who make models of any kind in their spare time. They are sometimes quite envious when they see English model catalogues, where ever-increasing ranges of parts and fittings for scale models are appearing.

"OO" Gauge Model Railway

Early this year I had some correspondence with the German owner of a OO gauge model railway, Mr. W. Richter, of Leipzig, who purchased materials and models for his railway from Nuremberg in pre-war days. In one of his letters to me he tells the following story of the conception of a novel idea which led him to convert his German railway into an English one:

"My models had, naturally, the Continental style, and when my layout grew larger the models had no further variety: one model of the factory looked like the other. During one Leipzig Spring Fair I saw for the first time 'The Railway Magazine,' and a new world opened for me. What a variety had the English railways by the four groups! Our Reichsbahn is uniformed, but here one railway company had other details and colours to another. That enticed me very much to rebuild my bought models in the style of the four companies. Then I saw in the magazine a notice, 'Model Railways—Bassett-Lowke': that was a new possibility to know more about English railways. With the help of the pictures and text I became an 'explorer,' subscribing to 'The Railway Magazine,' and receiving it monthly at Leipzig."

That, in his own words, is how Mr. Richter, with the help of English railway magazines and model railway catalogues, was able to rebuild his locomotives and coaches as he had planned. He believes that there can be very few in Germany who can claim to have such a model railway with English characteristics. One of the accompanying illustrations, Fig. 1, shows three of Mr. Richter's rebuilt model locomotives, which were originally German Reichsbahn 2-4-2 locomotives. Besides these Mr. Richter also has a Southern Railway electric, centre-rail motor coach model, a standard Southern Railway coach, a London Transport locomotive, and two articulated overhead transmission coaches, one Garrat and the other American. His total collection now includes representative rolling stock of all the four leading railway

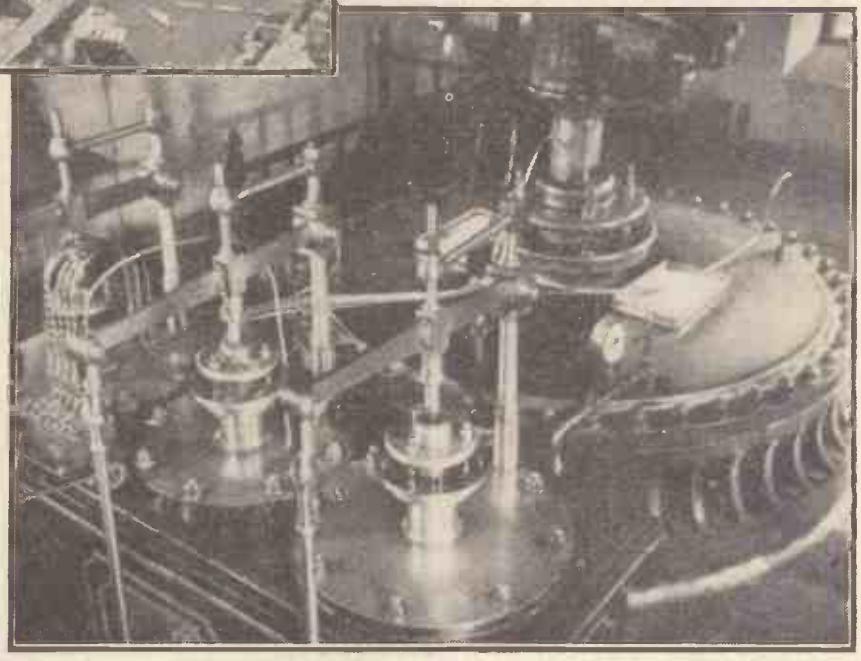


Fig. 3.—The upper cylinder and valve gear of the Cornish pumping engine in Cook's Kitchen shaft, South Crofty mine, Cornwall. This engine was built for a South Wales colliery in 1873, by Harvey & Co., of Hayle. Photograph from the Shell film "The Cornish Engine."

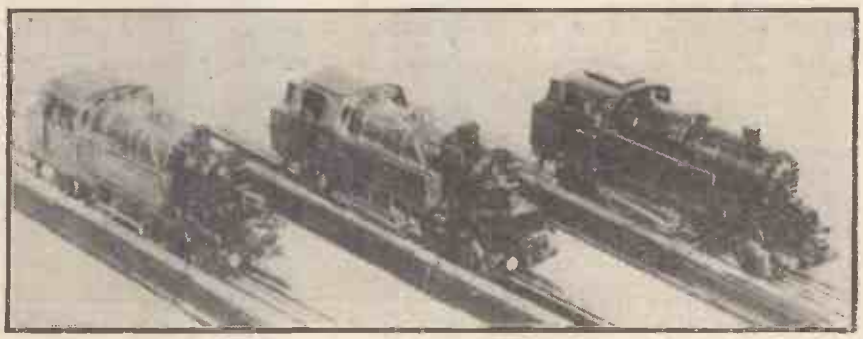


Fig. 1.—Three German OO gauge locomotives rebuilt into English style by Mr. W. Richter.

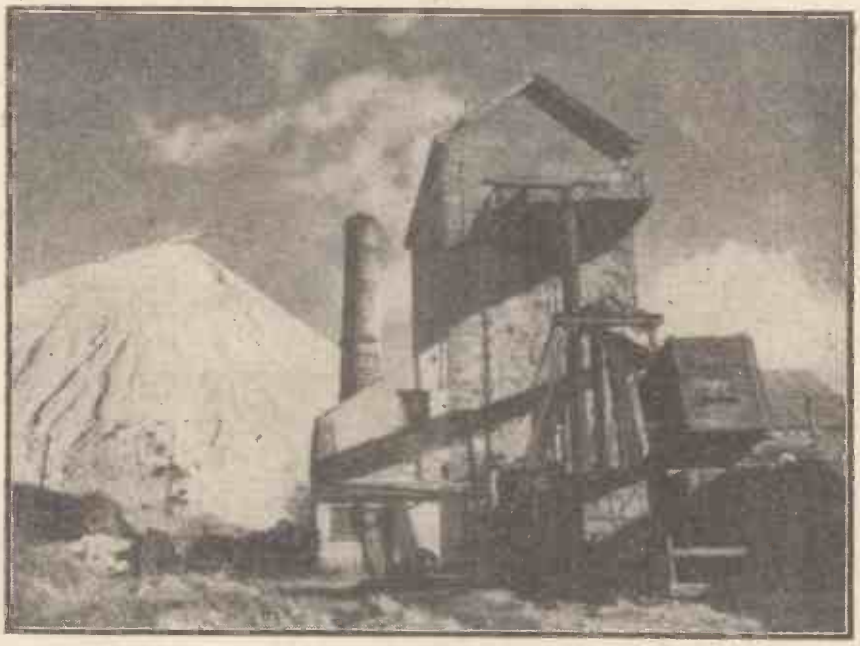


Fig. 4.—The engine house at Parkandillick, near St. Austell, in the Cornish china clay working district. The engine in this shaft was built in 1852 by Sandys Vivian & Co., of Hayle. It was moved to its present site in 1912. The white pyramid in the background is one of the waste tips of granitic particles left after the china clay has been extracted. Photograph from the Shell film "The Cornish Empire."

companies, as they were before being taken over by British Railways.

Naturally, Mr. Richter deplores that he can no longer subscribe to English railway and model magazines. He is among those who regret the prospect of uniform appearance for British Railways rolling stock, although he is hoping that the grouping system will still retain some distinctive features. At present Mr. Richter is engaged in constructing model coaches to show the development of English railway coach building. So far he has model trains representing 1835, 1860 and 1875. His chief raw material in this work has been tinplate obtained from ordinary tins such as are used in canning food, etc. Such is the shortage of supplies of material for this hobby in Germany.

A Model Harbour

I also have a model-making correspondent in Frankfurt-on-Main, Herr Emil von Bronsfeld, who is keenly interested in all branches of the hobby: railways, ships and architectural models. Mr. Bronsfeld's latest endeavour has been the building of a model harbour: this is to a scale of 1:1250, or approximately 100ft. to 1in., the same standard as is used a great deal in English waterline ship modelling.

The harbour prototype is imaginary, so that the buildings in the model represent various styles of national architecture, although they are, of course, predominantly German. Gabled houses flank the dockside, along with warehouse buildings and shipyards. There is a twin-spired cathedral, a model of Lubecker Dom, the old cathedral of Lubeck. Over four hundred waterline models of ships of many nations throng the harbour itself. Among numerous smaller craft can be seen stately sailing ships, modern battleships and many internationally known commercial vessels. These latter include a model of the first German ship to win the Atlantic Blue Riband, in 1906, the HAPAG liner, *Deutschland* also another German Blue Riband holder, which won the title in 1930, the Norddeutscher Lloyd liner, *Bremen*. Mr. Bronsfeld is particularly proud of two excellent waterline models of large modern liners, the Holland-America *Nieuw Amsterdam*, and the Cunard White Star R.M.S. *Queen Mary*, although he tells me that these two models are not his own work. In the photograph reproduced here (Fig. 2), Mr. Bronsfeld is seen with part of the model harbour; as he is placing a small ship into position his hand gives some idea of the scale size of this ambitious model.

Being also a model railway enthusiast, Mr. Bronsfeld is now setting out to build a model town, centred round his German OO gauge railway purchased in 1948. He is continually adding to this railway by making his own rolling stock, stations and other lineside buildings and equipment. Like Mr. Richter, Mr. Bronsfeld is thinking of including some English- and American-type locomotives and coaches to introduce variety into his layout.

As Mr. Bronsfeld has recently met one or two fellow townsmen who are also interested in the model railway hobby, he is hoping that they may be able to hold a small model railway exhibition in Frankfurt some time this year. In finishing his last letter to me he wrote that he was just off to a gathering of "model railway friends" in Wiesbaden, and has promised to send me a report on their activities.

Cornish Beam Engines

In the summer of 1947 I referred in one of my articles to Cornish beam engines, and the formation of the Cornish Engines Preservation Society. I am pleased to learn that the Shell Petroleum Company are taking a great deal of interest in the activities of this Society. To assist in the good work the Shell film unit has made a 16mm. sound film of the history of the Cornish engine. In addition the same unit has made six separate films (also 16mm. sound) showing individual engines that are still operating. These six films were all made in 1947: the first three show engines in the Camborne-Redruth mining area, and the others relate to engines in the St. Austell china clay working district.

Included in the Camborne-Redruth group is a film depicting the famous engine in Cook's Kitchen shaft, South Crofty mine. This engine was built by Harvey & Co. at Hayle in 1873 for a South Wales colliery. In 1881 it was reconditioned for work at Wheal Tresavean, near Redruth, when it was supplied with a new beam. Later it was moved to Wheal Grenville, near Camborne, and was finally erected at South Crofty in 1892, where it is still working in a specially built concrete engine house (Fig. 3).

