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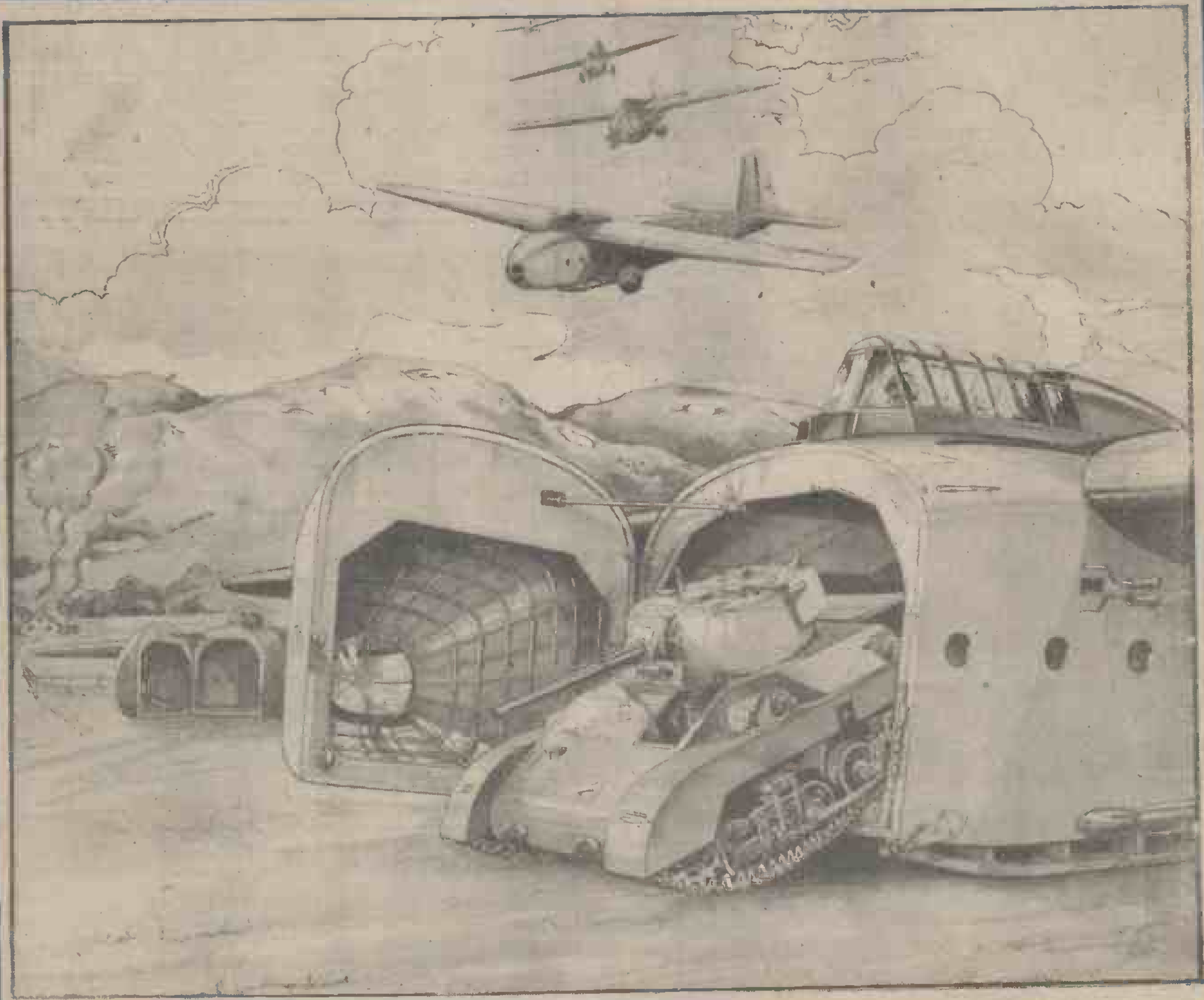

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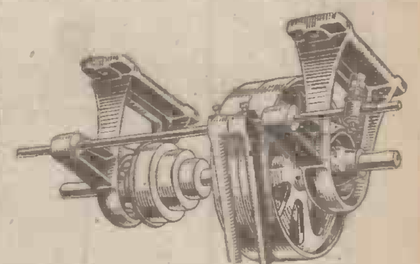

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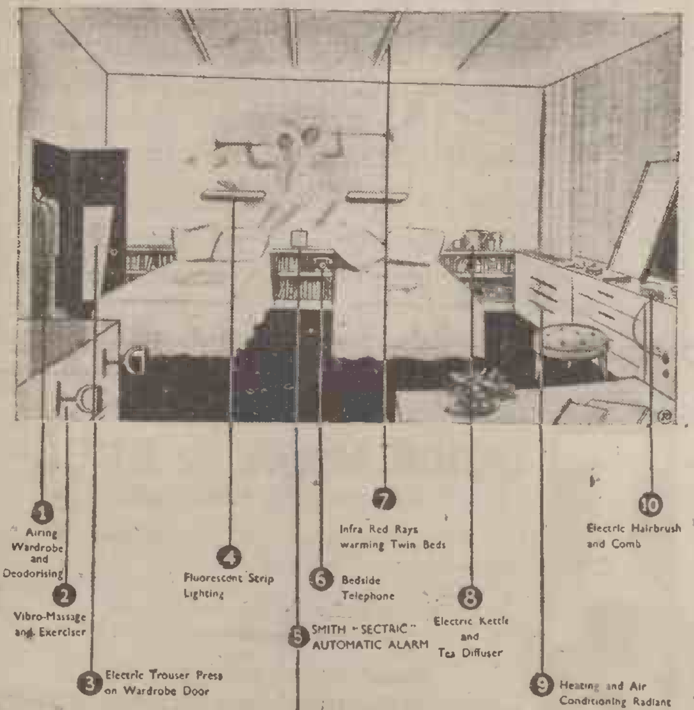

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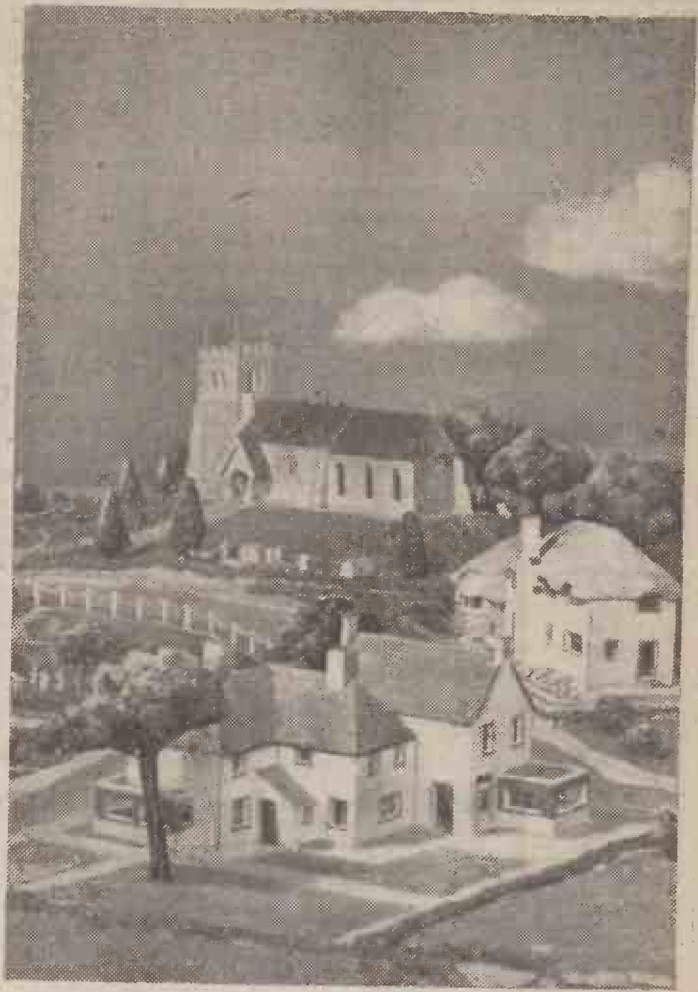

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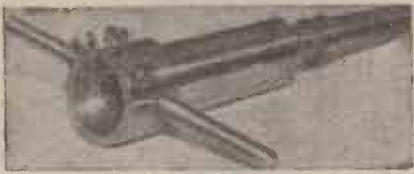

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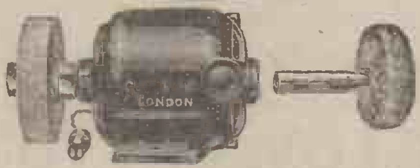

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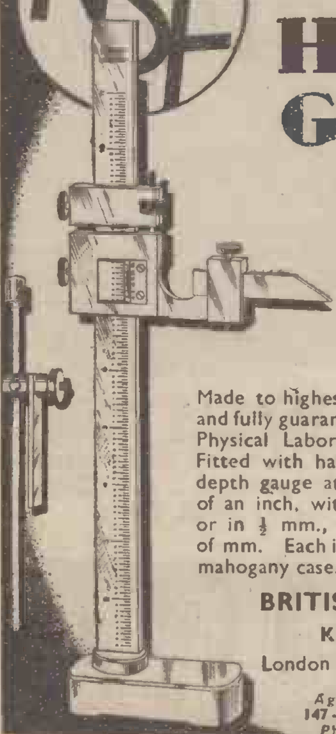

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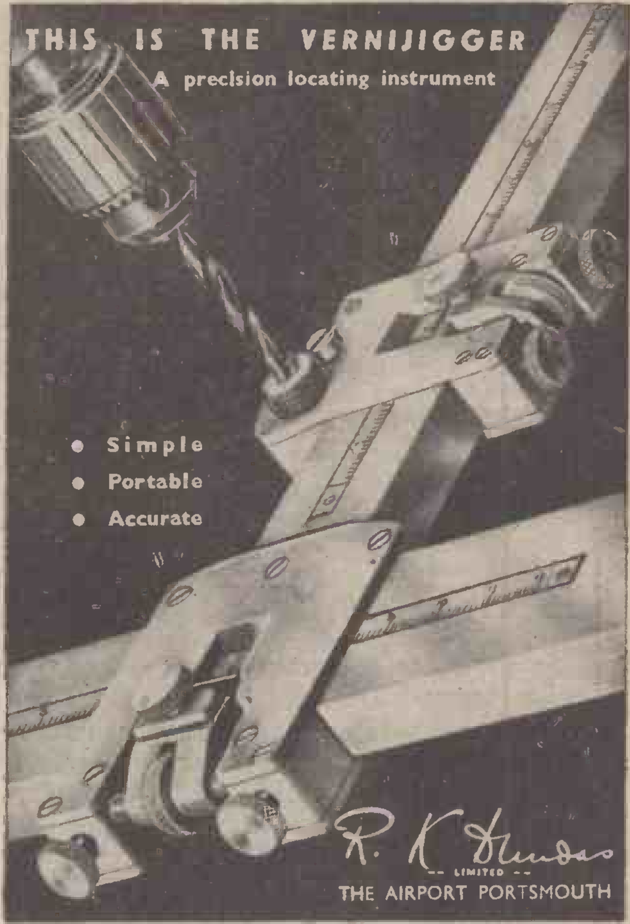

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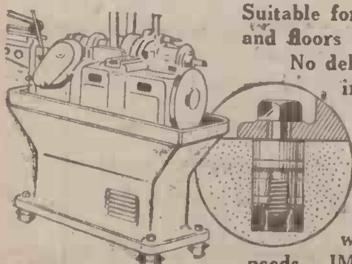

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XII FEBRUARY, 1945 No. 137

FAIR COMMENT—BY THE EDITOR

Training for Higher Appointments

THE Minister of Labour recently announced his plans for assisting the resettlement of men and women in the higher appointments—posts which call for administrative, supervisory, managerial, professional, or technical qualifications.

The plans have been made as a result of the recommendations made by Lord Hankey's committee last year. They provide for the reorganisation of the existing Appointments Department of the Ministry of Labour, and for its adaptation to meet the needs of men and women from the Forces or other forms of war service who are seeking to resume or start their careers in the higher ranks of industry and the professions.

Lord Hankey's committee realise that it is an urgent public need to avoid any waste of trained ability and they urge that a nation-wide State-provided agency for employment in the field of higher appointments is essential. This, however, would not be adequate, for evidence given before the committee shows that men and women in the Forces and on war service are deeply concerned about their future careers, and the opportunities which will be available to them after the war.