Each of the engines recorded in these films differs in some way from the rest. In the St. Austell group, for instance, there is a film showing an engine at Parkandillick, near St. Austell (Fig. 4). This engine was built in 1852 by Sandys Vivian & Co., Hayle, and was erected at Old Sump shaft, Wheal Kitty, St. Agnes. It was reconditioned and removed to its present site in 1912. Its particular feature is the arrangement of the valves, which allow a simple form to be

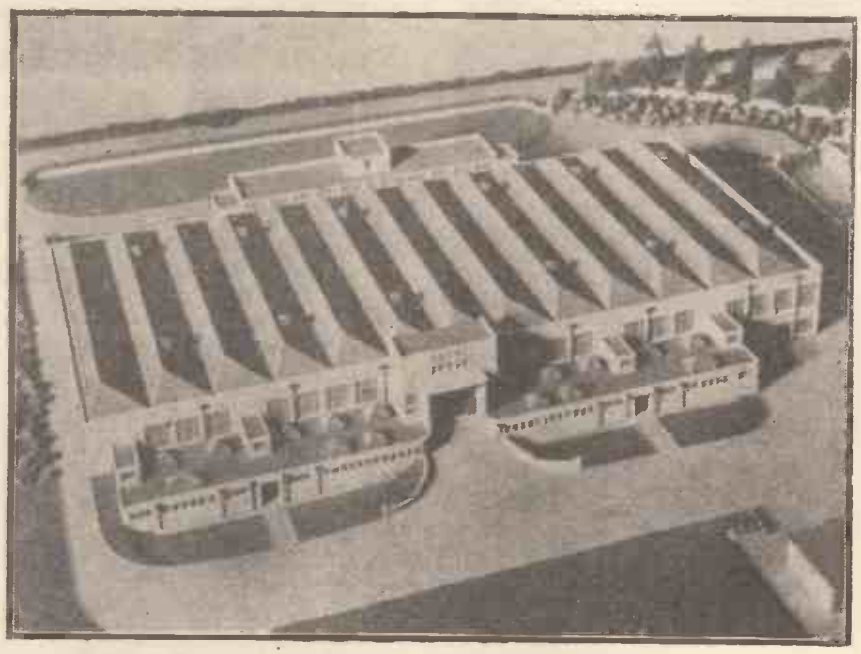


Fig. 5.—Model of the new Lotus factory at Stone, Staffordshire, built to a scale of ½in. to 1ft. The factory was designed by Mr. Raymond E. Hawkins, L.R.I.B.A., of Cannock.

employed for the steam passage, and it is the only engine left in Cornwall with this peculiar arrangement.

"The Cornish Engine" Film

Mr. Sturgess, of the Shell Petroleum Company, in introducing "The Cornish Engine" film to a large audience last February, said:-

"England and the world owe much to Cornish engineering pioneers, and this film makes a valuable contribution to steam engineering history. It is a tribute by the Shell Co., deeply involved in the prime movers of to-day, to the great engineers who developed the prime movers of the past."

Readers will no doubt be interested to know that these films are to be on free loan for specialist engineering audiences, universities, colleges and technical schools, from the Petroleum Films Bureau, 29, New Bond Street, London, W.1.

The travelling model railway exhibition organised by Mr. H. Elliott of Spalding, to which I referred in my model notes last December, is still touring the country and remains a cause of much attraction wherever it is shown. The exhibition was displayed at Derby last February and proved a great attraction. To his already considerable collection of locomotives and rolling stock, Mr. Elliott has added a streamlined "Pacific" locomotive and a new "Super Enterprise" steam locomotive. He is still hard at work modernising the whole of the signalling system on his railway. All model railway lovers would wish to congratulate Mr. Elliott on showing so admirably the capacities of this popular hobby.

A Scale Model Factory

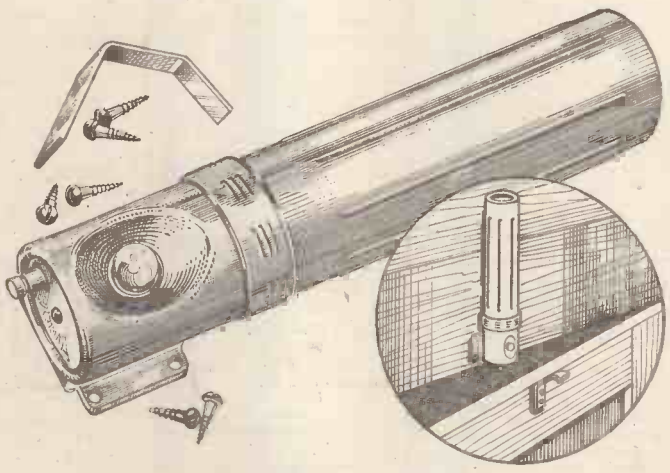
The drive for exporting British goods and the necessity for up-to-date factories and equipment with which to tackle this tremendous undertaking, has resulted in the building of a certain number of new factories and extensions to others. The illustration (Fig. 5) shows a recent model of a new factory erected by Messrs. Lotus Ltd. in Staffordshire: a splendid example of a well-planned modern factory, designed for efficiency. A striking feature of this factory is the complete absence of internal stanchions of any kind, which has resulted in a clear working floor space of 266ft. by 120ft. What a contrast are these modern buildings to the uninspiring edifices of the Victorian period, around which grew the mean slum areas which we all now so strongly deprecate.

Trade Notes

Varley "Door Light"

THIS new light is particularly useful for the home, garage, shed, cupboard, or cellar.

It came about by a demand for lighting up the interior of a gas refrigerator when opened, but to be switched off automatically when the door was closed. The already popular Varley "All Purpose" torch was reconstructed by devising a new "head" and fixture so that the closing of the door would depress the plunger or switch which would remain "up" when the door is open. This unique development enabled the "Door Light," as the invention was called, to be used where "mains" were not normally available. The larder, a dark cellar, a store cupboard can now have its "Door Light" and the danger of using matches, candles or other naked lighting is removed.



The Varley "Door Light"

To fix a "Door Light" is a matter of a few moments with a screwdriver, and it is sold in a special triangular shaped box complete with fittings and instructions.

The device can also be carried in the breastpocket and so free the hands of those on outdoor pursuits like postmen, travellers, etc., as the light is on the side, with a wide beam of great brilliancy and penetrating power.

Another style of "Door Light" can be fixed in car engines and in the "boot" and thus a light is under the bonnet when breakdown occurs or luggage is wanted.

The new "Door Light" is of robust make, cream coloured, and takes two dry cells of the U-type which last for a long time and can be replaced easily upon renewal.

The retail price is 9/9 plus 2/1 purchase tax; obtainable from all leading ironmongers, electricians and stores.

The manufacturers are Oliver Pell Control Limited, Cambridge Row, Burrage Road, Woolwich, S.E.18.

Photography and the Metric System

THE Photographic Industry Standards Committee of the British Standards Institution has agreed that the photographic industry should play a leading role in the introduction of the metric system for assisting the export drive.

To this end Messrs. Johnsons of Hendon have accepted their share of the responsibility for encouraging the practical use of the metric system in photography.

The use of metric weights and measures offers many advantages, hence the publications of most formulæ in alternative systems, but the complications involved in their presentation in imperial measures and avoirdupois, and sometimes even in apothecaries weights, are obvious to all.

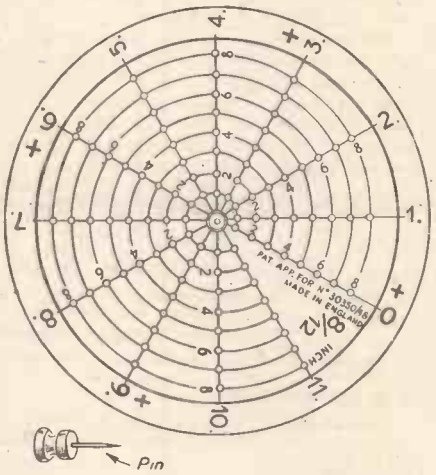
Messrs. Johnson's export trade and the need for increased production called for standardisation in packing and a start was made by marketing a new style Pactums in units of twenty and one hundred instead of selling in multiples of one dozen. Approximately twelve months ago the firm standardised Acid Fixing into 250-gramme and 500-gramme sizes, and Azol has subsequently been changed to metric sizes.

The firm are now making a further step in what must be a gradual change and are standardising the packaging of the majority of their solutions into metric sizes.

A folder giving further particulars and comparative tables can be obtained from Johnsons of Hendon, Ltd., Hendon, London, N.W.4.

The Circlometer

THIS novel drawing instrument quickly converts fine measurements into large divisions for marking off or drawing circles. It is simple to use, avoids eyestrain, and dispenses with compasses, dividers and rules. Made of transparent celluloid, the holes are arranged in two formations: in rows radiating from the centre of the disc, and in lines following an increasing spiral scroll. Each row is indicated with the finer divisions of the scale on the outer ring which is marked with a plus sign. Each line on the scroll is used for the larger divisions of the scale. By following the chosen scroll line to its intersection with the row required a great degree of accuracy is easily achieved. For example, using the architects' scale of 8ft. to 1in. (marked 8/12), the scroll line numbered 4 will intersect the row numbered 5, at 4ft. 5ins. from the centre of the disc. The corresponding setting on the 1/100th inch scale (marked 10/10) would be .45 inches. Directions for use are as follows: (1) Locate disc with centre over the required position; (2) Insert the pin securely through the central hole of disc; (3) Turn disc by pencil or marker in the hole at the required radius, as described. The instrument is priced at 5/- and further information can be obtained from the sole manufacturers, Pattim Engineering Works, Broadway, Weymouth.



The new Circlometer drawing instrument.

SAVE THAT CARTON

Every empty breakfast food, sugar, cigarette, soap-flake packet is urgently needed for salvage.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 64 (THE CYCLIST), must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader: Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Removing Oil Stains from a "Terazzo" Floor

COULD you supply me with a formula for a preparation which would remove oil stains from a "Terazzo" floor?

This floor seems to be porous, and the powder which was supplied to remove the stains is useless.—R. T. Forrester (Dunfermline).

YOURS is a very difficult query to answer without our having made an examination of the floor in question. We should want to know the exact type of terazzo material used, its matrix or binding agent, and, also, the nature of the staining oil.

If the floor has a matrix (binding agent) of tar or bitumen it will not stand solution treatment with petrol or paraffin. If, however, the floor has a cement binder between the terazzo pieces, try going over it with a paste of whiting and paraffin, white spirit or petrol; the idea of this being to dissolve out the oil and to absorb it into the whiting.

If the floor cannot be so treated, spread over it a paste of chloride of lime and water. Let this nearly dry. Then brush over it a dilute acetic or hydrochloric acid (one part acid, five parts water), or even strong vinegar. Chlorine gas will be disengaged (Note: this has a powerful, pungent smell, but is not harmful in small amounts), and this may destructively oxidise the oil stains, bleaching them away, in fact. The process cannot be guaranteed in its results, but it is worth trying.

If the stains are bad and they have not penetrated deeply, they may be found to be removable by going over the whole of the area with a fine abrasive so as to remove the surface "skin" of the stained fragments.

Capabilities of Electric Motors

MAY I request your advice on the following points?

I have only single-phase 230-v. A.C. power available, and it appears that motors of over ¼ horse-power for this type of current are not readily available.

(1) Would a motor of this horse-power drive a 12in. circular saw, or, alternatively, what diameter saw could be driven, assuming no heavy loads? What is the optimum peripheral speed of a saw?

(2) Secondly, is this power sufficient for a 10in. planer, and again, what tool speed is recommended?

(3) And lastly, will a ¼ horse-power motor be sufficiently powerful to drive (a) a single-cylinder compressor to maintain 50 p.s.i. for spraying and (b) a 12in. lawn mower (cutting cylinder only)?—D. Pearse Baker (Teddington).

(1) WE advise the use of a motor of at least 1 h.p. to drive a 12in. circular saw, a larger motor being suggested for heavy work. A speed of 2,000 r.p.m. at the saw is suggested. We would advise the ½ h.p. motor being used with a saw of not more than 8in. in diameter, the saw speed being 3,000 r.p.m.

(2) The ½ h.p. motor would be much too small to drive a 10in. planer.

(3) A 1/3 h.p. motor should be suitable for driving the cutting cylinder of a 12in. lawn mower.

It is not possible to say if the 1/3 h.p. motor would be large enough to drive the air compressor, without knowing the volume of air delivered at the 50lb. pressure. It would only be suitable for a very small compressor, delivering not more than one cubic foot per minute.

Painting Soldered Brasswork

CAN you please inform me of a simple treatment to be given to brass with soldered joints to enable enamel or paint to adhere more firmly; also whether paint or enamel would be more durable after the treatment?—P. R. Moss (Ware).

RUB the brasswork all over with a coarse emery cloth so as to roughen the surface slightly. Then give the surface a thin coat of a flat grey priming paint. When dry, rub this down with a fine sandpaper and apply a similar thin coat of the grey priming paint. Rub this second priming coat down a little but not as much as the first. On the resulting surface put the final coat of enamel. You will find that the above treatment will give an enamel coating of maximum durability.

Silvering Compound

I HAVE an antique brass dial belonging to a grandfather clock. I wish to re-silver the chapter ring. Can you please furnish me with instructions how this should be done?—J. Nicholson (Otley).

A SILVERING compound for the silvering of chapter rings of longcase clocks can be made from the formula below.

Silver chloride	20	parts (by weight).
Cream of tartar	60	"
Common salt	60	"

This powder is made into a paste with water and rubbed on the cleaned brasswork with a soft cloth. Silver in the characteristic "white" form is at once deposited. The chapter ring, when silvered, should be lacquered with a clear lacquer.

You should be able to get the above material from your local pharmacist, or, alternatively, you can purchase them from Messrs. Wm. Canning & Co., Ltd., Great Hampton Street, Birmingham, which firm also sells ready made silvering powder for the above use, in addition to a clear lacquer for finishing.

White Cement for Garden Ornaments

WOULD you please tell me how I can make cement white permanently, as I wish to make some cement curbings and ornamentations for my garden? Also, what percentages of sand, cement and colour should be used to ensure hard wear?—L. Eaton (Dereham).

MIX together one part ordinary Portland cement, two parts sharp sand (not sea sand) and one part of a white pigment such as zinc oxide of titanium oxide. When slaked with water, this will give a white cement. If you are going to make the cement into stones, artificial rocks, etc., you should mix large stone fragments with the cement. These stone fragments can be of any colour, provided that they do not show on the surface of the finished articles.

Readers are asked to note that we have discontinued our electrical query service. Replies that appear in these pages from time to time are old ones, and are published as being of general interest. Will readers requiring information on other subjects please be as brief as possible with their enquiries.

Weed-killers

I HAVE a 600ft. driveway which is overgrown mainly with grass, and would be quite impossible to clear properly by hand. Therefore I would like to use a non-selective weed-killer. Could you recommend a chemical or chemicals that would meet these needs?—R. F. Owen (Midhurst).

THE cheapest non-selective weed-killer for your purpose consists of a solution of creosote in caustic soda solution. Make up a strong solution of caustic soda by dissolving, say, 1 part of the caustic in 3 parts of hot water. To the solution add 2 parts of creosote. Apply liberally to the ground, preferably in dry weather, and at intervals of a few days. Three applications should be sufficient. Creosote is obtainable at any firm of builders' merchants or oil stores. Caustic soda can be had from any retail pharmacist.

Sodium chlorate would not be very suitable for the above use. It is too selective.

An alternative weed-killer consists of a strong solution of copper sulphate to which some sulphuric acid (the more the better) has been added.

There are, of course, very drastic weed-killers containing lead arsenate and other arsenic compounds. If you can obtain any of these at your local horticulturist's, you may care to use them. Their effects are permanent when used in quantity, but they are dangerous to handle and work with.

Leather Dyes

I HAVE a leather strap, tanned brown on one side, but natural colour on the other, which I wish to dye black. It is to be used as a shoulder-strap for a portable radio, so the dye must be heat resisting and waterproof so as not to mark clothing, etc.

Could you please advise me of a suitable dye or stain? Would a fixed Indian ink or marking ink be suitable?—D. J. Grant (Walthamstow).

YOU cannot possibly dye leather satisfactorily by means of Indian or any other type of ink, since these are all based on water, and they will not penetrate the leather sufficiently to give any depth of colour of general fastness.

You can use an oil-soluble dye or even a spirit-soluble dye, dissolve in methylated spirit, or in white spirit, paraffin or turpentine (genuine or subs.). Several applications of such solution to the perfectly dry leather, followed, finally, with a layer of a hard wax polish, should effect the result and produce a non-rubbing dye. It is, of course, best to use an actual leather dye which can be dissolved in any light oil and used in the same manner, several applications being made. In all cases the dye solution should be used as hot as possible and the leather itself should be as dry as possible in order to effect maximum penetration of the dye into the leather.

Such dyes are not soluble in water. Hence they will not wash out. But, unfortunately, they may tend to rub in too much dye accumulates on the surface only. This is best counteracted by sealing the dye in with a final layer of wax.

Before commencing operations the existing glazed surface should be gone over with fine sandpaper so that the surface "skin" may be slightly roughened and be brought into a more dye-absorbable condition.

Oil and leather dyes can be obtained in small quantities from any firm of wholesale chemical suppliers, as, for example, Messrs. Griffin & Tatlock Ltd, Kemble Street, Kingsway, W.C.2; Messrs. Baird & Tatlock (London), Ltd., St. Cross Street, Hatton Garden, E.C.1; or Messrs. W. & J. George & Becker, Ltd., 17-29, Hatton Wall, E.C.1

Filtering Tap Water

THE effect of impurities in the local tap water is causing me some difficulty in producing highly glazed photographs.

Since I use distilled water, and filter all solutions, the difficulty does not arise until the washing stage, small particles of dirt being then introduced, which not only embed themselves in the print, but also cause serious scratching of the chrome plate.

The large volume of water necessary for efficient washing precludes the use of distilled water. I have been experimenting with several filter funnels, but find that normal filtration is far too slow.

I should be obliged if you could suggest a suitable design for a water filter which will remove these troublesome impurities and yet allow a sufficiently fast rate of flow to be maintained.—M. Ailchin (Fareham).

A DISC of 200 mesh brass or copper gauze fitted inside a large funnel should prove satisfactory for filtering all coarse particles from a main water supply. Two such funnels would make doubly certain of the absence of such particles from the water, and the speed of flow should not be very appreciably reduced.

Alternatively, you can make use of the method of upwards filtration. For this you must provide yourself with a closed metal container having an inlet and an outlet pipe. The inlet pipe goes to the bottom of the container. The outlet pipe is taken from the top. A ring of the above gauze is fitted near the top of the container. The ring should have a metal "frame" and should be so arranged as to be removable for cleaning. The inlet water to this apparatus rises upwards to the outlet pipe, and, in so doing, must pass through the metal gauze, which will effect sufficient filtration for your purpose.

A combination of the above two methods should completely remove your troubles.

Painting Aluminium

I HAVE just built a large two-seater sidecar, the body of which is covered with sheet aluminium, with the exception of the rear locker, which is timber.

Will you please advise me on the priming, undercoating and finishing colour (finishing colour to be black) to obtain the best result? If you advise brush cellulose is it possible to slow down the drying?—A. Jackson (Hockley).

FIRST of all, dissolve 1 part of caustic soda in about 6 parts of warm water and go over all the aluminium parts with this solution. The liquid will remove surface grease and will slightly matt the aluminium surface. The woodwork should not be treated in this manner. Mop away all the caustic liquor with plenty of fresh water. Then wipe as dry as possible and give a very thin coating of a flat grey priming paint. Get the coating as even as possible, but the thinner it is the better. Do the same to the woodwork. Let the coating dry and harden. Then apply a similar thin coat. Let this dry and harden. Then, with fine glasspaper rub the whole of the coating until you get it as smooth as possible.

You can then work this up with either an oil enamel or a cellulose enamel. The oil enamel is more controllable and is slow drying. The cellulose paint is more difficult to apply but it gives a rather glossier surface and, moreover, it is unattacked by oil and petrol. You cannot very well slow down the drying of the cellulose enamel without altering its qualities.

Alternatively, you could use one of the bakelite enamels based on synthetic resin of the bakelite type. This gives a good gloss and is highly resistant to oil and grease. The Bakelite Co. at Birmingham would supply you with this material. You can get ordinary oil-based enamel from any good paint store, whilst an excellent firm of cellulose paint specialists is Messrs. Nobles & Hoare, Ltd., 3, Cromwell Road, London, S.E.1.

On the whole, unless you are well experienced we think that you should not attempt cellulosing your sidecar, but rely on either an oil enamel or a bakelite paint, the latter being easily brushed and being obtainable in a slow-drying oil variety and a quicker-drying spirit variety. The headquarters of Bakelite, Ltd., 18, Grosvenor Gardens, London, S.W.1, would, no doubt, be glad to give you exact information as to the particular type of their product to use.

Electric Light Cable

I HAVE a temporary garage about 10ft. away from my house. What type of cable should I run for electric light? Is it necessary to run the cable in tubing? I was thinking of using lead-covered cable, under the garden soil.—R. R. Gill (Burnley).

TWIN lead-sheathed cable would be very suitable for supplying the garage, as it is waterproof. The cable should, however, be protected from mechanical damage where necessary. This can best be done by fitting the cables in screwed conduit, preferably galvanised. Alternatively the cable could be protected where necessary by wooden casing above ground, and by covering this with strong tiles below ground. The sheathing on the cable should be connected by means of a stout copper wire to a reliable earthing point, such as a main cold-water pipe. It is advisable that a fuse be connected in the "live" pole of the cable where this is connected to the house wiring, with a removable link in the other pole.

Fireproof Roofing Tiles

WHAT is the composition of fireproof roofing tiles, and the general method of manufacture? I understand that they are composed of a special heat-treated cement.—N. Cooper (Birmingham).

THE roofing tiles which we think you refer to are of the asbestos-cement type. They consist merely of asbestos powder mixed with cement and then allowed to set hard in shallow trays.

Asbestos powder for this type of work can be obtained from Turner Brothers Asbestos Co., Ltd., Rochdale, Lancs.

The tiles are not heat-treated in any way, since the application of heat would tend to disintegrate the cement mixture. Such tiles have good fireproof properties, but they tend to "age" with lapse of time and to become very brittle. Moreover, they are not as weather-resistant as the slate tile, or that of the furnace-baked variety.

Removing Water from Gelatine

I SHALL be glad if you will inform me of an easy process to remove all water contained in inflated gelatine in order to re-use the latter for further application.—F. Costaras (Ismailia, Egypt).

THERE is no easy way of removing water from gelatine. The only method is one of prolonged heating at a temperature not exceeding 110° C., and, for preference, the heating should be done *in vacuo*, that is to say under conditions of reduced air pressure, in which instance a lower temperature can be employed and there will be less danger of the gelatine undergoing partial decomposition by heat.

The exact conditions of the process will depend on the type of gelatine, its physical and chemical nature, the amount of water to be removed, and the final purity of the material which may be required.

Polished and Toned Metal Window Frames

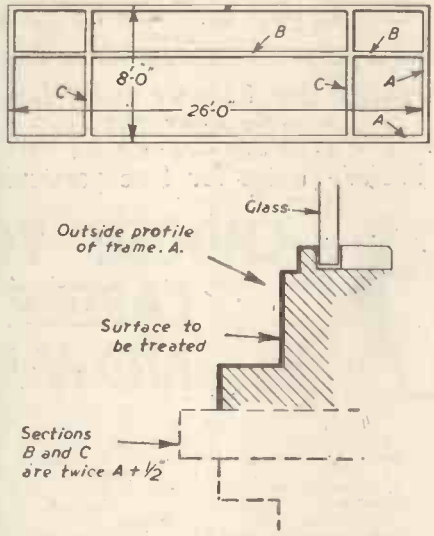
A CLIENT of mine has recently supplied, fixed and glazed complete, five large shop-front windows, each 8ft. high and 26ft. long, as shown in the accompanying diagram. The framing is in extruded bronze and all the windows are now in use.