Appointments Offices

The number of Appointments Offices is being reduced from 30 to 13, and they will be located in London, Reading, Bristol, Cambridge, Birmingham, Nottingham, Manchester, Liverpool, Leeds, Newcastle-upon-Tyne, Edinburgh, Glasgow and Cardiff.

Vacancies likely to be filled by engineers with full professional qualifications are to be dealt with centrally. A Careers Research Section has been established as part of the Appointments Department, and it has collected information about professions and callings, the results of which will be made available shortly in a comprehensive handbook, and a series of booklets devoted to individual careers.

The Appointments Offices will provide financial assistance to suitably qualified men and women who have been engaged in the Services or in other work of national importance, to undertake or continue education or training for a career. Information about trends of employment and particulars regarding various occupations will be made available to the public. Advice will be made available to those who propose to invest capital in business enterprises.

There will be standing advisory committees representing the principal professions and occupations, and it is intended that the Appointments Department should work in close co-operation with University Appointment Boards in order so far as possible to enlarge the field of employment for which graduates may be considered suitable. The new organisation will not have a monopoly of filling high appointments, for the co-operation of industry and commerce will be welcomed to ensure that the best use is made of specialised knowledge and ability. Contact is being made with representatives in every branch of industry, and special steps will be taken to enable Appointments Offices to give advice and assistance in connection with overseas employment.

Council of Industrial Design

THE President of the Board of Trade has set up a Central Council of Industrial Design to encourage by all practicable means the adoption of good design in British industry. Industries will be encouraged to set up design centres of their own, and the Government propose to make financial grants for this purpose. The new council will co-operate in the setting up of such centres, and it will provide a national display of well-designed British goods, co-operate with the education authorities in matters affecting the training of designers, advise at the request of Government departments and other public bodies on the design of articles to be purchased by them and approve the selection of articles to be shown in United Kingdom pavilions in international exhibitions.

The functions of a design centre will be to study the problems of design in relation to products of its own industry and to collect information about design and make it available to the industry. Grants to design centres will be made by the Board of Trade after consulting the council on a similar basis to that adopted by the Department of Scientific and Iudustrial Research for research associations.

Sir Thomas Barlow is chairman of the council which will be unpaid, arrange its own procedure and organisation, but will engage a paid staff to assist it in carrying out its functions.

National Certificates for Apprentices

A SCHEME to give higher status to all craftsmen engaged in the mechanical and engineering side of the motor vehicle and repairing trade was announced recently by the Ministry of Education.

Education authorities have been informed that a special training scheme for apprentices, including arrangements for technical education and certification on a national basis, has been agreed.

The Ministry of Education will issue certificates to all who pass the approved examinations. They will be signed by the principal of the college or school at which the student attends and by the chairman of the National Joint Industrial Council as certifying a standard of craft efficiency.

The City and Guilds of London Institute are adjusting their syllabuses in motor vehicle mechanics, and when finally agreed these will form the basis of the courses. Colleges and schools will be at liberty to use their own examinations or those of the regional examining unions.

The scheme was initiated by the N.J.I.C., representing the Motor Agents' Association as employers, and on the workers' side the Amalgamated Engineering Union, the Transport and General Workers' Union and the National Union of General and Municipal Workers.

Model Aircraft Exhibition

LORD BRABAZON OF TARA recently opened at Dorland Hall, Lower Regent Street, the first National Model Aircraft Exhibition. Whilst we cannot support the claims that it was "the greatest display of model aircraft ever seen under one roof," for some of the early Royal Aero shows had model sections which contained far more models, none the less, this was the first entirely model exhibition.

Large numbers of models of all types, flying and non-flying, scale and non-scale, rubber and petrol motored, were on view.

The exhibition draws public attention to the importance which the model aircraft movement has now assumed. It is estimated that there are half a million aero modellers in the British Isles. There are 300 live model aircraft clubs in the country, over 50 of which exist in the London area. These clubs are in addition to those attached to the Royal Air Force, the Navy and Army Cadets, the Air Training Corps, the Scouts, the Spotters' clubs, the Defence Units, etc.

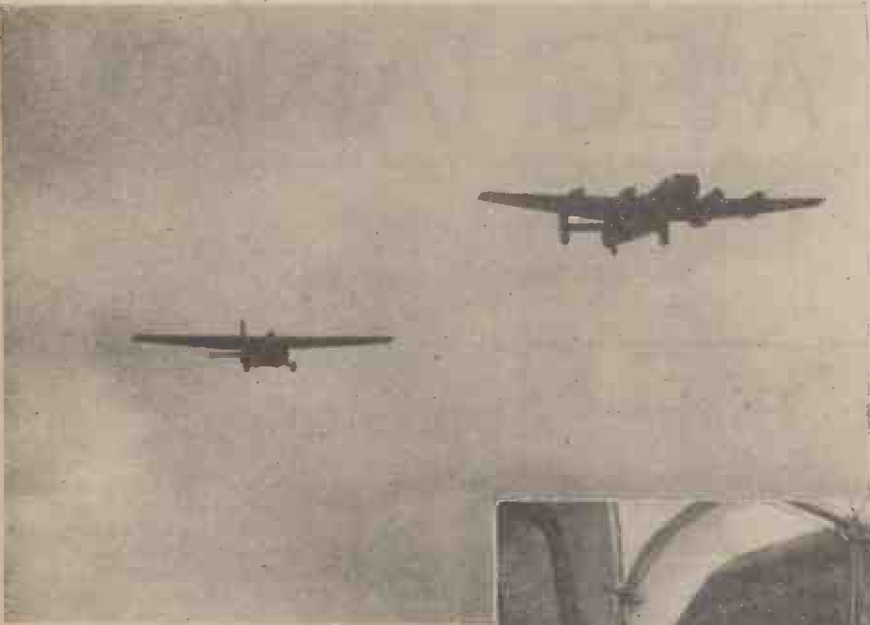
Large numbers of aero modellers who have joined the Forces have by their knowledge of aircraft through models gained promotion to higher ranks. Most of our successful full-size aircraft designers were originally model builders. Headmasters of public and secondary schools and technical institutes are encouraging students to build model aircraft. Most aeroplane factories have formed a model aircraft club.

The competition side of the hobby has assumed an international aspect, the Blue Riband of the movement being the Wakefield contest. Model aircraft competitions often attract a crowd of 8,000. The governing body recognised by the Royal Aero Club is the Society of Model Aeronautical Engineers.

F. J. C.

The "Hamilcar" Glider

Details of this Remarkable Military Transport Aircraft



A Hamilcar glider being towed by a Halifax four-engined bomber.

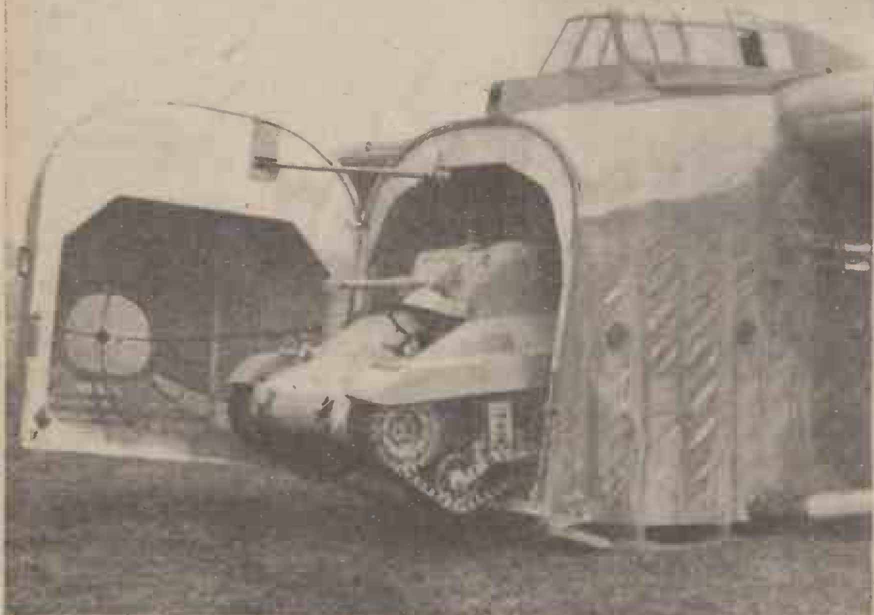
THE Hamilcar Military Transport Glider is the second contribution made by General Aircraft Ltd. during the war period to meet the requirements of the Airborne Division. It was preceded by the Hotspur Glider, designed to carry eight men and equipment and which eventually became the standard glider trainer for the Airborne personnel. The all-up weight of the Hotspur is 3,600lb. The Hamilcar, which weighs 36,000lb. fully loaded, therefore constituted a major design development.

After preliminary conferences and design studies the general lay-out for the Hamilcar was finalised early in 1941. It was considered advisable to design and construct a half-scale flying model. A design team of over 100 draughtsmen and 20 technicians was allocated to the complete task and the resources of the Royal Aircraft Establishment and the National Physical Laboratory were made available to provide structural and wind tunnel test data. The prototype was designed and built in 12 months and successful test flights were made in the early spring of 1942. Flight trials were completed in three weeks.

Wooden Construction

The Hamilcar is the largest wooden aircraft ever constructed. It was designed to carry heavy armoured vehicles, or combinations of vehicle equipment. For this to be done with structural and aerodynamic efficiency, it was necessary to select a wing loading much greater than anything previously contemplated for a glider—21.7lb./sq. ft.—and the aircraft took on itself more the character of an aircraft without engines as opposed to the popular conception of the lightly loaded sailplane of pre-war years. With it developed the technique now so well appreciated in airborne operations—that the time taken to land after release from the tug aircraft should be a minimum, so that the glider is exposed to fire from the enemy ground defences for as short a time as possible. One noteworthy feature of the Hamilcar design is, therefore, the large and powerful wing flaps, operated by servo-pneumatic means, which enable the pilot to control at will the angle of glide, and to effect a landing in a confined space,

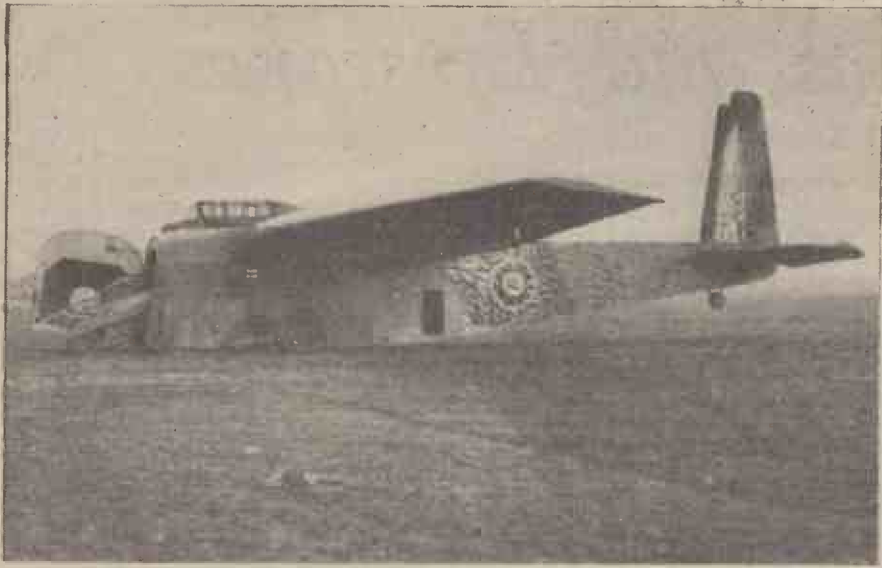
A view through the open door showing an American Locust tank, with its crew, in the fuselage.



A close-up of an American Locust tank emerging through the open door.

Four-engined Bombers for Towing

Because of its great size, the Hamilcar needs our largest and most powerful four-engine bombers to act as tug aircraft, and the Halifax has an excellent operational record in this capacity. Apart from the engine power available in the tug, the successful take-off of a heavily loaded glider depends on the total weight of the tug-glider



A side view of a Hamilcar just after landing, showing a tank "touching down."

combination. Consequently every effort had to be made during the design to keep the Hamilcar structure weight within strict limits. This was done with such effect that the aircraft came out 800lb. lighter than the original estimate. The Hamilcar is able to carry almost its own weight in the form of military load.