The point is this: These windows were specified to be finished in sandblast and toned, although at the time I pointed out that polished and toned would be more suitable. However, at the architect's request they were finished as specified. Now after three months the architect dislikes the somewhat dulled and dingy appearance of what could have been a beautiful job.

Can you suggest a means of brightening the surface of the metal to give the appearance of polished and toned?—C. L. New (Birmingham).

WE entirely agree with your views on the superiority of the polished effect of the toned metal. However, the man who pays the piper is justified in calling the tune, and, quite clearly, you are absolved from all responsibility for the unsatisfactory nature of the metal framing.

The best means of brightening the surface of the frames in the manner which you require is a very simple one. Use a scratch brush. But be sure that the



Layout and section of metal window framing (C. L. New)

brush is of *brass*—not of steel, which is too hard for the metal frames. A brass scratch brushing will, we think, give just the effect which you want. After this, the frames should be sprayed over with two coats of a clear cellulose lacquer.

You can tone the metal by brushing over it, before lacquering, a solution made by dissolving 1 part of sodium sulphide in 99 parts of water. Sodium sulphide is a photographic chemical, obtainable from any big photographic dealer. It does not keep well, so do not buy more than an ounce of it, which should suffice for your purpose.

Try the effect on a small area at first, and if the toning is too severe, dilute the solution.

Do not emery the surface. You will only make it duller—and blacker.

Fluorescent Dyes

WOULD you please let me know, under their correct names, which dyestuffs give the brightest fluorescence under ultra-violet rays in the following colours, these being the fluorescent colour with an indication of the colour in ordinary light:

Blue, green, yellow, scarlet, orange, violet (mauve).

The dyestuffs are required to be solvent in methylated spirit.—L. Crisp (London, W.).

BY using pure substances you will probably not be able to get the precise fluorescences which you aim at, but by suitable admixture you will find this possible.

The following are the dyes which, in spirit solution (unless otherwise noted) give fluorescences of the various colours under ultra-violet ray excitation:

Yellow
Phloxine, eosine, eosine scarlet, safranine, rhodamine.
The above solutions are yellow to red in normal lighting.

Orange
Rose bengal, fast acid violet (in aqueous solution), violamine (in aqueous solution).

Red
Resorcine blue, rhodamine, 3.B.

Green
Benzoflavine, uranin (in aqueous solution).

Yellow-green
Fluorescein, eosine. phosphine.

Blue
This type of fluorescence is not given by dyestuffs. It is best seen in an aqueous solution of quinine bi-sulphate, or in a solution of Vaseline in paraffin or petrol. Cadmium or calcium tungstate also give a good blue fluorescence in the dry state.

A mauve fluorescence must be obtained by experimental admixture of other fluorescent materials.

Papier-mâché Work

I SHALL be glad if you will give me some help. I have been using paper pulp with a handwork class in school, modelling it round bowls, plates, etc., as moulds. I have been using a mixture of newspaper pulp, flour paste and whiting. When dried, with or without heat, this dries with a very rough surface. Could you tell me how to retain the smooth finish obtained when the pulp is wet?

Also, is it possible to prepare a pulp which will resist the effects of water when dry? This would be used for bulb bowls and the like, as at present these soften even when varnished and painted.

We are also troubled a good deal by warping especially when a fairly flat surface is aimed at, so perhaps you could advise regarding this.—J. Williams (Teignmouth).

THE rough surface of your papier-mâché work is, we think, due to the use of flour paste. If you would use glue instead of the flour paste, the general effect would be much smoother. Use a solution containing 10 parts of glue dissolved in 90 parts of water, and add a few drops of carbolic acid, creosote or clove oil to it to act as a preservative. The solution will set to a jelly when cold. It must, therefore, be used warm.

By spraying the finished papier-mâché article thus prepared with a dilute solution of formalin, or by immersing it bodily in such a solution for a few minutes and afterwards allowing it to dry again, the glue will become water-resisting. This is due to the fact that the formalin renders the glue completely insoluble, even in hot water. As a working solution for spraying, brushing or immersion, mix 1 part of commercial formalin with 3 parts of water. The solution will remain good indefinitely, but care should be taken to avoid getting it on the skin, since it has a powerful hardening action of the skin and nails, causing them to break.

To a large extent the warping which you complain of can be avoided by incorporating a little inert filler with the paper pulp. Any inert, white fine powder will suffice, particularly zinc oxide or barytes. Asbestos powder (obtainable from Messrs. Turner Brothers Asbestos Co., Ltd., Rochdale, Lancs, or from Messrs. A. M. MacCarthy, 37, Sandford Road, Moseley, Birmingham, 13) will also have a similar effect.

The tendency to warp may also be counteracted by building up the papier-mâché articles in several laminations, allowing the one to dry before forming the other and, again, by gluing down a sheet of paper or thin fabric over the first lamination before laying down the second one.

"Embossing" Glass

I SHALL be obliged if you will assist me with the following problem:

How does one go about embossing glass; what is the acid used, and the wax? Can you explain the full procedure and preparation? Also, can you inform me were I can obtain the acid, wax and the lead sheet or tinfoil used? I can obtain the glass and vitrolite.—B. Anderson (Liverpool).

GLASS articles are not directly "embossed." Such embossing is normally moulded in the glass, or else cut into it. The process is not one in which any etching acid is used.

If you refer to the technique of marking designs on glass surfaces, this is effected (a) by sandblasting, the glass being covered with a steel stencil and then subjected to a hail of sharp sand particles shot from a sandblast gun, or (b) by acid etching, the glass surface being wax- or resin-coated, the design inscribed on the prepared surface and an acid poured over the latter.

Sandblasting is the more usual process, and plant for this technique can be obtained from Messrs. Grauer and Weil, Ltd., 3/4, Hardwick Street, London, E.C.1.

The etching fluid used in the latter process is strong hydrofluoric acid. This is a somewhat dangerous fluid since it is capable of inflicting burns on the skin. It cannot be obtained in glass bottles, but it is sold in ceresin or vulcanite containers, which are non-returnable and which are charged extra to the cost of the acid. The acid can be obtained from any chemical merchants, your nearest one probably being Messrs. Reynolds and Branson, Ltd., Leeds. London chemical merchants supplying this material are: Messrs. Griffen and Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2; Messrs. A. Gallemkamp and Co., Ltd., 17-29, Sun Street, Finsbury Square, London, E.C.2: Messrs. W. and J. George and Becker, Ltd., Hatton Wall, London, E.C.1.

Any wax can be used as a resist for the acid. A good composition is a mixture of ceresin or paraffin wax and resin, used about 50: 50. This is wiped over the glass surface when molten. After setting, the design is inscribed with a sharp stylus on the wax, so that the surface of the glass is thereby bared for the solvent action of the acid. The acid is poured (sparingly) on to the design and allowed to act for about five minutes, after which the wax is cleared off the surface, thereby revealing the design permanently etched on the glass.

The process is not easy, and it is rather dangerous on account of the highly corrosive nature of the acid.

Lead sheet and tinfoil are not used in the acid-etching process, since they would both be attacked by the acid.

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Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

Cycle Thefts

IT might be thought, in view of the large number of bicycles which are stolen every year, that magistrates would be particularly severe when a cycle thief is brought to the dock by the vigilance of the police. Cycle thefts are difficult to detect, and the bicycle, because of its very tractability, is easily stolen. Many thousands of them are never recovered, and few of the thieves are caught. An alert police officer the other day, however, was in a cycle shop at the same time as a man was endeavouring to dispose of a bicycle. Suspecting it to have been stolen he looked for the frame number, only to find that it had been filed off. The Forensic Science Laboratory were able to establish the number from the deformation of the metal structure caused by the metal marking stamps, and upon this evidence the thief admitted his guilt. When he was brought before the magistrate he was fined the comparatively modest sum of £3, and as the bicycle had been stolen over a year before, the thief had had the use of a bicycle for just over a shilling a week. This unwarranted leniency on the part of the magistrates can hardly be said to discourage cycle thieving. What is wanted are a few stiff prison sentences.

An aspect of the matter which is surprising is that a number of bicycles reported as stolen are recovered by the police and remain unclaimed, or the owners are unable to identify them. Few can remember the frame number or any distinguishing details. It is important to keep a note of the frame number, the date of purchase, and the receipt.

The new brake lock which renders the bicycle unrideable deserves to be popular. A yale lock is incorporated in the fulcrum of the brake-lever, and the brakes are locked in the hard-on position when the bicycle is left. Thus the bicycle can be carried away, but it cannot be ridden or wheeled away. If a yale lock is good enough to lock the doors of an expensive motor-car it should be adequate for a bicycle.

The Countryside Bill

RAMBLING has always been ancillary to cycling, and the National Parks and Access to the Countryside Bill will make available to the public a large number of beauty spots at present enjoyed only by the few. It is proposed to spend about £100,000 a year on a National Parks Commission, and the proposal is to provide free access to mountains, moors, downs, beaches, and other beauty spots at present closed to the public. Local planning authorities will manage the national parks, and it is also intended to provide hostels and camping sites in the parks, especially for children. The Youth Hostels Association should benefit from this recognition, by the Government, of their work.

Wheel Sizes

ARGUMENTS for and against 26in. wheels and 28in. wheels have been going on for the best part of 40 years, and we thought that the undoubted advantage of the 26in. wheel had been recognised and, except for touring bicycles, standardised. This contentious subject, however, has reared its head again. It is suggested that the conditions which favoured a 28in. wheel have returned because of the poor state of our roads due to the ravages of war traffic. Very little money is being spent on the roads at present due to shortage of labour, shortage of material, and an economic policy which requires the money for other purposes. A 28in. wheel is undoubtedly more comfortable to ride on than 26in. over rough roads. The smaller wheel will tend to follow the contour of the road and give a more bumpy ride than a 28in. wheel, which will bridge the pot-holes. On the other hand, the 26in. wheel gives a lower riding position, enabling the bicycle to be straddled with both feet on the ground at traffic stops, and it therefore makes for a safer machine. Also, the frame can be made slightly lighter. For fast cornering, the lower riding position is at a disadvantage in that it cannot be inclined to the same angle as a machine fitted with 28in. wheels. For this reason 6½in. cranks are normally fitted to machines having 26in. wheels. In our view, road surfaces to-day, in general, are so good that the larger wheel is unnecessary. Nor do we altogether agree with the compromise of a 27in. wheel.

Safety Cyclists

AN analysis of accidents statistics shows a steady drop in the number of cyclists killed. In 1948, for example, 827 were killed, in 1947 812, in 1946 833, in 1945 918, in 1944 1,185, in 1943 1,069, in 1942 1,134, 1941 1,355, 1940 1,363, 1939 1,374, 1938 1,390, 1937 1,421. Not all of the credit for this decline can be due to the increased care exercised by cyclists. Some credit must be given to the safety measures which have been introduced, and perhaps a little to the instructions which those of accident-prone age receive at school. At the present rate of decretion it would appear that in about 10 years fatal accidents to cyclists will be non-existent. Indeed, if the law of average holds good, we can plot a graph and estimate almost to the month when accidents to cyclists will cease! Things, however, may not work that way. Petrol restriction has cut down the number of miles covered annually by motorists, and the less miles a motorist travels the less is the possibility of an accident. Satisfactory though this tendency is, accidents are still deplorably high.

Sixty Years of Progress

IT can be said of the late J. B. Dunlop that he built better than he knew. We do not believe when he produced the pneumatic tyre, for his son Johnny, that he had any other intention than to relieve the discomfort which the boy felt in riding over the rough stone setts of Dublin. It was others who foresaw the immense possibilities of riding on air, and we think that most credit should go to the Du Cros family who, with commendable business acumen, perceived that the days of the solid tyres were numbered. In spite of the importance of the invention, the pneumatic tyre was by no means accepted in its early days. It was vigorously opposed by competitive interests. Many race promoters banned its use, and handicappers imposed vicious handicaps to make sure that the pneumatic tyre was kept out of the race. It is almost unnecessary to say that the arch-apostle of lost causes—the N.C.U.—supported, surprisingly enough, by the late George Lacy Hillier, vigorously opposed the pneumatic tyre. Those tyres were not the light and lithe tyres which make bicycles such lively things to-day. They were crudely attached to wooden rims, and it was a major operation to repair a puncture. The tyres, complete with the wheels, had to be sent back to the makers. They were large in section, but notwithstanding this the rider could put up faster times than with solids.

One member of the Du Cros family is still alive and active—Sir Arthur Du Cros, who has set down in *The Wheels of Fortune* the whole history of the inception and development of pneumatic tyres. He is to be fêted in London shortly by the Roadfarers' Club, of which he is a member, and as announced elsewhere in this issue some of the relics of the past will be shown.

New N.C.U. President

H. S. ANDERSON succeeds E. J. Southcott as president of the National Cyclists' Union. Southcott has been keenly interested in the National Cyclists' Union all his life, and now that he becomes the first past president he becomes an officio member of the General Council.

At a recent meeting of the N.C.U. conditional compensation for loss of wages to racing men competing outside the United Kingdom was approved. A motion to permit massed start racing on the highway was defeated by 30 votes to 15. This highly debatable topic was fully discussed, and the voting shows that members of the N.C.U. are by no means unanimous in their opposition to it. We wonder whether the opposition, such as it is, is a matter of expedience, and because certain of the officials have not the courage to admit they are wrong. It cannot be denied that there are many in the N.C.U. who allow their pugnacity to blind their judgment. They intend to impose their will on the majority.

The new president is 49 years of age, and a member of the Manchester Wheelers. He has been closely associated with N.C.U. section activities.

Certain classes of membership will cost more. Affiliated fees will be 4/- per member with a minimum of 40/- per club as compared with the 3/- and 30/- formerly imposed. Associate members will now pay 1/- more, bringing the annual cost to 4/- per member. Permits for race meetings will cost one guinea.

PARAGRAMS

By the old bridge at Portinscale, Cumberland

With Lorton Fells in the background.

Club Secretary Dies

THE death has taken place in Chesterfield Royal Hospital, at the age of 26, of Mr. Haydn Victor Brooks, of 31, Hollingwood Crescent, Hollingwood, Derbyshire, a well-known local cyclist and Chesterfield Spire Club's racing secretary. Tribute to the work of Mr. Brooks was paid at the meeting, a few days after his death, of a neighbouring club, Bolsover Castle Cycling Club, at which members of the Spire Club were guests.

Good Going

ELEVEN-YEAR-OLD David Baines, of Woodston, Peterborough, appears to have the makings of a good cyclist. In company with his father he set off the other Sunday to ride 60 miles or so to Hunstanton. They set off about five o'clock in the morning and reached Hunstanton before 10 and after several hours by the sea David and his father faced the return journey against a head wind; reaching home about eight o'clock at night. That night he slept very well indeed!

Bicycles for Berlin

FOR the first time since the beginning of the Russian blockade of Berlin bicycles have entered the city for sale. Aircraft of the airlift have just taken in the first batch of 125 machines, which will be sold at normal prices, in spite of the increased cost due to the machines having to be taken to the city by air. When the news got round it was expected that there would be long queues of foot-weary Berliners waiting for the chance to buy themselves a bicycle.

Olney Pancake Race

TO encourage the competitors taking part in the annual Olney Pancake Race, in which local housewives have to run 200 yards and toss and catch a pancake in a frying pan three times, Mr. R. Perkins, of Olney, appeared at the course riding the old penny-farthing cycle which his father used to ride. To add to the old-world atmosphere he wore an old-fashioned smock and a false beard. According to the rules, as well as running the course and tossing their pancakes, the competitors must all wear aprons.

And the Policeman Said?

"I THOUGHT I was being chased by a drunken man," explained a 15-year-old Grimsby girl when she was stopped by a policeman and told she would be reported for cycling without a front light. What the policeman said in reply was not told to Grimsby County Juvenile Justices, who dealt with the charge against the girl and fined her 10s.

Eighth Time Lucky

AFTER some discussion, Grimsby Town Council, after allocating seven of the new shops on their Nunsthorpe housing estate to various tradesmen such as grocers, chemists and fish fryers, have decided that the eighth shop may be let to a cycle agent and dealer in radio and electrical goods.

Disappearing Landmark

THE gales with which March heralded its arrival turned Northamptonshire's last remaining post mill, that at Bozeat, into a heap of smashed timbers and rubble. The mill had been a landmark in the village since it was built in 1761, although it is many years since it was in use. It stood about 35ft. high on a stout oak post measuring nearly 3ft. square and the wind toppled over post and mill with a crash that startled the villagers. An oak beam 25ft. long projected from the body of the mill and so well was it adjusted that the mill could be turned into the wind by one man walking round pushing the beam.

Mile for Every Year

WHEN Arthur Richardson, ex-soldier and former trawlerman, of Calverton, near Stony Stratford, reached the age of 52 he thought it was time he learned to cycle, so he bought himself a brand new machine and, to celebrate the occasion, rode a mile for every year of his life. The next year, to mark his birthday, he cycled 53 miles, and to celebrate his last birthday, his 69th, he has just ridden 70 miles to make an even figure and give himself good measure. So far, in the past 17 years, he has ridden some 50,000 miles, and he feels fit enough to see a few thousand more miles pass under his wheels.

More Cycle Sheds Wanted

SO many children are now cycling to Peterborough schools, that in some cases lack of parking space is so acute that cycles are stacked six deep against the school walls, and the teachers are forced to limit the use of cycles to scholars living more than a certain distance from school. For some time the education authorities have been urged to provide more cycle sheds and racks, and they have now allocated £800 in the current year's estimates towards helping to solve the problem. One headmaster, commenting on the position, said: "To-day, just as parents want a car, so the child wants two wheels, and wants to be able to ride to school, however short the distance."

Footpath Cycling Allowed!

AT the March meeting of Huntingdon Borough Council the Deputy Chief Constable told surprised councillors that cyclists can ride on footpaths in Huntingdonshire "which do not adjoin roads" without committing any offence. He admitted that the practice was dangerous and said that notices might help to stop it. He suggested the Council should make a by-law prohibiting the practice, as otherwise the police were powerless to take action.

Kettering Club's New Trophy

WHEN she presented the prizes at the annual dinner and prizegiving of Kettering Friendly Cycling Club, Mrs. D. F. Underwood, of Kettering, told members that she intended to present the club with a new trophy. The club's 1948 season proved very successful, and there are high hopes for an even better season this year.

Saved for the Nation

BY the efforts of the Royal Society of Arts, a row of eight 16th-century cottages, known as Arlington Row and standing by the side of the mill stream in the picturesque village of Bibury, in Gloucestershire, have been saved from demolition and will be handed over to the care of the National Trust. Twenty years or so ago these cottages took the fancy of an American visitor, who tried hard to buy them for demolition and rebuilding in the United States.

How to Train

MR. LEWIS COOPER, of Boston, who has just retired at the age of 65 after 50 years in the printing trade, was well known in the town and district as a racing cyclist in his younger days. He suggests that his success on the track was due to his early training when he first started work, for then he had to ride nearly eight miles to work and back every day. Also, there was no fear that he might eat or drink too much and get out of condition, for he earned the magnificent wage of half a crown a week.

More Cats' Eyes

HOLLAND (Lincs) County Council have decided to install cats' eyes on a further 24 miles of roads in their area, which will increase the mileage of roads having them to 64. The council consider that for safety reasons the work is amply justified.

New Lincolnshire Club

A NEW Lincolnshire club, to be known as Kesteven Aces Cycling Club, and with members from the West Kesteven area of the county, has been formed, and the officers were elected at the inaugural meeting of the club held at Grantham. The officers elected are: president, Mr. J. J. O'Connor; secretary and treasurer, Mr. H. Sutton (of the Midland Cycling and Athletic Club); runs and social secretary, Mr. A. Broughton, and committee members, Miss J. Willitts, Miss E. Law, Mrs. J. O'Connor and Messrs. K. Willitts and J. Rougham. Preliminary plans for the coming season's activities are being prepared.

Illuminated Targets

IT is reported that certain of the policemen on traffic duty in Paris have been issued with illuminated batons, having red lights at the end, and white helmets and white caps. The authorities apparently think that the mortality rate among the police is not high enough, so they are offering those crazy Parisian motorists better targets. Perhaps they will next give the police bicycles so that they can make a quick getaway, and so add to the sport.

Furious Youth

A 14-year-old boy, charged at Lutterworth (Leics) Juvenile Court with cycling furiously at night, was said by the prosecution to have made three policemen leap for safety because he was riding at such a high speed. This thrill costs the boy a 5s. fine, with a second 5s. for riding without lights, so his Dick Barton activities did not cost him as much as they might have done.

New Yorkshire Bridge

WEST RIDING COUNTY COUNCIL are to proceed with a road improvement project, estimated to cost £87,000, at Thorpe Marsh, near Barnby Dun, Yorks, provided a satisfactory grant is obtained from central funds and the River Ouse Catchment Board contributes £52,000. The scheme includes the construction of a length of new road, and the construction of a new bridge over the River Don. A channel has been cut to divert the river and the bridge will cross this new channel.

Fancy Tyres

AMERICAN cyclists, many of whom seem to like their cycles to resemble motor-cycles as much as possible, will now be able to buy tyres with white sidewalls to add to the decorative effect. The new tyre has been produced by the Firestone Tire and Rubber Co., of Akron, Ohio. Rayon is used instead of fabric in the making of the tyre, which is said to produce one twice as strong as an ordinary tyre in resisting impacts and with a mileage life double that of tyres in which fabric is used. So although the tyre may be a bit fanciful it appears to be a very useful effort on the part of the manufacturers.

Paddle-cycle!

AN American inventor has produced a water-bicycle which he claims can carry several persons without any risk of capsizing. There are two pontoons carrying a light superstructure on which is a seat and steering-wheel and pedals. The pedals drive an eight-bladed paddle-wheel through a stainless steel shaft, and with the use of plenty of muscle power a speed of about four miles an hour can be reached. Only a foot of water is needed for this water-bicycle, which can go backwards quite as easily as it goes forwards.

Modern Morals

DURING a talk to members of a Baptist church club at Peterborough, a local magistrate referred to the problems that magistrates have to face. He said he was recently addressing members of a youth club when a schoolboy asked: "Will you tell me if, when I am riding a bicycle without lights, a policeman shouts after me, can I say I haven't heard him?" Also, on the subject of juvenile offenders, he suggested that the publication of names of the delinquents in the local newspapers might in some cases act as a deterrent.