High-wing Monoplane

The decision to design the Hamilcar as a high-wing monoplane with a nose-opening door was to ensure that, with the aircraft lowered on to its skids, armoured track vehicles could be driven straight out without needing special ramps. They could, therefore, be in action in as little as 15 seconds after the aircraft had come to rest. To assist in this rapid exit, the vehicle engine is started up in the air prior to landing, the exhaust pipes having temporary extension pipes to the outside of the aircraft, which disengage as the vehicle moves forward. In the case of tank and Bren gun carrier loads it has been arranged that the anchorages, which hold the vehicles securely in place in the aircraft, can be discarded instantaneously by pulling a lanyard from inside the vehicle. The forward movement of the vehicle then operates a mechanical device which frees the nose-door lock and automatically opens the door.

Landing Technique

Originally, the Hamilcar was intended to make skid landings when used for military operations. For this purpose it had a special chassis for take-off which could be dropped by parachute (the chassis weighs $\frac{3}{4}$ ton). For more normal purposes the aircraft is fitted with a permanent under-carriage. The development of the strategy of airborne landings, however, caused a change in technique. The possible landing sites are usually very restricted, and, in order that they may be used by the maximum number of gliders, they must be kept clear. It was therefore desirable that the aircraft should land on its normal chassis and use its speed, combined with differential wheel brake operation, to steer itself clear of the landing strip. Immediately it came to rest, high pressure oil in the chassis shock absorber struts was released, causing them to telescope and permit the aircraft to sink on to its skids for the vehicle inside to drive out.

Military Load

The variety of equipment which the Hamilcar can carry presents a formidable list, and it is continually being augmented. Up to a military load of 17,500lb. (7.8 tons) it includes:

Tetrarch Mk. IV Tank.
Locust Tank (American).
2 Bren gun universal carriers.
3 Rota trailers.
2 Armoured scout cars.

17 pdr. anti-tank gun with portee vehicle.
25 pdr. gun with portee vehicle.
Self-propelled Bofors gun.

Jeep and universal carrier with slave batteries.
Universal carrier for 3in. mortars and eight motor-cycles.
Bailey pontoon bridge equipment.
48 Panniers containing equipment and ammunition.

Airfield Construction Equipment:
D4 Tractor with Angledozer.
Scraper with Fordson tractor.
Grader.
HD.10 Bulldozer (carried in three Hamilcars).
HD14 Bulldozer (carried in three Hamilcars).

Anchorage Equipment

The design and construction of the basic aircraft has been only part of the whole problem. Each variation of load has required special study in respect to anchorage equipment. With heavy and dense loads there must be no movement during flight.

Special praise is due to the expert team of works personnel who have been operating up and down the country on the various aerodromes to which Hamilcars were allotted. It has been their task to install the formidable series of modifications entailed by the variety of military loads and to be on hand at all times, to advise and instruct the R.A.F. and Airborne Division personnel. During the period prior to "D" Day they played a considerable part in the final preparations.

A final word for the pilots of the Glider Regiment and the men of the Airborne Division who flew in the Hamilcar. They liked the aircraft, they liked its controlability, they felt safe in it in the event of a crash landing and learned to handle it extremely well. Their confidence and ability put the ultimate seal on the success of the Hamilcar in Normandy and later at Arnhem.

Hamilcar Details

Wing span, 110ft.
Overall length, 68ft. 1in.
Fuselage width (external), 9ft. 3ins.
Wing Area, 1,658 sq. ft.
Wing chord at root, 18ft. 6ins.
Wing thickness at root, 3ft. 8ins.
Local carrying space in cabin, 25ft. 6ins. long by 8ft. wide by 7ft. 6ins. high.
All-up weight, 36,000lb. (16.1 tons).
Empty weight, 18,500lb. (8.3 tons).
Military load, 17,500lb. (7.8 tons).

A light U.S. Army invasion glider, which is much smaller than the Hamilcar, taking a jeep on board.

Diascopes and Episcopes

Constructional Details of Simple Projection Equipment

(By courtesy of The British Film Institute)

DURING the last ten years, whatever differences of opinion may have existed as to the comparative merits of different optical aids, a great and increasing demand for projection equipment of all kinds has been in evidence, and it has become clear that economic considerations are the limiting factor which checks the full satisfaction of this demand.

It has been observed that in areas where most has been accomplished in this field schools have made for themselves those types of apparatus and projection material which it was within their power to make, and have thus saved money which they have expended in buying from manufacturers larger quantities than they could otherwise have afforded of the more technically specialised kinds of projection equipment.

The purpose of this article is to aid those schools which have already decided to follow this course by bringing to their notice designs for an episcope and diascope which are extremely easy to make and have been made already by many users.

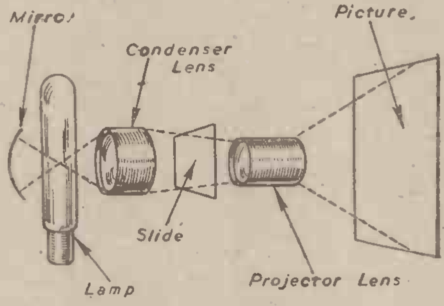
These instruments may be of service even to large schools already equipped with projection apparatus if their existing equipment is insufficiently portable for convenient classroom use.

The elements of a simple diascope are shown in the diagram. Begin by considering the relation between the slide, the projection lens, and the screen. In ordinary circumstances the distance of the projection lens from the slide is slightly more than the focal length of the lens, and the ratio of the width of picture on the lantern slide (which is 3in. square within the slide bending) to the width of the screen picture is the same as the ratio of the distance of the slide from the lens to the distance of the screen from the lens. The focal length found to be most convenient for classroom work is from 8-10ins.

The purpose of the lamp, mirror and condensing lens is to pass light through the slide, and to do so in such a way that as much as possible of the light which leaves the slide enters the lens. As much light as possible must be collected by the condenser, which should be designed to allow the lamp to work as near to it as possible. The mirror collects light which would otherwise be lost and redirects it to the condenser and slide.

Adjustment

If the maximum efficiency is to be attained the combination of lamp, mirror, and condenser must be in correct adjustment with the combination of slide, projection lens, and screen, the cone of light produced by the first combination being as nearly as possible equal to the ideal cone of light required by the second. This is most conveniently done in the following manner: Set the projection lens in any convenient position on its slide and switch on the lamp, the mirror being for the moment swung out of its normal position. Adjust the lamp until the cone of light is centred on to the projection lens, the lamp being moved up and down, from side to side, or towards or away from the lens to find the right position. Then, having clamped the lamp in position, remove the projection lens and focus an image of the lamp filament on to any convenient screen; a sheet of paper will do, or the main screen—in doing this it might be necessary to move the lamp towards or away from the lens, but do not upset the vertical or horizontal setting. Now swing the mirror into its normal position and adjust it up and down, or side to side, until a second image appears on the screen, approximately central with the first filament. In addition to being central the second image should be in focus, and to bring this about it might be necessary to adjust the mirror towards or away from the lamp. When the two images are equal and superimposed upon one another the mirror should be fixed in that position, and in any subsequent adjustment it should not be moved relatively to the lamp, but when it is necessary to move the lamp, the mirror and lamp should be moved together as a single unit. Now replace the projection lens, insert a slide, and focus the slide on to the required screen; remove the slide and move the lamp and mirror together towards or away from the lens until the most brilliant and uniform illumination on the screen has been obtained.



Schematic diagram of a simple diascope.

Slides and Film-strips

At the present time three important forms of illustrative material suitable for projection by means of the diascope are available to teachers: (a) the standard lantern slide, 3¼in. square; (b) the sub-standard slide, 2in. square; and (c) the film strip, 35 mm. wide with pictures 1½in. by 1in.

Each of these forms offers special advantages which are not shared by others, and if a school is to enjoy all the advantages it must be able to use all three forms.

A. The Standard Lantern Slide

The standard lantern slide consisted at one time only of a glass plate on which was a photographic image, the emulsion being protected by a cover glass. That form is still available, but in addition there is the standard film slide in which a piece of cut film, which carries the photograph, is bound between two cover glasses, so that when a slide is dropped and the glass broken the picture is not lost but requires only new cover glasses. Pictures or sketches which are printed on to cellophane, or sketched on to it by the teacher, may be placed between two pieces of glass, hinged together on one edge, for projection. Such flexible material is convenient to file between the pages of teachers' notes and occupies insignificant space. Similarly, teachers' notes may be typed on cellophane and the sheet placed between glass for projection. These alternative uses of material 3¼in. square have given this size increased importance, so that it cannot be excluded by the alternative forms. At present it is not possible to obtain the most brilliant coloured transparencies in the 3¼in. square, but possibly that is a temporary limitation.

B. The Sub-standard Slide

The 2in. slide has one most important advantage over the larger form—pictures in colour may be obtained at a production price for unbound film of 36 for 12s. 6d. This does not mean that single pictures can be made at 4½d. each, but that is the price if a number are required and a whole spool of film can be run off. The cost of binding is still comparatively high, and the cost of a film slide ready for projection works out at about 7½d. However, this is a most economical means for obtaining coloured pictures for classroom projection in daylight, and because of the relative economy the 2in. square slide will probably continue to be important even when the same colour material is available in the standard 3¼in. square slide. Another advantage offered by the 2in. slide is that contact prints may be made from negatives taken by miniature cameras—some users prefer to make enlargements on to the larger size and secure at the same time the control of content and scale of picture which an enlargement offers, but still there is an important field to be served by the contact print. It might be mentioned that the advantage which the small glassbound slide has over the larger form in that it is more easily stored ceases to be important when the larger form is on cellophane and unbound; in fact the advantage is then with the larger form. On account of its small size printing and typewriting are not possible on the 2in. slides and ordinary hand-made sketches are not usually satisfactory.

The sub-standard slide has a picture 1½in. wide, while the available picture space on the standard slide is 3in. wide, therefore, if the picture from the small slide is to have the same width on the screen as that of the standard slide, and is to be projected from the same distance, the projection lens must have one-half the focal length of that of the lens employed for the projection of standard slides, and the distance between the slide and the lens must be about one-half of that for the standard slide. Moreover, if the small picture is to receive the maximum illumination it must be placed in a different position in the cone of light, so that cone which covered the 3in. picture will now cover the 1½in. picture.

It is important to note that if a 2in. slide is placed in the same position as that of the standard slide, then the projection lens must be moved towards it and a large proportion of the light which is available does not pass through the slide, while the cone of light which does pass through is not suitably related to the projection lens.