Around the Wheelworld

By ICARUS

The Jubilee 50

THE Jubilee Unpaced Scratch 50 organised by the Bath Road Club, Ltd., was this year run over the Roadman's Hilly 50 course. There are no freakish hills, but it is a sporting course of give-and-take roads. The only item worth recording this year is the fact that the invitation was extended to tricyclists, as it was thought that riders of the three-wheeler would like to try their speed on a course of this type. When is the Bath Road Club, Ltd., going to organise an event in which its own members will distinguish themselves? At present they are organising events for other clubs to win, and their own members put up very poor shows.

The Cycle Show

THE Cycle Show this year, which takes place from October 21st to October 29th, at Earl's Court, will include two Saturdays, as last year's Show indicated that this is desirable. The King and Queen have agreed to be patrons of the Show.

Coloured Tyres

WHITE, red, silver and translucent cycle tyres are being produced. I cannot say that I have seen many departures from the orthodox colour, but I think that coloured tyres are a move in the right direction as ordinary rubber rather spoils the appearance of a bicycle finished in flamboyant colours. I do not think that they would go well with the sombre black finish which is still the most popular "colour" for bicycles and I do not know whether sunlight has a deleterious effect on colours other than the normal. Any reader who has had experience in this direction is invited to write to me.

Careless Pedestrians

A RECENT M.O.T. analysis of road casualties informs me that during the month of January "1,102 pedestrians stepped, ran or walked off the footpath or verge into the road," and as a result became involved in accidents. In spite of the continuing efforts to save pedestrians from the results of their folly the accidents continue on an alarming scale. Take the Bath Road from Hyde Park Corner to the end of the Great West Road. There are over 100 traffic stops and well over 200 pedestrian crossings, as well as island refuges. This seriously delays traffic, but pedestrians do not use the devices made for their safety. It is my view, which remains unshaken in spite of the vapourings of so-called cycling critics and scribes, that pedestrians should be compelled to obey traffic lights and also to use the crossings. I am also of the opinion that a pedestrian is as much a vehicle as a cyclist. After all, a bicycle is only a device for geared walking, and as it is possible for pedestrians to *cause* accidents without injury to themselves, and escape any penalties for their rash acts, it seems sensible to adjust the law to make it apply to them. It is thought by the authorities that accidents can be prevented by means of regulations, and it is only logical that the regulations should be made to apply to all those likely to be involved in accidents. It may be true that a chicken crossed the road in order to get to the other side, but pedestrians want to cross the road at any particular point. There are other sections of road users to consider, apart from pedestrians, and we do not hear anything about the number of accidents they cause in which they escape scot-free.

Jubilee Year

THE Roadfarers' Club is to pay tribute to the invention of the pneumatic tyre, and the tribute will take the form of a dinner at which will be present most of those fortunately still with us who were associated with its developments. Sir Arthur Du Cros tells me that he is the sole survivor of the Du Cros family, which founded the company that acquired Dunlop's patent. He has set forth stories in a remarkably interesting book entitled "Wheels of Fortune," and at the Roadfarers' dinner he will be the chief guest of honour. Bob Carlisle, who has been with the Dunlop Rubber Company for 50 years, and who was present at that famous cycle meeting, the Queen's College Sports Meeting, at Belfast in 1889, will also be a guest of honour.

William Hume, who won the first race on pneumatic tyres at that meeting, died a few years ago. He was a well-known Belfast linen manufacturer. During Jubilee year, in 1939, he wrote to me pointing out that the bicycle which he rode in those events was destroyed, and therefore the late H. W. Bartleet's claim to have this bicycle in his so-called "museum," which was really a heterogeny of nondescript crocks, was spurious. I have no doubt that all of these points will be mentioned at the dinner, which promises to be historic.

There will be exhibited a bicycle of the boneshaker type as well as some examples of the earliest pneumatic tyres.

A Critic of G. B. S.

GEORGE BERNARD SHAW presumes to express opinions on every subject under the sun, not excluding cycling, of which he can know very little, in spite of his lengthy membership of the C.T.C. As a cyclist he was merely a perambulating prattler. I wonder what the views of Oscar Wilde, from whom Shaw learned the art of wise-cracking at a time when Shaw was comparatively unknown except as a music critic, writing under the name of Corno de Bassetto, would have been on the subject of cycling? Would they have been corny like those of Corno, more associated with bassoons than bicycles? Anyway, Shaw's views on the Highway Code have penetrated to New Zealand, and one of my readers, Mr. C. H. Mason, who resides there, was constrained, after reading Shaw's views, to indite the following epistolary effort: "I happen to be two years younger than G. B. Shaw, and after 70 years as a cyclist, eight in Yorkshire and 62 in New Zealand, I have had only two spills; these were after sunset and due to pedestrians keeping to the left in the track of wheel traffic. The ordinary cycle lamp is often completely neutralised, and pedestrians in dark costumes become almost invisible in the glare of an approaching car's headlights, as every cyclist who has ridden in the dark knows. In my opinion every bicycle should be registered before it appears on the public highway, and every adult cyclist should be entitled to vote on all cycling matters."

The suggestion that the registration of cyclists will improve their status is quaint, and as for the other suggestion it will be many years before any Government adopts the referendum. Legislation is usually restrictive, and under such a system no Government would get anything done. For example, a referendum as to whether income tax should be increased would not receive one vote in its favour, and a similar referendum on any contentious cycling topic would produce similar nugatory results. If cyclists, for example, were asked if they were in favour of rear lights, the majority of them would vote against it, and I should be one of them. I am against rear lights on any vehicle. The headlights of a car are sufficiently powerful to pick up anything on the road ahead. It is not the duty of the owner of any vehicle to warn those behind of his presence.

Stratford-on-Avon, Warwickshire. The church where Shakespeare lies beside the lovely Avon. It dates from the twelfth century, and contains many relics and associations with the great poet and his family.

Wayside Thoughts

By F. J. URRY

Aylesbury, Bucks. The fine parish church of St. Mary with its massive battlemented tower. The King's Head in the market square close by is a good example of a Tudor inn.

Our Good Fortune

ON a Sunday evening late in January—a wonderful month for winter cycling—I came home from a fifty miles' jaunt full of fresh air, and very hungry. After satisfactory attention to appetite I sat by the fire for an hour and idly pondered on my good fortune—the enjoyment of a day along the road free from any stress or strain, the sight of so many inconsiderable but delightful things, the company of a good fellow, and above all the desire to live this little achievement for the sheer joy of it. That is good fortune, and particularly is it good fortune at seventy. What makes it possible and what is the urge of it? To answer this last question first, I think it is just simple, everyday fitness allied to a love of the ever-changing visions of the countryside. There is a whole host of things contained in that reply, enough to fill a volume, and you can gather them all to yourself if you have the good fortune to be a country-lover, and I believe most people are that with the right training and outlook. But at the moment I am more concerned with the query as to what makes it possible. The answer is the bicycle; but what kind of bicycle, for it is a certainty that if I had to ride some of the machines I see on the road I should not be a pleasure cyclist. It is the type of bicycle and its equipment that counts, and remember, in this matter I am writing as an "old man," as the boys call me, but as someone who, loving touring, knows very fully the type of machine that gives me comfort. Often enough we old riders take so many things for granted and imagine every newcomer knows all about the differences between riding a bicycle and comfortably riding a bicycle. I had just returned from a fifty miles' jaunt, half of that distance dead into a brisk breeze, yet sitting in restful ease I was totally unconscious of having had a saddle as a close companion for over five hours. What a thing to be thankful for, and what a compliment to the best in seating accommodation. I think the right saddle is indeed the basis of all cycling comfort, and the most important accessory; yet how casual people are in the matter of choice.

The Gift of Gears

I THINK I would put change gears next on the list; I remember I am writing as an old cyclist and a very happy tourist. My bicycles are normally geared to 60in., a very modest ratio which allows me to make a 12 m.p.h. speed by easy pedalling, for I remember many a year gone that F. T. Bidlake—that elegant pedaller of the long-ago—told me a man can pedal when he can't push. And how true it is you young folk will discover in due time, in fact you can test it now on any steep hill by making a slow climb on the lowest ratio of a four-speed. I do not change my gears frequently on ordinary give-and-take roads; it isn't necessary, for the elastic power in the human muscle is still the greatest factor in cycling; but when conditions of road and wind and weather do become antagonistic, what a comfort it is to increase the leverage by reducing the gear, while retaining a decent approximation to the normal speed of the foot circulation. That is the ideal way of using speed gear changes: to hold to the normal beat of the pedals and not go racing after them to keep the speed level, a mistake that too frequently occurs with the unwary. I use all types of gears, and as far as I am concerned the same remark applies to each. I think my high gears are used only as a kind of special treat, for the conditions have to be ideal before they are brought into operation. After all, I've no urge to travel fast, and no intention of working my passage when I can make it easy and thoroughly enjoyable with the aid of a few more minutes. It is a point worth remembering if you desire to ride in comfort—as I do. There is a lot of nonsense talked about gears, and most of them are badly misapplied in operation, which is a pity, for personally I find them very good indeed. Perhaps they were misnamed at the time of their invention; they never should have been called speed gears, but change gears, for the designation "speed" only applies to the top ratio, and then if used with bad judgment can, and often does, involve hard work.

Running Easily

I AM thankful, too, for my light-weight open-sided tyres. They are not racing tyres in any sense, or they would conform to the narrowest pattern as detachables fitted to rims. They are 1¼in. by 26in., and after trying every conceivable size for my purpose of easy riding I want none other. Keep them properly inflated and I find their average life is round about the 7,000-miles mark if they have the "luck of the road," as the Irish say. That works out at 1s. 3d. per thousand miles per cover; but the price is a side-issue, for in buying comfort and ease, resilience and sweet running, the cost is merely a compliment to the makers and a joy to the user. I know quite a lot of people are frightened of them—they seem so flimsy!—but in reply to that notion remember I am a town rider daily, with granite setts in my path, I weigh well over 11 stone, and should hate to be forever repairing tyres. Such tyres then are certainly another cycling comfort we sometimes fail to fully appreciate, and it is a mistake to imagine their daintiness is a frailty. These things are the counting factors in comfort awheel, they make an enormous difference to your enjoyment of the pastime, and if they are as they should be, part of a decent specification, the only thing to complete the perfection is the correct riding position for saddle and bar. And do not be afraid of a slightly dropped bar to give you a leaning position equally dividing the body weight between saddle, pedals and bar, a writing position at which you can sit all day without cramping or stretching, yet bent to the blast or the slope without adopting an awkward poise that hurts the arms and wrists. Having enjoyed experience, I know what I want and generally manage to get it. Now I am quite settled into comfortable cycling and am duly thankful for these things that have helped me to that attainment, and in suggesting them to you I would have you remember I am seventy, so they may need a little adjustment in gear ratio, but nothing else I submit if your desire is to ride in easy comfort over this delightful land and feel as happy when the day ends as when it started—except for the loss of it.