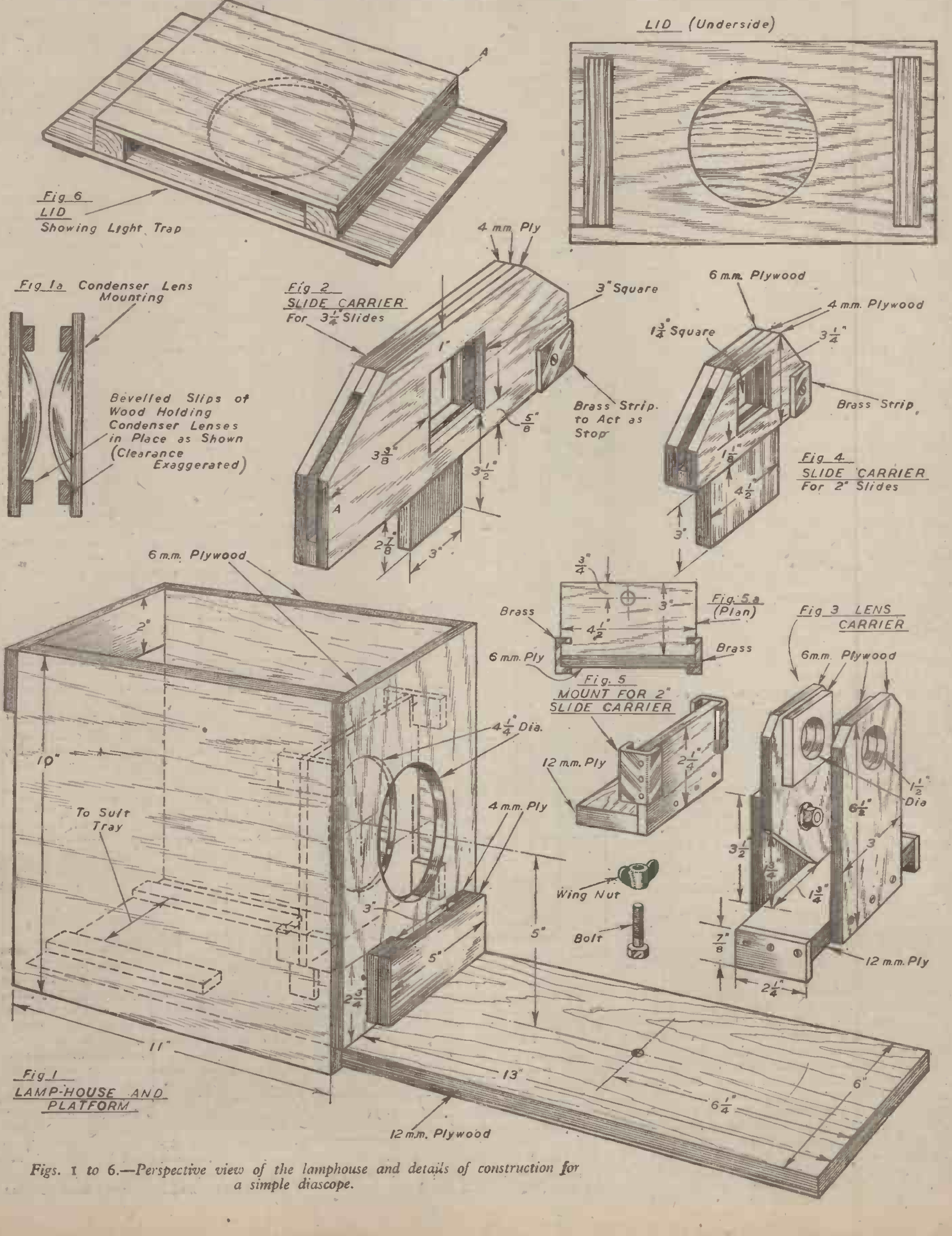
C. The Film Strip

The film strip contains pictures of the same size as those in the 2in. slide, but they are normally unprotected by glass. The sequence is naturally fixed, and as no subsequent binding is necessary and the film can be printed at high speed in a machine, the production cost of a large number of copies of a series of pictures is low. However, colour pictures are not suitable for distribution on unprotected film, and even the half-tone pictures are exposed to a much higher rate of damage than the glass-protected forms. The film strip is most suitable for highly organised picture distribution, and meets the transient demand for pictures which are wanted by many schools at the same time for a short period.

Film strips, having pictures the same size as sub-standard slides, will require to be placed for projection in the same plane as the small slides, but they need a different mechanical arrangement to carry them. Some users prefer to cut the film strip into short lengths containing about four pictures. These short lengths are placed between two glass strips, hinged together, to form a temporary glass slide for projection purposes, the strip being filed in a cardboard folder or between the pages of the teachers' notes when not required.

Compliance with Electrical Regulations

This projector, like all modern ones, is a piece of electrical apparatus which is connected to the main supply; therefore it must comply with the electricity supply regulations. If the lamp is bought already connected to its flexible cable and plug it may be tested by the supplier, who accepts responsibility for its safety. If it is school-assembled, it should be examined by a member of the staff who is qualified in electrical matters. Where there



Figs. 1 to 6.—Perspective view of the lamphouse and details of construction for a simple diascope.

is no such member the electrical fitting should be tested by a competent person before it is put into use. Teachers are reminded that most local education authorities have their own regulations governing the use of electrical apparatus, which should be observed.

Performance

The light-output of a diascope made in accordance with the design described below is sufficiently powerful to enable it to be operated in controlled daylight whether it is projecting large or small colour-slides or film-strips.

Simplicity of Construction

The design described has been simplified so that an effective instrument is within the manufacturing power of a boy who is equipped with a few simple tools and has the ability to use them. The design may be modified so as to employ different materials and different methods of construction, or more elaborate optical parts may be used, to suit individual tastes and requirements.

Components

(a) Lamp-holder for E.S. Cap. (Unless 6-volt or 12-volt lamp is used.)

(b) Concave mirror.

(c) Flexible cable, switch, and plug connector.

The above parts may be bought assembled together on a stand which is called a "tray," and probably that is the most convenient form in which to obtain them. Cost, about £1.

(d) Two condenser lenses: Diameter, 4$\frac{1}{2}$in.; focal length, about 6$\frac{1}{2}$in. each glass. Cost, about 5s. each.

(e) Two projection lenses: Diameter, 40 mm.; focal length, 8in. each glass; type, achromatic combination. Cost, about 7s. 6d. each.

These lenses may be obtained from the following firms among others: Messrs. R. J. Beck, Ltd., 69, Mortimer Street, London, W.1; Messrs. Broadhurst, Clarkson and Co., Ltd., 63, Farringdon Road, London, E.C.1; Messrs. Kalee, Ltd., 60, Wardour Street, London, W.1; Messrs. The British Optical Lens Co., 315, Summer Lane, Birmingham; Messrs. United Kingdom Optical Co., Ltd., Mill Hill, London, N.W.7.

(f) Lamp

For maximum simplicity, cheapness, and portability: Mains voltage, 250-watt, class A1, 63 mm. diameter, E.S. Cap. Cost, £1.

Mains voltages are declared at a particular value, but may, in fact, be slightly different from the declared value; if it is known to be usually slightly higher, then the lamp should be specified to work at a higher voltage, e.g., if the declared voltage is 230 and it is found that frequently the voltage rises to 235, or even 238, then a lamp for use on a 240-volt circuit should be selected.

For maximum efficiency: 100-volt 250-watt, class A1, 63 mm. diameter, E.S. Cap. Cost, £1.

Where no mains supply is available: 12-volt 100-watt, class F, projector lamp, E.S. Cap. Cost, 10s. 9d.

6-volt 36-watt motor headlamp. Cost, 3s.

12-volt 60-watt motor headlamp. Cost, 4s.

Note.—Lampholders for car headlamps will require to be specially fitted to the "tray."

In some cases a 60-watt 12-volt lamp is employed even though there is a mains supply available, the lamp being somewhat overrun. Such an arrangement requires the use of a transformer or a series resistance, and will usually have application only in rooms where transformers are in any case available, or where it is desired to make use of smaller-powered lamps which can be bought cheaply and overrun.

Experience shows that in general the simplicity and portability of the projector with mains voltage lamp are of great value, while additional fittings such as resistances and transformers impede free movement of the apparatus.

In the science laboratory, however, where the lantern may be put to many other uses, the low-voltage lamp has certain advantages, and in the laboratory the resistance or transformer is a normal piece of apparatus which is familiar enough to all who are likely to use it.

Construction

The dimensions and construction of the diascope are shown in the attached figures. Fig. 1 shows the lamp-house and base, which is made mainly of plywood of the thicknesses indicated. The wood should be flat and true. The long edges of the base should be planed carefully and truly parallel. The body is assembled with $\frac{1}{8}$in. oval nails or panel pins *and* adhesive. The two sides should be fitted first and the round hole cut in the front piece before it is fitted. It will also be found to be convenient to make the slot for the slide carrier before the front piece is finally fitted. The edges may be smoothed after fitting together.

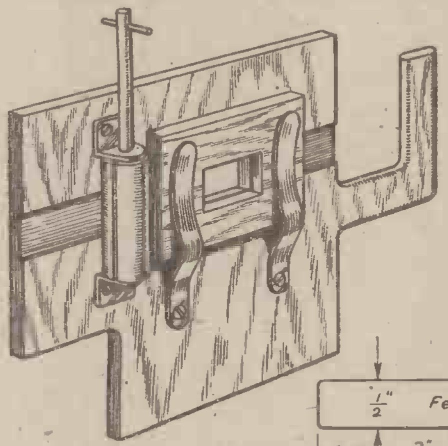
The condenser lenses are carried between two wooden blocks which are slightly bevelled to hold them against the wood (see Fig. 1a). A third block, which need not be bevelled, acts as a stop. These details should be fitted before the lamp-house is assembled. A panel carries the second lens in a similar manner. This second lens panel should be mounted to give ample ventilation above and below. The condenser lenses should be mounted with their curved faces towards one another, and near together. A refinement is to make the inner panel, whose height is 6in., removable by providing guides down which it slides, and a stop to limit its movement.

It is desirable to leave a little clearance under the bracket which holds the slide-carrier, as otherwise it would form a cavity difficult to reach for cleaning purposes.

A velvet curtain to prevent glare of light from the back of the lamp-house will be required, but is not shown.

The slide carrier is shown in Fig. 2. This is made from two pieces of plywood with two packing-pieces. The slides are pushed through the carrier in sequence; the slide which was last shown being pushed forward by the next slide and stopped in the correct position against the brass clip, which should be placed with its top edge about $\frac{1}{2}$in. above the slide track. The entry to the carrier should be well rounded to allow free insertion of the next slide. If the dimensions shown are adhered to the first slide of a series may be accurately located merely by inserting the second slide behind it and pressing it along with the thumb until the part marked "A" acts as a stop to the thumb. The overall height of the carrier is 7$\frac{1}{2}$in., its overall width is 9$\frac{3}{4}$in. The top and bottom packing-pieces are $\frac{1}{2}$in. wide.

The projection lens mount is shown in Fig. 3. The two lenses are mounted with their plane faces outward. This arrangement is different from that commonly employed for such combinations, but it will be found



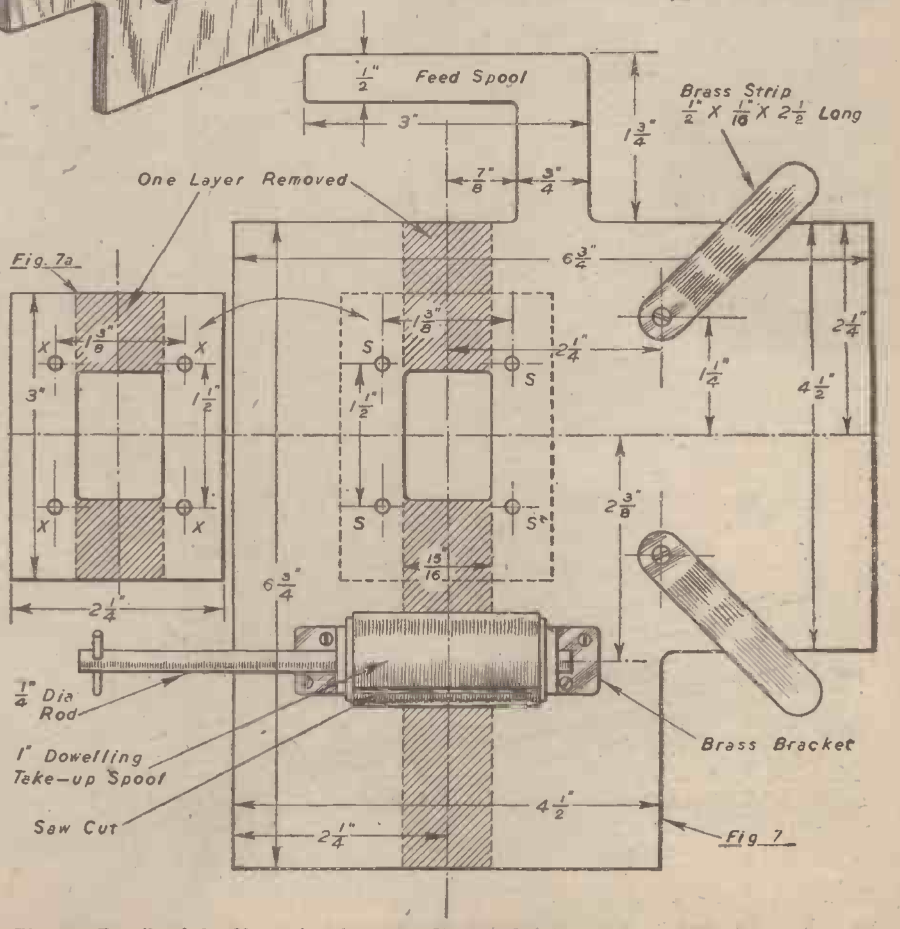


Fig. 7.—Details of the film-strip adaptor. The complete unit with pressure plate in position is shown in the inset.

to give the best all-round result with the lenses described. When standard slides are being projected only one lens is employed and the convex face should then face the condenser. The centres of all optical details—lamp, mirror, and all lenses—should be 5in. above the baseboard. The holes in the main lens carriers are cut 1½in. diameter, which is slightly smaller than the diameter of the lens. The small 2½in. square of plywood which actually carries the lens is cut so that the lens just fits the hole. It will be most convenient to cut the hole in a piece of scrap wood and then trim the square to size. A rather neat fit is required, and it might be necessary to make a trial cut if a washer cutter is employed. The edge of the lens is smeared with adhesive, placed centrally over the hole in the support, and then the 2½in. square is pressed over the lens and fastened to the support by pins or small screws.

The member near to the condenser lens is pivoted so that the second lens may be swung out of the line of light when one lens only is required. The bolt should have washers at both ends, and preferably a spring washer. It will be necessary to clinch the end of the bolt with a hammer to prevent the nut coming loose.

The sides of the lens carrier are made from hard brass strip, and by bending the strip it may be made to grip the base sufficiently tightly while at the same time allowing the lens carrier to slide freely when required. The front and back edges of the side strips should be bent outwards to prevent their digging in.

Fig. 4 shows the carrier for sub-standard slides and Fig. 5 shows the mount into which the carrier is inserted when it is required. Fig. 4 calls for no comment, for the carrier is similar in design to that for standard slides. Its overall height is 6¼in. and its overall width is 6in. The top packing-piece is ⅜in. wide and the bottom packing-piece is 1in. wide. It must be removable to allow free passage of light when the standard slides are being shown. The mount is made of two pieces of plywood and two pieces of brass cut from curtain-runners. The brass pieces must be so positioned that they provide an easy guide for the carrier, at the same time being free from looseness. The mount is bolted to the base with a ¼in. bolt and thumb-nut.

Fig. 6 shows the top of the lamp-house. It may be constructed entirely of plywood, or the top part A may be of tin-plate or other metal.

Construction of the Film-strip Adapter

The film-strip adapter consists mainly of one piece of 6 mm. plywood (Fig. 7). The roll of film is slipped on to the projecting arm at the top, and the leading end is drawn down and tucked into a saw-cut in the wooden roller at the bottom. By turning the roller, the film is wound on to it and drawn past the central aperture. There are four small pegs S, made by screwing in four ⅜in. No. 4 brass screws, in the positions indicated, until the threaded portions are just hidden in the wood. The heads are cut off, and the stumps are smoothed with a small file. The film will slide between these pegs, as indicated by the dotted lines, and is kept flat by a pressure plate, Fig. 7a, made of 6mm. plywood. The four holes X are ¼in. in diameter, and correspond to the four pegs S. The pressure plate is held on to the adapter by two strips of hard-drawn brass, ¼in. × $^1/_{16}$in. × 2½in. long. (These are shown in Fig. 7.) One end of each strip is pivoted on a $^3/_{16}$in. bolt, and the strips are suitably bent so that they can be swung round until the free ends press firmly on the pressure plate, when the latter is in position on the pegs. By paring away one layer of wood, as indicated, on both the adapter and the pressure plate, it is ensured that only the edges of the film touch with wood as it is drawn through.

The film-strip attachment is so designed that it can be stood in the holder with the film running either vertically or horizontally.

All the woodwork should be finished, inside and out, with ebony black paint.

(*To be continued.*)

Aviation Notes

10 Hours 25 Minutes to Cairo

A DIRECT non-stop flight from London to Cairo in 10 hours 25 minutes was recently accomplished by a four-engined York aircraft of R.A.F. Transport Command. This is an average speed of 238 m.p.h. for the 2,480 miles journey.

Taking off from an airfield near London at 12.10 p.m., B.S.T., one day in November last, the York landed at Cairo at 10.35 p.m., B.S.T., with a crew of six.

It is the first time that a York has made the trip non-stop, and probably the fastest journey between the two capitals made by any four-engined aircraft. The Avro York is an adaptation of the famous Lancaster heavy bomber.

"Thunderbolts" on the Burma Front

THUNDERBOLTS flown by R.A.F. fighter pilots are attacking Japanese aerodromes, river communications, and military installations from airstrips in the Arakan. Fitted with long range fuel tanks they strike deep behind the enemy's lines, causing destruction on the ground as well as shooting down aircraft that come up to meet them.

World's Busiest Airfield

IN one month, 3,438 aircraft received from the United Kindom.

More than 7,000 tons of freight handled.

4,280 passengers received and despatched, and

7,200 casualties evacuated to England.

An R.A.F. Thunderbolt fighter with long-range fuel tanks slung under the mainplane, just airborne off a forward R.A.F. airstrip on the Burma front.

This is the astounding record of an R.A.F. Transport Command airfield somewhere in Belgium.

Only a few months ago the airfield was in German hands, scarred and pitted, but busy with Luftwaffe transport and fighter aircraft. To-day the only German aircraft there are the wrecks around the perimeter. Runways have been repaired, buildings made habitable and the airport, still only a moderate car ride from the front line, was destined to become the busiest airport in the world.

Two days after its capture, a Wing of R.A.F. Transport Command moved in and, on the following day, was in full operation, handling 174 aircraft and 378 tons of vital freight.

On some days aircraft took off at the rate of one a minute from dawn to dusk. There were periods when one was airborne every five seconds. As others came in they were unloaded (at one period at the rate of 58 aircraft in 38 minutes), filled with wounded, and airborne for England in an astonishingly short time.

The wounded were brought in from the front line in "Sparrow" aircraft, converted Handley Page bombers with roomy fuselages. These aircraft have the advantage of an extensive wing span enabling them to take off from a limited landing strip. A regular shuttle service was maintained, the casualties being rapidly transferred to waiting Dakotas which landed them near a big R.A.F. hospital in the West Country.

In addition to Transport Command, the airfield was extensively used by United States Transport aircraft. Between the two, it was quite usual to count as many as 30 aircraft waiting their turn to come in.

Recently, some Luftwaffe prisoners of war were waiting on this—the world's busiest air-field—for transit to England. They were astonished by the vast activity. They had never seen anything like it before. Nor had anyone else, for it was here that Transport Command achieved the impossible.

Rocket Propulsion

Mails by Rocket: Rocket Propelled Aircraft

By K. W. GATLAND

(Continued from page 101, December issue.)

MANY new research groups and individuals featured prominently in the development of rocket science during the middle 1930's. Apart from the rocket organisations previously mentioned, three more such groups were formed; in the U.S.A., the Cleveland Rocket Society, established in 1933, and the Peoria Rocket Association (Illinois), and in Holland, the Stichting Nederlandes Rakettenbouw (Dutch Rocket Society), both founded during 1934. The Cleveland Society was originated by Ernst Loebell and E. L. Hanna. The former was a prominent engineer of the German Raketflugplatz, before becoming nationalised as a U.S. citizen.

In 1935, another valuable contribution was made to the available rocket literature, by the publication of *L'Astronautique Complement*, R. Esnault-Pelterie, A. Lahure, Paris, a supplement to Pelterie's monumental treatise of 1930.

Zucker experimenting before the German military in 1933.

Gerhard Zucker

Another advocate of the rocket as a mail carrier was German born Gerhard Zucker. This experimenter conducted his initial postal rocket trials in 1933, when he established a successful delivery over the Hartz Mountains, N. Germany. Subsequently he demonstrated large powder rockets before the German military authorities.

A year later, in May, 1934, Zucker travelled to England, and during his stay carried out several mail rocket experiments. None of these further tests, however, can be said to have been crowned with great success.

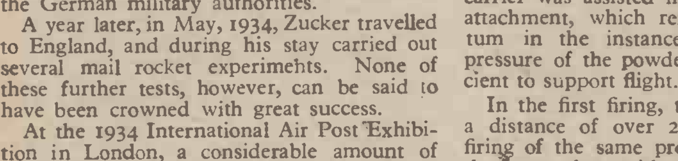
At the 1934 International Air Post Exhibition in London, a considerable amount of interest was aroused by one of the Zucker postal rockets which had been specially entered. It was reported at the time of the exhibition that Zucker's plans for long-range rocket mail delivery were looked upon favourably by both the Air Minister and the Postmaster-General, and it would appear that a measure of official support was sanctioned, at least for the initial tests of rocket mail carriers in this country.

First Trial

The first trial of a mail rocket in England took place near Rottingdean, Sussex, on June 6th, 1934. The rocket projectile used in this particular experiment contained over 1,000 letters, and was fired from an inclined wooden launching rack. The rocket carrier was assisted into flight by a catapult attachment, which rendered initial momentum in the instance before the reactive pressure of the powder charge became sufficient to support flight.

In the first firing, the rocket travelled for a distance of over 2,600 feet. A second firing of the same projectile took place later the same day, with similar success. After this latter flight, the mail was transferred from the rocket and taken to Brighton by mail van, final delivery being made through the conventional G.P.O. service.

The next Zucker rocket mail experiment took place in the Outer Hebrides on July 31st of the same year, the intention being to link the islands Scarp and Harris, in the Western Isles.



Raketenflug-

V 1

Dieser Raketenflug-Erinnerungs-Brief ist im Juli 1928 mit der Schmiedl'schen Versuchsrakete "V1" geflogen. Mit der Rakete "V1" sind insgesamt 19 Stück solcher Erinnerungs-Briefe geflogen, welche alle fortlaufend nummeriert sind; dieser Erinnerungs-Brief trägt die Nummer: 14.

Schmiedl

World's first flown rocket message, by Schmiedl's postal carrier "V.1." A translation of the message is as follows: "ROCKET-FLIGHT-COMMEMORATION LETTER. This rocket-flight-commemoration letter was flown with the Schmiedl experimental rocket 'V.1' in July, 1928. With the rocket 'V.1' were sent 19 such letters, which were all numbered consecutively; this commemoration letter bears the number 14. Schmiedl."

The rocket used in this trial was of a larger type than its predecessors, and within a hinged nose compartment were contained 1,200 letters. Again, powder was employed as a propellant. Unfortunately, however, the rocket exploded before it could lift from the launching rack, and was completely destroyed, and tattered and charred remnants were all that remained of its postal cargo. A further and similar test was later carried out in the Western Isles, but this, too, was culminated by an explosion.

Mainly because of these failures, official support of the Zucker postal rocket experiments was withdrawn. Indeed, while carrying out a later rocket trial in the Isle of Wight on December 25th, 1934, the police intervened and stopped the launching of a rocket intended to reach the mainland, on the grounds that official permission had not been sanctioned. It was made clear that the test could not take place unless the projectile was made to fall into the sea, offshore of its destination.

In order to meet the requirements of the authorities, Zucker was forced to reduce the propellant charge. When fired, the rocket rose successfully from the launching rack, but lacked sufficient power, and wind blew it from its course. The mail, which landed in Pennington Marshes, was recovered and taken to Leamington for normal G.P.O. delivery. Had the Isle of Wight trials been allowed to take place as originally planned, it was considered that success might finally have been achieved. As it was, the difficulties imposed by the British authorities made it obviously clear that no further gain would result from remaining in the country, and early in 1935 Zucker returned to Germany. Since that time, news on any further activities has been entirely lacking. This year, however, the *Sunday Express*, quoting the German *Hamburger Nachrichten*, published a report concerning an announcement that Herr Gerhard Zucker had been shot by the Gestapo for trying to communicate to a foreign Power secrets of German rocket developments.

Mail-carrying Rocket Aircraft

Small, power-driven rocket 'planes were employed by the German J. K. Roberti in mail experiments carried out in 1935-36.

One of these aircraft, flown just prior to the German postal-rocket ban, was launched from Duinbergan, on June 4th, 1936. The 'plane, which represented the most ambitious mail carriage experiment conducted by Roberti, had an overall length of five feet, and a wing-span of nearly six feet. The weight of the aircraft, fully laden with 2¼lb. of mail, was just over 6½lb. Particular care was taken in design to ensure that structural weight would be the very minimum.

A small catapult-assisting device was employed for the take-off, and when fired the 'plane rose perfectly, flying in the direction of Knocke. Unfortunately, due to a

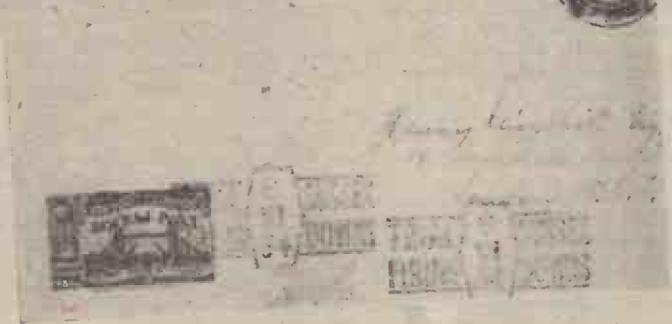
Reproductions of Rocket Flown Envelopes and Cards

Card carried by Schmiedl's 'N.3' in 1935, showing parachute descent. Signed by Schmiedl.

(Below) Envelope carried by a Zucker rocket in a night firing experiment at Hasselfelde (1933). Signed by Zucker.

Card flown by the first U.S. rocket 'plane at Greenwood Lake, N.Y. (1936). Signed by Willy Ley.

World's first trial under postal authority, Cuba, 1939.



(Right) Letter flown in Zucker's first postal rocket experiment in Gt. Britain —Sussex Downs, 1934.