Each to His Own

A YOUNG man said to me the other day that no one could be called a cyclist unless he was an all-the-year-round rider and undertook a few night journeys. A real lover of the country this, but I think his definition of a real cyclist is a little too vigorous, for I have known many riders—and good ones, too—who are innocent of all night journeys, and would look upon such a suggestion as a form of gentle madness. And, of course, there are people who, owing to defective eyesight would be most uncomfortable in those dark hours before dawn. I have made many night journeys in my time, frequently in order to get well away from my usual orbit when holidays were afoot and I did not want to spend my limited cash in buying train aid. And I've been of a club company on numerous moonlight rides when these fixtures were very fashionable before long-distance lorries thundered along our main roads; but afterwards I have nearly always regretted that loss of sleep, for the next day has found me dozy and a trifle stale, with the memory of the night journey a little blemished by the daylight weariness. Perhaps I am one of those fellows who like my bed at the proper time, and that is the explanation. Yet I would not dare say no one can be considered a full-fledged cyclist who has not ridden through the night on numerous occasions. In these times I prefer the daylight, but that is probably owing to the years that have gone over me. I can, and occasionally do, enjoy a moonlit jaunt providing there is supper and a bed at the end of it; but I do not believe the majority of cyclists enjoy the aftermath of an all-night ride. The last I did was in the early part of the late war when a couple of us passed over the Scottish border in the early hours, had a five a.m. breakfast in Dumfries, and almost the next thing we knew was a lunchtime wake-up by the Solway, some miles beyond Dalbeatie, very cold, very hungry, and rather cross. Newton Stewart was quite far enough for us that day, and we went to bed with the sunset and very little interest in anything beyond the counterpane.

When Comparisons are——

I HAD a new bicycle delivered the other day. "Whatever do you want another bicycle for?" my wife queried, and, like a complacent husband, I answered, "To ride, my dear." Apparently it was not the right reply, for she enumerated the machines I possessed, and expressed the opinion I was planning to live out the century. And to be truthful that would be very nice, providing I remained supple and sane. Of course I have too many bicycles, but I like 'em and they give me the best money value I know. I explained this during the genial argument that followed, incidentally mentioning that if all my bicycles cost a fifth of the good lady's motor-car, we could not afford them, and the upkeep of the latter. I can understand her attitude, but occasionally she finds it difficult to understand mine, even though in earlier times we were the best of tandem partners. Nor am I now complaining, for considering all things I am given great liberty of action to follow my travel habit; and, to be candid, there are times when a car is quite useful; theatres and things, and sometimes a little shooting when an intelligent dog is part of the load. Once there was a horse and trap to collect the goods and do the distant shopping, and the whole outfit cost little more than a couple of good bicycles; but now—well, think of it in terms of money and it makes you wonder at the enormous changes that have taken place in the last half century. Once I could spend a jolly cycling week-end on five shillings and do myself well—once!

This Pitiful Pall

ROAD deaths and accidents are our travel bogey. They make me shudder every time they are published, and yet most people accept them with complacency. I see so much of road conduct in my twenty miles a day in town and suburban areas that I know most of them could be avoided if people would be a little more human, just a trifle more cautious. We do not stop to think; to consider our attitude to the other fellow is just as important to be correctly friendly as his to us. Part of the trouble is that the swift fellow gets away with it because he leaves you no time to remonstrate, and sometimes very little to act for the purpose of your own safety. And candidly I cannot see the need for all this haste which leads so easily to recklessness. Cars, and sometimes cyclists, too, pass me, and in half a mile I have caught them again where the traffic stream thickens, and willy-nilly, we all have to crawl for a period. The other day I assisted an elderly dame over a crossing near the works; she was scared by the hastening stream, although the rule of the road is supposed to give her a safe passage. It is a shame that people at the beginning and end of life should be imperilled by conduct that takes no account of them other than as a nuisance on the road. There has been some criticism of the traffic police; they were wasting time endeavouring to check faulty road-users instead of catching burglars. Yet think, the road tragedies are burglaring life and limb to the tune of hundreds and thousands a year, and in my opinion the police are doing too little rather than too much overseeing. Doubtless man-shortage is part of the trouble, and the killings and maimings are not helping that problem. If you and I are decent law-abiding folk we have nothing to fear in the conduct of a far greater mobile police force, and personally I would welcome it as the only present method of restoring sanity in the manners and in the minds of some travellers. I do not want to see liberty curtailed, but if good manners will not be absorbed by certain types of traveller, then surely they should be imposed by the only method known for the better protection of that huge majority of decent people now horrified at the size of the casualty lists.

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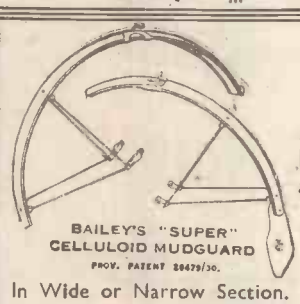

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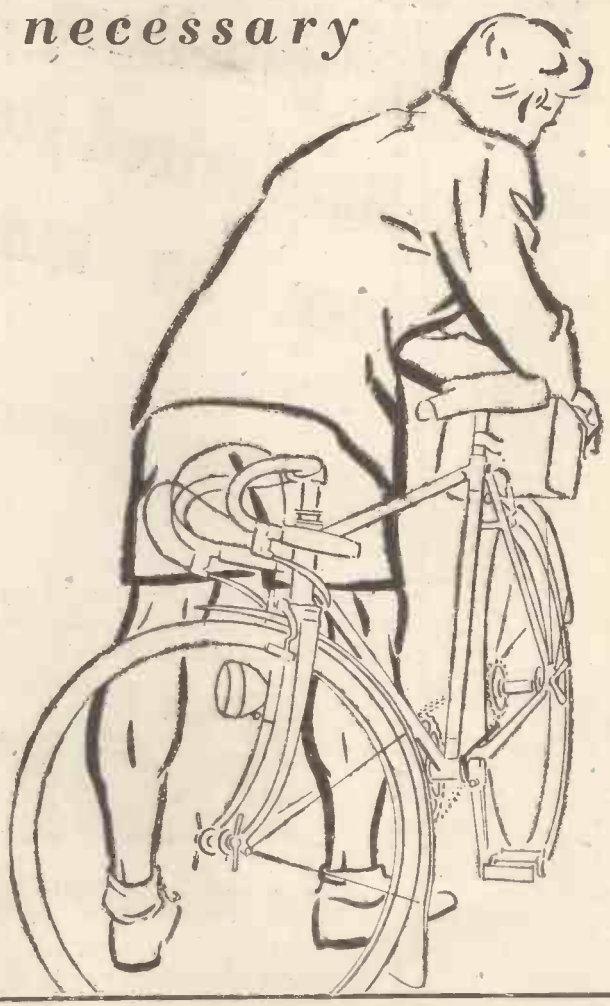

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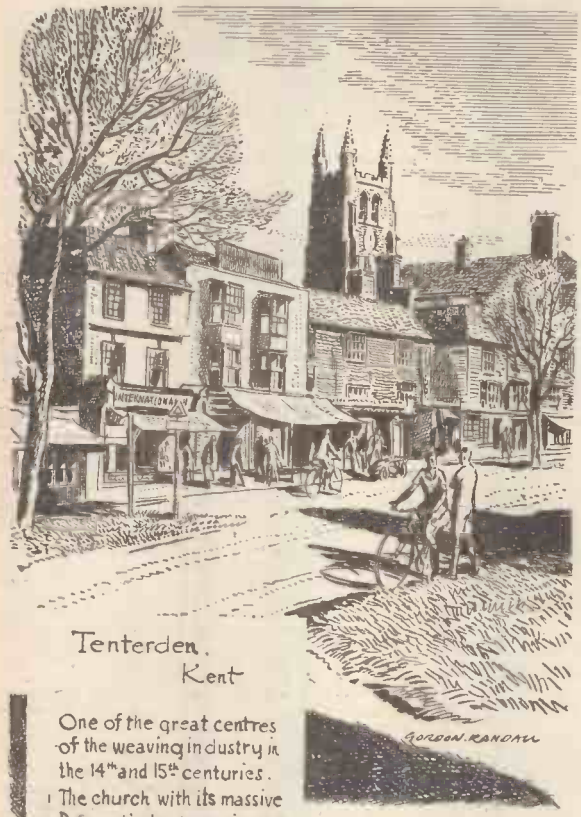
CYCLORAMA

By H. W. ELEY



Tenterden, Kent

One of the great centres of the weaving industry in the 14th and 15th centuries. The church with its massive Perpendicular tower is a well-known landmark. . . .

GORDON RANDALL

Hobbies for the Cyclist

ONE of the great beauties of cycling is that it blends in so well with various hobbies, and lately I have had some interesting chats with riders who have been telling me of the hobbies which they have cultivated, and which they are able to exploit to the full because of their love of the cycling game. One good fellow (I met him in a little inn in Buckinghamshire) was an enthusiastic and quite talented "sketchist," if I may be permitted to coin a word! On his tours he carried around with him a sketch-book, and he was particularly fond of sketching old village churches and inns. In that little and cosy inn not far from Ballinger-of-the-Cherry trees, I looked at his fine sketches of ancient village churches, of inns beside village greens and ponds, and thought how much genuine pleasure he was getting from his twin hobbies of cycling and sketching. A fine and pleasing combination! Another rider talked of his passion for entomology, and told me of his travels in Hampshire, that paradise for the butterfly hunter; he told me of quite rare specimens he had found on heath and commons; of the joy of "mounting" his finds, and putting them into his cabinet. He talked of Holly Blues, and Orange Tips, and Yellow Underwings, and Purple Emperors, and took me back to my own days when, with net and specimen box, I sallied forth in the hope of a good "bag." Entomology is a fine hobby and, again, goes particularly well with cycling. Then there is photography—what a joy to ride out and take pictures of all the good old buildings, the ancient abbeys, the crumbling ruins, the picturesque old timbered manor houses, which abound in this England of ours!

Cycle Exports Continue to Soar

SURELY no industry has contributed more valiantly to the "export drive" than the cycle industry? The latest available figures show a continuing upward tendency, and I imagine that Sir Stafford Cripps must be proud of the great efforts which the cycle manufacturers have made towards bridging that famous "gap." And the industry, because of the energy of its leaders, has found it possible to maintain good supplies to the home market . . . and this is most important, because the bicycle is no "luxury line," but a vital necessity to many thousands of workers. I get about a good deal in agricultural areas, and it is there that one realises how important is the bicycle as a means of transport. Recently, in East Anglia, that good and easy cycling land, I was struck by the universality of the bike. Yes! the British cycle industry has a great record, and it has maintained it valiantly during these difficult post-war years.

The Baby and the Bike

SOME young married couples of my acquaintance seem to deplore the fact that when King Baby arrives he robs them of outdoor pleasures and curtails their normal interests. Others solve this problem by fixing a "baby basket" on their machines and conveying the infant with them into the countryside. The other Sunday, when I dismounted after a good ride and entered an inn for what I considered a well-earned tankard of ale, I chatted with a smiling couple, the proud parents of a bonny baby whom they had conveyed away from the desert of North London into a pleasant little Hertfordshire village. He had travelled in a very efficient-looking basket affair, on the back of father's bike, and seemed to have enjoyed the experience. "We are making him a cycling enthusiast in his infancy," said the father over our pots of ale. And I thought how wise . . . and what a good thing it was, on this bright Sunday morning, for this couple and their child to be finding pleasure and fresh air, and the delights of the road . . . instead of skulking in some flat in a North London street. Housing problems beset many a young married couple, and the seeds of marital troubles are sown in fertile ground when a family is cooped up in unsuitable rooms. Is the cycle with the "baby carrier" one of the solutions?

The Eternal Wanderer

SOME folk do not like gipsies; they mistrust the tawny-faced folk who wander around the countryside and earn a somewhat mysterious living by selling pegs and mats; who love to sit over wood fires, and smoke blackened clay pipes, and let their shaggy horses graze by the roadside. But, personally, I love this ancient wandering race of people, who abhor buildings and streets, and all the crowded life of the town or city. For them . . . the blue canopy of heaven for a roof; the song of the birds for music; the whistle of the wind through the trees to lull them to sleep when the purpling dusk comes. They are with us still . . . though one does not meet them so much as in former years. But in the south, in Hampshire lanes, in the by-ways of Sussex, and in the leafy lanes of Buckinghamshire, one may still meet the groups of men and women, the dark-skinned children . . . the ponies, the gaudy vans with their shining brass-work, and I feel that they bring romance to our modern world. The lure of the road is in their blood, and they cannot be conformed, or controlled, or docketed. A little contemptuous, I think, the Romany goes his ancient way . . . and has no envy of the sheltered life. . . .