The first U.S. rocket 'plane in flight at Greenwood Lake (1936).

Rocket 'plane leaving the launching installation at Greenwood Lake, N.Y.

structural weakness, both the wing installed rocket units tore loose from their mountings after a few seconds' flight, continuing as projectiles, and fell several miles distant. The fuselage of the 'plane crashed into a boulevard near Knocke-Zoute.

Tail-less Rocket 'Planes

Other experiments, conducted at Wesermünde, concerned the propulsion of small, unmanned tail-less rocket aircraft, designed by Herr Espenlaub and Herr Sander. The latter will be remembered as the manufacturer responsible for the propellant charges of the Valier-Opel rocket car and 'plane experiments.

A rocket aircraft of this type, towed into the air by a conventional light aeroplane, and released at a height of approximately 60 feet, travelled for a distance of one and a quarter miles. This tail-less machine was fitted with a single powder propellant charge installed on the centre-line, at the c.g. The wings, which were swept back to the tips, incorporated large controllable dual purpose aileron/elevators at the trailing edge, close to the wing tips, and also, vertical stabilisers, one at the extremity of each wing.

Liquid-fuelled Rocket Aircraft

Perhaps the most interesting and technically progressive rocket 'plane mail trials, made to date, took place at Greenwood Lake, New York, U.S.A., during the winter of 1936. The motors of these rocket 'planes, of which there were two, were designed and built by Nathan Carver, of the Reaction Research Laboratories, New York, and prominent member of the American Rocket Society. The propulsion unit, which Carver termed the "concentric feed reaction motor" (Fig. 15), employed liquid oxygen, with denatured alcohol as fuel, and incorporated a unique pre-mixing system, by which the oxygen was introduced directly from the motor "head," the fuel entering through an annular manifold. By this system the oxygen is surrounded by a layer of fuel which acts as insulation, and functions to prevent oxidation of the chamber walls, which are protected until the propellant is adequately mixed, and combustion is virtually complete. the principle of the "concentric feed" motor is shown in Fig. 16.

Concentric-feed Reaction Motor—Initial Tests

Theoretical consideration prior to construction set the desired minimum reaction of the rocket motor at 35lb., with a firing period of 30 seconds.

A number of the Carver concentric-feed motors were subsequently built, with interchangeable nozzles and chamber sections, and numerous proving stand trials conducted, the various motor sections being interchanged until the desired specifications were met. During a final test run, which took place on January 2nd, 1936, the motor recorded a thrust reaction of 41lb., operating for a period of 37 seconds, thus amply fulfilling the requirements. Further details of the test are as follows:

Motor—General Particulars

Propellant, denatured alcohol, 3.35lb.; liquid oxygen, 7.23lb. Tank pressure throughout, 150lb. Motor (material, brass and monel), overall length, 15.5ins.; weight 2.5lb. Nozzle (material, monel), length 4ins., throat diameter, .50in., orifice diameter .75in.

Proving Stand Data

Reaction (first test run), 34.50 seconds, 40lb. Second test run, 2.50 seconds, 50lb. (Due to the burning out of a plug, the nozzle was blown off at the beginning of the second firing run.) Impulse, 1,517lb./sec. Average jet flow, 28lb./sec. Average jet velocity, 4,700 ft./sec. Average fuel input, 850,000 ft. lb./sec. Average jet output, 96,000 ft. lb./sec. Thermal efficiency, 11 per cent.

Rocket Aircraft—Design and Trials

The 'planes themselves, designed by Willy Ley and F. W. Kessler, were of the high wing cantilever type, 11ft. in length, with a wing span of 14ft. 6ins. The mails were housed within a hinged nose compartment, and the liquid oxygen and fuel tanks positioned about the machine's centre of gravity. The reaction motor was fitted within the extreme end of the fuselage, the nozzle protruding from the rear.

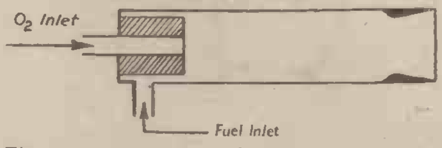


Fig. 16.—Principle of the concentric-feed rocket motor.

For the actual flight trials entirely new motors—duplicates of the most successful motor form previously tested—were specially constructed.

The initial free-flight was scheduled to take place on February 9th, 1936, between Greenwood Lake, New York, and Hewitt, New Jersey, and a special catapult installation was previously assembled for the launching. This took the form of a large inclined track along which the rocket 'planes were intended to take off from a trolley cradle, drawn to the top by a hawser. Unfortunately, due to unforeseen technical difficulties, the test did not take place on the date planned, causing a postponement of two weeks.

On February 23rd, after necessary alterations had been carried out, the aircraft were finally launched. The first 'plane rose successfully from the launching apparatus and climbed away steeply, unfortunately so much so that it ultimately stalled and dived to the lake surface, slithering along the ice before taking to the air a second time for a brief flight, although the motor was severely damaged.

The second aircraft was launched directly from the ice and took off evenly, but, unfortunately, the wings lacked rigidity and one broke off completely. The motor continued to function, however, and drove the 'plane a considerable distance across the lake. The machine was actually airborne for 17.8 seconds.

Although these rocket 'plane trials could hardly be said to have been successful, failure was entirely due to weaknesses in the aircraft themselves, and was no reflection on the Carver concentric-feed motor, which functioned perfectly at all times.

Rocket Terrestrial Transport

A prominent member of the Austrian rocket group, Ing. Dr. Eugen Sänger (University of Vienna), has contributed a number of important theoretical works on the subject of rocket-propelled aircraft. Sänger featured largely in the development of certain high-speed (supersonic) wing sections and body forms, and was among the first to propose practical aircraft forms for operation at forward speeds in excess of sound.

The propulsion of *aircraft* by rocket power presents many problems. To obtain optimum efficiency, the rocket reaction means must operate at high speeds, and in vacuum —clearly, the atmosphere is the prime limiting factor.

On the other hand, it has been argued by the advocates of the *projectile* transport 'craft that this form of conveyance would provide a far greater economy than the machine employing lifting surfaces for terrestrial purposes. Among those who have suggested the rocket projectile are Max Valier and Prof. Oberth.

Oberth's theoretical conception made provision for commencing the flight vertically so as to impose the minimum air resistance. At an altitude of between fifteen to twenty miles, the projectile, having attained a certain desired acceleration factor, would be turned towards its destination. The balance of the journey would then be made under momentum, the 'craft, upon entering the more dense atmosphere, descending in a similar manner to the orthodox aeroplane, or gyro-plane.

As has been mentioned earlier, Dr. Eugen Sänger is another theorist of rocket aviation, and his writings comprise the most complete mathematical investigations yet published on the subject.

Unlike Oberth, Sänger suggests ascent of the rocket 'craft at thirty degrees, and although the time taken to reach a given altitude is greater, distance is covered at the same time. Other details of performance closely resemble the methods suggested by Oberth; both advocated the employment of supporting 'planes for the descent and landing.

The results of these initial investigations are given in *Racketen-Flugtechnik*, Eugen Sänger (220 pp. R. Oldenbourg), Munchen and Berlin, 1933.

The illustrations which accompany this article are reproductions from collections of the well-known air mail specialist, F. J. Field, and are included by the courtesy of Francis J. Field, Ltd. (philatelic dealers), Sutton Coldfield, Birmingham. Some are of actual specimens of flown mail, and these comprise a valuable historic record of the memorable experiments made by the pioneers of the postal rocket.

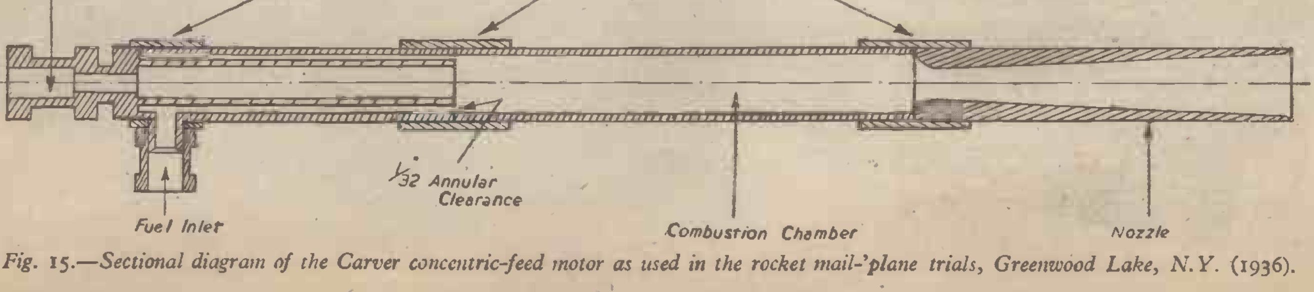


Fig. 15.—Sectional diagram of the Carver concentric-feed motor as used in the rocket mail-'plane trials, Greenwood Lake, N.Y. (1936).

NEW SERIES

The Annals of Electricity—1

Electricity in Ancient Times

WHO invented electricity?

If you are in a facetious mood, you might possibly give as your reply: "Noah—because he made the Ark 'light on Mount Ararat,'" but, really, to this far too common question there is no answer. One might as well ask who invented steam, or gravity, or heat, as to make inquiries concerning the supposed invention of electricity.

Electricity, the natural energy-source which, in our days, has come to be regarded as the manifestation of the flow or accumulation of electrons, is associated with matter. Where there are material substances there will always be electricity, just as much as where there is high temperature there will inevitably be the emission of light. Electricity, obviously, was never "invented." It has always existed. Only its applications and the special means of its convenient and controlled generation can come into the category of man-made inventions.

Almost certainly, the first electrical manifestation which was known to primitive mankind was the lightning flash, the gigantic fire-blitz of the heavens. Well must this mighty release of pent-up electrical energy have stirred the inborn fears of the rude savage, and even of the more civilised portion of mankind in those long-distant days. For there was no possible explanation of the phenomena except that the lightning darts, and the heavy cannonade which accompanied them were direct manifestations of the anger of the gods. The soul of primitive mankind saw in the lightning flashes a veritable force of the gods which was apparently meant to destroy or, at least, to threaten, humanity, and to visit human habitations with the searing devastation of flame and fire. A lightning storm constituted the world's first experience of an aerial raid.

The Maiden and the Comb

At the other end of the scale one can well imagine some early primitive maiden combing out her tresses with a roughly fashioned comb made from animal bone. In a dry climate, and as the daylight waned, the girl or woman might possibly have been astonished to have heard crackling noises and even to have witnessed the transient flickerings of pin-points of vivid light as she vigorously and industriously applied her evening beauty-treatment. Little, indeed, would she ever have dreamt that there was a direct connection between the frictional flashes in her hair and the mighty lightning flashes before which, very possibly, she instinctively cowed in terror.

Lightning—"the fire of the gods" at which the ancients wondered.

And when, in a later age, someone first strung together an ornamental necklace of that yellow fossil-resin known as amber and noticed that after a few minutes' rubbing contact with the dry skin the resin acquired the curious power of being able to attract bits of dust and fluff to it, the association of this mild attractive force with the lightning's terrible fire-raising power was surely never conceived.

Thales of Miletus (640-548 *B.C.*), *one of the "seven wise men of Greece," who recorded the attractive power of rubbed amber.*

The ancient Greeks had the rather pleasant knack of inventing plausible stories about things which they didn't understand. When they picked up bits of glistening yellow amber on the shores of their seas and, discerning that it was quite unlike any natural mineral which they knew, they concocted the queer yarn that these small yellow sea-washed nodules were really the congealed tears of the Meliades, daughters of the sun. The Greeks named the Sun-god "the Shining One," and, therefore, what was more natural than that they should call this yellow amber (as we now know it) "Electron," which means "the shining thing," since they were the products of the Sun-god's daughters?

Thus, from amber or "electron" we derive our present word *electricity*, the word which now dominates our present civilisation and implies to us so much which is associated with power, convenience and comfort.

Amber, or electron, the dried tears of the Sun Maidens, was known and prized for ornamental purposes nearly thirty centuries ago. Even in prehistoric times it seems to have been traded in by the Phœnician merchants, those same wandering traders who, creeping in primitive sailing vessels up the shores of Spain and France, touched the Cornish coasts, and in return for the native tin of that delectable duchy, brought to England its first Mediterranean imports, of which, no doubt, amber was one.

Thales of Miletus

There seem to be quite a number of old historical records relating to the strange attractive power of amber. It appears that Thales of Miletus (640-548 B.C.) mentions in his writings the mysterious force associated with amber or electron.

Now Thales was a big philosophic noise in his day. He was a mathematician, an astronomer, a predictor of eclipses and, to some extent, a chemist. He was honoured by his countrymen by receiving officially the designation of "Sophos," or wise man. There were half a dozen other of these honoured people, so that Thales has, in history, come to be known as one of the "Seven Wise Men of Greece."

Thales sought for an explanation of amber's attractive power. All he could think of, however, was that, like many other things, amber had a "soul" and that the mysterious power of amber was, in reality, an outward manifestation of that soul. Naturally, the idea of associating amber's attractive power with the lightnings of the heavens never occurred to him. Many centuries of the Christian era had to elapse before the first glimmerings of that possibility dawned upon scientific and philosophical thinkers.

It seems, however, that Thales of Miletus made the *first* written record of amber's attractive power, for which reason his name is usually associated with the first beginnings of electrical investigations. Nevertheless, the observations of Thales constituted a very scant and meagre beginning for the science of electricity, one which was so transient and indefinite that it led nowhere.

The next Greek gentleman who had a few words to say (or, rather, to write) about what we now know to be electrical attraction was the far-famed Aristotle (384-322 B.C.) who is easily the most famous representative of the science of the ancient world. Aristotle merely recorded the observations of Thales, but one of his pupils, a philosopher named Theophrastus, made, about the year 321 B.C, the observation that jet, a coal-like mineral, would behave like amber when rubbed.

In between these historical landmarks, two or three of the old-world philosophers seem to have meditated upon the attractive power resident in amber, but none of them came to any useful conclusions.

Another Greek named Eustathius seems to have been the first to draw attention to the electrical properties of the human body, for in his *Commentary on the Iliad of Homer* (written about A.D. 415) he mentions the

Amber, or "electron"—the natural fossil resin from whose name the word electricity is derived. When rubbed it acquires the power of electrical attraction.

fact that, in some instances, sparks can be drawn from the warmed surface of the dry skin after it has been rubbed with a heated cloth. Here, of course, we come a little nearer to the first useful beginnings of electrical experiment and observation, but, unfortunately, our friend Eustathius treats the fact quite inconsequentially, and dismisses it in a very desultory manner.

Besides the thunderstorm and the lightning display, the ancients must have been sometimes familiar with the phenomenon of the Northern Lights or the "Aurora borealis" which we know now to be due to electrical discharges through the rarefied air at the earth's polar regions, but they had no explanation for such natural displays.

The mariners of the ancient world must, also, have observed the St. Elmo lights, that is to say the luminous electrical haze which appears under certain atmospheric conditions around the mast-heads of ships, but there is little known for certain about any such observations.

Curiously, though, there is one use which the ancients did make of electricity. This comprised the application of one or more of the "electric fishes" in the practice of medicine.

The Medical Torpedo

In various Mediterranean regions a flat fish known as the *torpedo* is to be found. The name is quite an ancient one, it being originally applied because these strange fish were known to possess the power of being able, apparently at will, to give off strong electric shocks which rendered men and even large animals such as horses unconscious or *torpid*. Our modern use of the word "torpedo" follows something like the same meaning and implication, but, of course, in a much enhanced degree.

Now, this type of fish, which is sometimes known as the "electric ray," attains a length of some 5ft., and a weight of more than 70 lb. On the authority of Dioscorides, a Greek physician of the 1st or 2nd century A.D., the torpedo could be used for curing headaches! Apparently, according to old Dioscorides, all you had to do to cure a headache was to touch an electric ray, and your bad head disappeared as if by magic!

Possibly, however, the resultant cure was *too* permanent for those who tried it.

However, there must be some residue of truth in these old-time assertions of the power of electric fishes to alleviate medical conditions, for there exist writings which attribute the cure of gout and even rheumatism to such sources.

The ancients must have known the electric eel, of Africa, and the Silurus, another inhabitant of African waters, but, of course, of the nature of their electrical shock discharge they never inquired.

If we are to include a knowledge of magnetic attraction among our survey of ancient electrical philosophy, we have a little more material to go on.

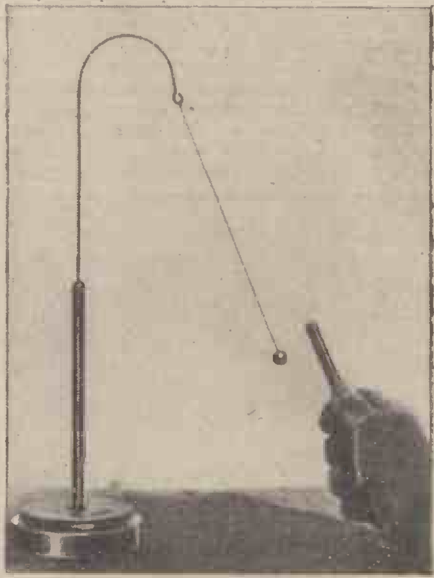
The Lore of the Lodestone

There is evidence that the magnetic power of the *lodestone* was applied at a very early date in the history of mankind. Very possibly, it was known to the ultra-ancient Hindu civilisation. Almost certainly the ancient Chinese were in possession of the directive property of the lodestone, and they made actual use of such property.

But it was not until the time of the Greeks that the lodestone was taken really seriously. Thales, of course, gave the lodestone a "soul," which was about the best thing to do, for in those days, if you were unable to comprehend the reason for an inherent property of a substance, you attributed a "soul" to the substance and thus got away with it nicely.

"Lode" means *way*; the word is connected with our verb "to lead." Consequently, the lodestone is the stone which leads the way. Actually, as the reader will most likely be well aware, lodestone is a natural black oxide of iron, Fe_3O_4. We now call it "magnetic iron ore."

Quite a lot of ancient people had observations to make on the lodestone. Aristotle regarded it with some awe. He calls it "*The* Stone," and said that it would attract iron, and point the way.



The well-known experiment of the pith ball and the rubbed ebonite or glass rod, whereby the light pith ball is electrically attracted to the rod.

But the individual to whom we are most indebted for our knowledge of ancient opinion on the subject of the lodestone and the magnet is Lucretius (96–55 B.C.), a Roman philosopher and poet, and an honest individual withal whose views most accurately give us a summary of contemporary pseudo-scientific philosophy on a number of subjects.

Magnetic Transmission

Lucretius tells us that the origin of the name "Magnet" is from Magnesia, a country in Lydia, whose capital city was Heraclea. Lodestone, or magnetic iron oxide, abounded in that country, the mineral being sometimes known as *Lapis Heracleus*—the "Stone of Heraclea." Lucretius goes on to say that the magnet "stone" will "lead out iron," that is, it will attract that metal, and he mentions an experiment in which a magnet is made to hold up a chain of iron rings, a highly important observation since it provides the first indication of the transmission of magnetic power through contacting metals.

Electricity usefully harnessed in the modern world. A photograph of a high tension electrical display sign.

The same philosopher also records his observation of iron being attracted to a magnet-stone and then jumping away from it—again an important observation, since it obviously implies magnetic repulsion.

But, in general, the twin and associated phenomena of magnetic attraction and repulsion were more or less unknown to the Greeks or the Romans, and, as to magnetic attraction solely, their ideas on this subject summed up to practically nothing. To some of the Greeks, as we have already seen, the magnet or lodestone had a "soul." To Claudian, a Roman thinker, the lodestone was an extraordinarily hungry material, and iron was its natural food! But there was no explanation of the manner in which a piece of lodestone when suitably suspended always pointed approximately northwards.

Even our best observer of these times, the above-mentioned Lucretius, disappoints us sadly when he comes to theorising about the magnet, for, ultimately, he dismisses the whole subject with the words "There is nothing, however, in all this worth discussing!"

The Lodestone Bridge

Yet the ancient philosophers must have had some inventive ideas on the subject of the lodestone. There is, for example, a curious and rather humorous story concerning one Ptolemy Philadelphus (309–247 B.C.), King of the Egyptians, who, in his way, had a scientific bent, and encouraged mechanical and inventive habits among his subjects. King Ptolemy's idea was to build a bridge or an arch of lodestone, and to suspend below it in air an iron statue (probably of himself). Apparently the worthy King's idea was that the semi-circular field of the lodestone arch's attraction could result in the statue's remaining immovable within its radius. Needless to say, the lodestone bridge never materialised.

Then again, Pliny, the Roman historian, tells the yarn of there existing in India two adjacent mountains comprised of lodestone. One of these mountains attracted iron; the other repelled it. Consequently, travellers having nails in their shoes could not raise their feet from the ground when they approached the one mountain, nor could they touch the ground when in the vicinity of the iron-repelling mountain!

Arabian Nights

An intriguing story; and in the "Arabian Nights" you will find another similar narration concerning a sailing-vessel which approached an iron-attracting mountain, the result being that the nails and bolts of the vessel were all extracted from it, with the ultimate wreck of the ship!

The existence of such fantasies does, however, prove that the ancient world was more or less consistently aware of the elementary property of magnetic attraction and repulsion. Its misfortune was that it had no means of explaining it, or even of approaching such an explanation.

To the ancients, electricity was non-existent, although its manifestations were all around them. The world, after the inception of the Christian era, had to wait for nearly 1,600 years before, beginning with the application and explanation of the magnetic needle, these subjects gradually raised themselves and means were found for their true investigation and explanation.

With some of the more fascinating and engrossing phases and personalities in this scientific search into the twin subjects of electricity and magnetism this new series of articles will deal.

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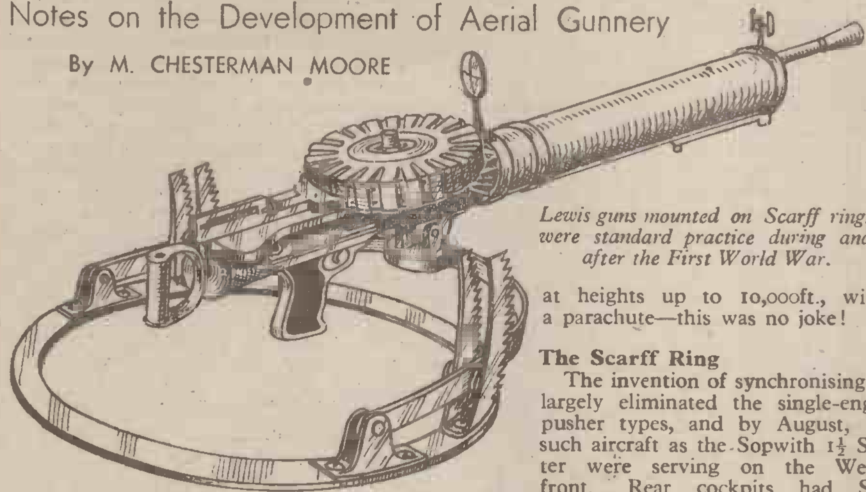
The Aircraft Gunner's Position

Notes on the Development of Aerial Gunnery

By M. CHESTERMAN MOORE



Lewis guns mounted on Scarff rings were standard practice during and after the First World War.

THROUGH the passage of the last twenty years, aerial gunnery has become an advanced military science. Even the most uninitiated layman would instinctively realise the folly of dispatching heavy bombers on operations without suitable defensive armament. To speak of the gunner's position in a modern aircraft is to envisage in one's mind multi-gun power-operated turrets, or, alternatively, heavily armoured sections of an aircraft with flexibly mounted armament. In the design of a new military aircraft, the accommodation of the air-gunner is, to say the least, a pressing problem.

At the dawn of the air age, the idea of utilising the "new fangled" flying machine in a military capacity was frowned on by all but a small percentage of militarists. In the years immediately prior to the First World War, a number of experiments were, however, carried out with the fitting of offensive and defensive armament on observation machines. The United States Army equipped a Wright biplane with a machine-gun in the spring of 1910, and in 1912 the first British experiments took place.

The question was to find the most suitable type of gun for mounting. A Hotchkiss was tried on a Henri Farman at Farnborough, but with little success. The Lewis seemed the most likely, and experiment proved this assumption correct. Marcus Manton took-off from Bisley in a 50 h.p. Grahame White biplane on November 27th, 1913. The machine was also carrying a gunner strapped to the undercarriage; and during the flight he trained his Lewis gun on special ground targets, scoring many hits.

The First World War

When the R.F.C. went to France in 1914, only a mere handful of machines were armed, and it was not until the September of that year that the first aircraft mounting machine-guns arrived. This type, the Maurice Farman Shorthorn, may also logically be said to have been the first military aircraft in production to carry an air-gunner—or rather, an observer-gunner.