Personal Note

MOST of my readers know, I think, that I am leaving the hurly-burly of business and entering the backwater of retirement. On March the ninth some of my friends gave me a wonderful farewell party at the Dorchester, and among the good friends there was Noel Brealey, of the B.S.A. Company—representing the cycle industry, and particularly, the Motor and Cycle Trades Benevolent Fund—an organisation which will remain, in the days of my leisure, very near to my heart. Thank you, Noel, for the kindly words you said . . . and be assured that in my days in grey Derbyshire I shall cycle quite a lot, and the bike will remind me of the industry with which I have been connected for so long.

Great Times!

A MARCH morning . . . and how good the world can be! In the garden, the daffodils swaying in the breeze; out in the road, the gay pink blossom of the almond trees in bloom; from the horse-chestnut tree on the corner, the glad song of a blackbird greeting the new day. And purple and yellow crocuses dotting the lawns with colour after the long winter. Salute to another spring!

Diet for the Cyclist

I SUPPOSE that in these days of strict rationing, and of difficulty in obtaining certain foods, the question of diet for the cyclist has fallen into the background: it is largely a matter of "getting what one can." But the subject is, nevertheless, an important one, and it is obvious that if a rider is to get the utmost out of his pastime he must pay some reasonable attention to matters of diet. When undertaking fairly long tours in the "good old days" before we heard of ration books, or of Mr. Strachey, my own practice was to have a light breakfast, rather after the French rolls-and-coffee style, endeavour to get some bread and cheese and a tankard of ale about noon, and then maybe have a cup of tea at one of those good cottages which used to abound, displaying notices "Teas Provided"—and then, at the end of the day's ride, eat a substantial supper. It seemed to work very well as a system, and, after supper and a peaceful pipe, I used to go to bed feeling serene and content. Of one thing I am certain, it is a bad thing to eat big meals while "on the job," and indulgence in alcohol should be sparing. Perhaps the new tourist I chatted with about these matters the other week will read and benefit from these brief notes.

My Point of View

By "WAYFARER"

Blossom Time in Kent. A picturesque corner of Newington

Better Left Unsaid

A GENIAL motorist who has just been deposited in a safe place for three-quarters of a year as a punishment for driving when "under the influence" is reported to have exclaimed, before turning his car over, that he "would like to knock all cyclists down." Of course, he didn't mean it, but it is not a thing to say from any point of view.

Incidence of Punctures

FROM one of the club journals which I see from time to time I glean an enlightening piece of information on the subject of punctures, which so many people think occur every ten minutes or so. One member's mileage for last year totalled 14,763. Five punctures were collected—say, one in every 3,000 miles! Those figures include 4,359 miles of cycling to and from work, yielding one puncture. This is about an average experience, I think, and the figures constitute a useful answer to the folks who fancy we cyclists spend most of our time dealing with roadside perforations. That, of course, is a figment of the imagination.

Biography

A LEADING article in *The Times* on the subject of stolen bicycles contains this sentence: "The mending of a puncture and the straightening of handlebars are for the unmechanically-minded the topmost limits of practical engineering." That statement may be viewed as a thumbnail sketch of yours truly! I admit the accuracy of the assertion as regards myself.

Speaking Seriously

THE comment in the foregoing paragraph was written in flippant mood. There remains an aspect of the matter which calls for a serious word. I put it in this way: My complete lack of mechanical knowledge, and my total inability to carry out more than the simplest operations to a bicycle, have not prevented me from obtaining an absolute optimum of enjoyment from the pastime, nor has the fear of anything vital going wrong discouraged me from visiting and loitering in such remote places as the Isle of Mull or the Bloody Foreland. Now, as always, it is the place which is farthest from what we call Civilisation (with a capital "C") that calls me most vociferously. No cyclist—and I say this with the greatest deliberation—has extracted more fun from his chosen pastime: no cyclist has experienced less trouble with "the bridge that carries him." Nobody could be more ignorant with regard to the mechanics of the bicycle, but, always riding a quality bicycle, and one without anything in the way of complications, the dice have been loaded in my favour. And so, it seems to me, one can cycle hundreds of thousands of miles (as I have done in the last 60 years) armed with no more knowledge (or, at any rate, little more) than that characterised by *The Times* as "the topmost limits of practical engineering"! Let no cyclist hesitate to get far afield because of what might go wrong with his steed. In practice, it doesn't happen!

Taking Pace

IT must be admitted that I always view with some little concern the action of certain cyclists who like to ride behind, and very close to, fast-moving motor vehicles, especially buses. One is aware, of course, that the front wheel of the bicycle can actually rub against the stern of the vehicle it is following, but the possibility which hits me between the eyes is of that vehicle having to make a sudden stop. If the cyclist's normal reaction to an emergency of this sort is satisfactory, all well and good, but he has to be pretty quick on the uptake in checking his speed and avoiding a crash, which would not be at all healthy for either himself or his steed. Moreover, while he is taking cover in the manner indicated, he must concentrate the whole of his thought on the vehicle in front and must have eyes for nothing else. Admittedly, this practice of taking cover looks a lot more dangerous than it actually is. Nevertheless, I do feel that, in these days of intensive safety propaganda, it is a practice which is better avoided. Taking pace behind another cyclist is a very different matter, because the paced rider can see what is happening ahead of him, and evasive action can be taken simultaneously with, or even in advance of, the leader.

No Change

SUPERFICIAL thinkers appear to imagine that the process of reversing the Rule of the Road in any country—in this country—is as simple as boiling an egg. All you have to do is to issue a notice to the effect that on and after a specified date traffic will keep to the right of the road instead of the left, and the change is achieved. Or is it? A moment's straight thought will demonstrate the weakness and the folly of that attitude. There is much more in this business than merely issuing an order or a notice. The reversal of the Rule of the Road would involve the reconstruction of millions of motor-vehicles, including buses and trams—reconstruction, in their case, at both ends. With a keep-to-the-right driving plan you could not have a vast majority of motor-cars, etc., with their existing right-hand drive, nor could you allow passenger vehicles to disgorge their patrons into traffic-streams.

Then what about our road system as a whole—our one-way streets, our roundabouts, our wayside signs, our automatic signals, etc.? An enormous amount of work—and expense—is envisaged by the mere thought of the alterations which would have to be effected. And a point which would weigh with me, personally, is that I would have to learn how to mount, and dismount from, my bicycle on the right-hand side. I have never attempted to master this reversal of the usual method of doing these things, but, naturally, I could—and am quite prepared to—try; and I should hate it to be thought that my objection to having the Rule of the Road reversed rested on the fact that throughout my long cycling career I have got on and off bicycles on the left-hand side thereof. No! what matters is the expense attaching to the oft-suggested transformation scene. I have frequently wondered what the total cost would be, and I am now interested to learn that this has been authoritatively put down at the stupendous sum of £150,000,000. We need not bother our heads about the advantages (if any) which would accrue were we to align our Road Rule to that of (I believe) the majority of other countries. The frightening cost disposes of the whole problem, even were this country to possess frontiers abutting on to lands where the Rule of the Road was different from ours—and I shall continue my innate conservatism by mounting, and dismounting from, my bicycle on the left-hand side!

Notwithstanding

SOMEBODY, describing himself as "a cyclist of some standing" (the name is quite unfamiliar to me), writes to one of the daily newspapers to say, amongst other things, that "when cycling in Hyde Park I invariably take advantage of the mounting blocks," and he proceeds to express regret "that traffic conditions have caused so many of these useful aids to the cyclist to disappear." This is indeed a discovery, and it seems odd that I have been able to get through quite a long cycling career without having recourse to the "useful aids" in question, whether in Hyde Park or outside those few country pubs which still feature them as a relic of bygone days. I am presuming, of course, that the mounting blocks referred to are those established for the use of horse-riders. Now, the saddle on a horse is much farther away from the ground than the saddle on a bicycle, and I am wondering whether our friend (of "some standing") is not perched too high up in the world. Would he not be able to dispense with mounting blocks (which, in any event, are few and far between) by the use of a bicycle with a low bracket and a frame of reasonable height? The suggestion is worthy of consideration, if only from the viewpoint of safety, because the low-built bicycle is the safe bicycle—an important point as regards traffic-riding.

I am bound to say that I have seen bicycles with the saddle so remote from Mother Earth that it might almost serve the cyclist as a crutch. The riding position which results is probably one of great dignity. If that point possesses any importance, then no doubt those good folks who like to sit high up in the world will continue in the error of their ways—for error it is. For my part, I place safety and effectiveness first—and dignity nowhere!

Development

I HAVE no doubt that many cyclists view with grave concern the several schemes which are going forward for the setting-up of hydro-electric stations in Scotland and Wales. With certain aspects of this inevitable march of progress we, in this journal, need not bother our heads. As citizens, of course, we may well be glad if the projected development results in the return to life of the deliberately depopulated Scottish glens, but that matter is outside our view here.

I always tend to view with grave suspicion these development schemes of which so much is heard, and no doubt many of my fellow-cyclists are in like case, but it appears to me that we must try to take a long—and realistic—view of these affairs, setting aside selfish considerations. Development does not, of necessity, mean the destruction of amenity. Who is there that will dare to say that the construction of those reservoirs in the Elan Valley—made so that the citizens of Birmingham would not die of thirst—despoiled the countryside? On the other hand, has not man definitely improved on Nature, and thus "painted the lily"? Personally, I think so. Exactly the same remark might be made as regards Lake Vyrnwy, Thirlmere, etc. Did Thomas Telford ruin the Great Glen when he constructed the Caledonian Canal? I think not. I mind me that I cried aloud against the construction of a new road through Glencoe, which I felt was unnecessary—and unwanted. I have long since eaten my words and taken back all my criticisms. That new road—no longer new, of course—is an enduring delight to all cyclists, thanks to its fine surface and easier gradients. It has not spoilt Glencoe, and, to me, the traverse of that highway is a constant source of inspiration and joy.

Perhaps I have wandered a little from my main theme. The hydro-electric schemes under way will not ruin the countryside. Public opinion, now very much alive to the importance of amenity, will see to that. And, as regards that scheme which concerns Loch Morar, I rejoice to learn that every care has been taken of this matter of amenity. At the loch itself the hydro-electric station has been constructed inside a cavern hewn out of solid rock beside the river. If corresponding care is taken elsewhere, we cyclists will not complain of the march of progress.

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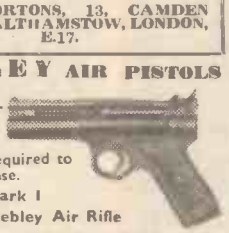

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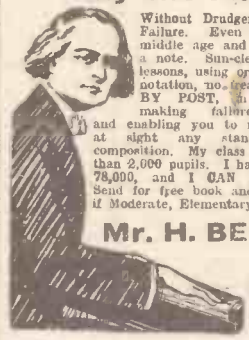

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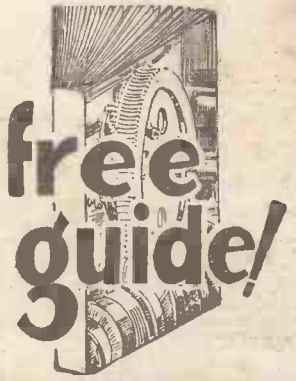

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