An interesting attempt at a two-seat fighter was the F.E.2b pusher biplane of 1915. It carried three Lewis guns, one firing backwards over the top plane, one firing forwards from the observer-gunner's position, and a fixed offset gun controlled by the pilot. If an attack was being delivered from the rear, the observer had the hazardous job of standing up in the shallow open cockpit. This not only exposed his body to a head-on attack, but set up a grave risk of him being jerked from the cockpit by buffeting; and at heights up to 10,000ft., without a parachute—this was no joke!

The Scarff Ring

The invention of synchronising gear largely eliminated the single-engined pusher types, and by August, 1916, such aircraft as the Sopwith 1½ Strutter were serving on the Western front. Rear cockpits had Scarff ring mountings, greatly facilitating the more accurate aim of the observer-gunner's Lewis gun.

With the advent of the twin-engined bomber came the straight air-gunner. Aircraft like the H.P. 0/400 carried several gunners in special vantage positions, all armed with machine-guns on Scarff mountings.

Such was the position at the conclusion of the last war, and for many years the movable free mountings were standard on the majority of single-engined, two-seat fighters, bombers and general purpose types; this also applied to multi-engined types.

The Advent of the Gun Turret

As the speed of aircraft increased, the control of flexibly mounted guns was affected by the slip streams, and designers began to look for a means by which this difficulty could be overcome. The Bristol Company evolved a transparent cover to be fitted over a Scarff ring, a space being allowed for the protruding gun barrel and for the elevation of the gun. This hand-operated gun turret was fitted to the Bristol 120 and served as a basis for the development of the first Bristol power-operated turret in 1935.

Meanwhile, the Boulton Paul Company was developing on similar lines, and produced the world's first power-operated turret in 1934. This was fitted to the "Overstrand."

Experiments were also undertaken with single-engined fighters, and a Hawker Demon was equipped with a semi-enclosed armour gun-turret. This idea was, however, dropped in preference to the transparent power-operated turret.

The Gunner at War Again

The opening of the Second World War was a critical moment in the history of aircraft armament. Britain, unlike her enemies, had pinned her faith on the power-operated turret. But that faith was soon justified. The turrets fitted to the Wellington and Whitley bombers were most successful, while the appearance of the turret-armed Boulton-Paul Defiant over the beaches of Dunkirk was outstanding in its result.

Remnants of the old ideas still exist. Many single-engined machines such as the Barracuda, Swordfish, Dauntless and Boston still mount hand-operated guns, as do the majority of multi-engined types for beam defence. The enemy was particularly slow in his adoption of the power-operated turret, and even to-day he has not managed to attain British or American standards.

The Gunner Himself

We have looked at the gunner's equipment, now what of the man himself. He has often been called upon to carry out his duties in uncomfortable positions, as, for example, in the F.E.2b arrangement of the last war, or the ball turret of the Fortress to-day. The gunner has had to do everything but stand on his head. He has spent hours in confined spaces where even the slightest movement, except for the control of guns, was almost impossible.

Future Possibilities

Whether the air-gunner as we know him to-day will undertake the same duties in another twenty years' time remains to be seen. Already cannon comparable with the lighter types of ground artillery are in use on aircraft, and it seems quite feasible that rapid strides may even be made in the field of aerial gunnery. Perhaps the air-gunner of 1965 will be faced with a mass of intricate equipment, which will put even the present power-operated turrets in the shade.

A Spitfire XI ready to take off. In addition to carrying three bombs (one of 500lb. in the centre, and one of 250 lb. on each side), the aircraft has an armament of two 20 mm. cannon and two .5 Browning guns.

Colour Photography—3

The Processing of a Colour Film

By JOHN J. CURTIS, A.R.P.S.

WHEN a spool of colour film has been exposed it should be processed as soon as possible and, until such time occurs, it must be stored in a dry place where there is no excessive heat. If you have used a Kodachrome film you must send it to the makers to be processed, the price charged for it including a fee for the processing; further, the makers do not issue any instructions. It is, however, possible for you to carry out this very interesting work with a Dufay film, but I would suggest that your first film be done for you. The makers have a special department for amateurs' roll-films, and if you include a note asking for a criticism as regards the exposures you will obtain some valuable advice for the future.

This may seem to some rather a break away from my usual advice, namely to do your own work, but you will have read sufficient to realise that colour work is much more complicated and requires more thought in its manipulation than monochrome negative making; also, as exposure is such an important factor in the making of perfect transparencies, it is an advantage to have expert advice regarding your first attempts, rather than to continue without knowing whether your methods can be improved.

There are six stages in the processing of a Dufay film: developing, bleaching, clearing, second exposure, redeveloping, fixing and washing, and only by carefully following the instructions can the reaction of each be satisfactorily accomplished.

I do not like giving a lot of formulæ in an article of this character, but as no instruction leaflet is issued with the films, it is necessary to give at least one for each of the processes, and to include it with the description of the work.

First Developing

This must be done in complete darkness, or with an Ilford "GB" Safelight, but even this must be placed so that no direct light reaches the film. A developing tank is an advantage, but, failing this, the see-saw method with a dish must be used. When the film is removed from the spool it will tend to curl with the emulsion side outwards, therefore during the see-saw development care must be taken to prevent the emulsion side contacting with the surface of the dish and becoming scratched or otherwise damaged. As soon as it is thoroughly soaked with the solution the curl reverses and then the see-saw action can be carried on with the emulsion face upwards—a small point, but one worth noting. Where a tank is to be used avoid as much as possible touching the emulsion with the fingers, as it is more delicate than ordinary film coating, and grease markings are not helpful to good results.

Develop for three minutes at 65 or two and a half at 70 degrees Fahr. in a solution made to the following:

Metol (Johnson's), 53 grains; Soda sulphite cryst., 4 ounces; Hydroquinone, 106 grains; Potass. bromide, 48 grains; Ammonia (S.G. 880), 210 minims; Water up to 40 ounces.

Dissolve the chemicals in the order given and be sure to use fresh ammonia; your stock bottle of this should have either a glass or rubber stopper, as the strength rapidly deteriorates. The solution does not keep well, and as the film makers advise fresh solution for each spool, you should not prepare more solution than is necessary for the work in hand.

When development is complete the film should be rinsed for two minutes in water, but as it is necessary to stop development rapidly it is as well to make use of the alternative, namely, a bath consisting of one per cent. acid acetic.

Bleaching Bath

This is made up as follows:

Potass. permanganate, 40 grs.; Acid sulphuric (conc.), 200 minims; Water to make 40 ounces.

The developing produces the ordinary negative silver image, and as soon as the film is placed in the bleaching solution this begins to disappear and should be completely dissolved out in five minutes. At the end of the first minute the white light may be switched on and the remainder of the processing done with the light on. A point to be remembered at this stage is that the bleaching bath must be kept agitated during the first minute at least.

Another hint is that when making the bleaching solution add the sulphuric acid a few minims or drops at a time; do not drop or pour the whole of the 200 minims in at once or suddenly. After use this bath must be thrown away.

Clearing Bath

The film after bleaching has a brown stain and should be washed in water for a couple of minutes and then transferred to a bath consisting of potass. metabisulphite, 1 ounce; water to make up to 40 ounces. The stain will quickly disappear, and then the film is again well washed for about five minutes. This solution can be retained for further use if desired.

We now have reached a very interesting stage—that of a second exposure, and, as you will understand, it needs care. The film has now to be exposed to a 100-watt lamp for four minutes at 3 feet, or 20 to 30 seconds at 1 foot, and with the emulsion side to the light. If you have been using a Johnson's tank, you can remove the spiral complete with film, and make the exposure, but see that the light is allowed to pass through the slots at each end of the spiral. You will be certain to damage the film if you attempt to remove and replace it in the spiral. If you have used dishes for the work so far, then you will find it best to lay the film on a flat piece of glass, cleaned previously, emulsion side to the glass, and make the exposure through the glass; remove all drops of water from the surface of the film before making the exposure.

Redevelopment

The makers state that it is preferable to redevelop the image with the used first developer (full strength), and to allow the film to remain in this for four to five minutes.

You will have noticed that the coloured image became visible after the redevelopment stage, but the perfect effect of the colours is not reached until after the film has been through the fixing bath and been dried, so do not be discouraged by the lack of brilliance in the image at this stage.

The film requires a slight rinsing to remove the developer from the emulsion and before placing it in the fixing solution, which can be the usual plain hypo or acid-hypo bath; two minutes will suffice for this, and the film should then be finally washed for fifteen minutes, and then hung in a position where the back can be carefully mopped with a pad of clean cotton wool to remove any drops of water that may be found adhering to it, and where the emulsion side is well away from anything which may come in contact with it.

In our first efforts with colour films we should be very fortunate if we succeeded in obtaining 100 per cent. correct exposures, giving thereby perfect sets of transparencies, therefore it would be wrong to omit information for overcoming errors of under- and over-exposure; the makers give us directions by which these can be located, and also formulas for the treatment.

There are methods of treating the film requiring reduction during the processing, before the bleaching bath, but as a large number of workers use a tank for the developing, etc., it is a risky operation to remove the film in order to examine for the errors, and so it is advisable to confine our talk to the methods to be adopted as "after treatments" only, i.e., when the film has been completely processed, and capable of being examined by transmitted light, and the faulty sections removed for further treatment.

Under exposures will yield dense transparencies, and these will respond fairly readily to the hypo-ferricyanide bath, made up as follows:

Sol. A.—Soda hypo, 1 ounce; Soda carbonate ¾ ounce; Water, 20 ounces.

Sol. B.—Potass. Ferricyanide, 50 grs.; Water 20 ounces.

For use mix equal parts of each A and B just when you are ready to use.

This bath acts quickly, and the film must be kept agitated after it is immersed, and when the density appears correct by visual examination, remove it at once and wash it for fifteen minutes.

Over exposure will, of course, be indicated by thin transparencies lacking in colour and these should be given a bath of:

Mercuric chloride, 100 grains; Potass. bromide, 100 grains; Water to make 10 ounces.

Place the film in this to bleach right through, which takes about three minutes. It then has to be washed for ten minutes in running water, and then blackened in a 5 per cent. solution of soda sulphite, and again well washed and dried.

To those readers who have not the time or facilities for mixing these solutions I would recommend the outfit marketed by Johnson's for processing Dufay colour films; it was prepared in collaboration with the makers of the films and contains all the necessary chemicals ready mixed for diluting or dissolving.

You have been told that the emulsion is very delicate; it is still so after the film has been processed, therefore masking and mounting should not be neglected or put off. This is best done in the same manner as one masks and mounts a lantern slide with black cut-out and cover glasses; it can then be handled quite freely, and is ready for projecting on to a screen. If there is any delay in the protection of the film I would again remind you that dust may have settled on it in the meantime, and should be removed with a soft hairbrush or piece of material.

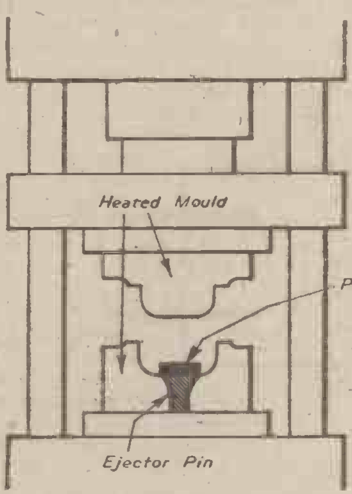
High-frequency Heating

A Paper Read Before the Royal Society of Arts, by L. Hartshorn, D.Sc., A.R.C.S., D.I.C., A.M.I.E.E., Department of Scientific and Industrial Research, National Physical Laboratory

THE heating of materials of various kinds is one of the most fundamental of all technical operations. Take a cross-section of the community in whatever direction you will, from the cook to the industrial chemist, or from the tinker and tailor to the builders of aircraft and ships, everybody is directly concerned with methods for making things hot. And this is no doubt why the development of new processes for heating has exercised such a fascination for mankind since the time when our remote ancestors first rubbed two sticks together. Certain it is that the announcement in recent months of new developments in methods of heating, based on radio technique, has stimulated not only widespread general interest, but activity in research and development work that can be described as feverish in more senses than one, besides a good deal of speculation about future possibilities. My aim in this paper is to give a brief survey of this activity, and a sketch of its scientific background. For this purpose it will be well to consider first the physical nature of the process.

The Physical Problem

Heat we believe to consist in the agitation of the countless particles from which all materials are built up—atoms, molecules, protons, electrons, and so on—and this agitation is one of the forms of energy. The central problem in heating is therefore to find some means whereby energy, already available in some form or other, can be transferred to the constituent particles in some given object. We have to find some means whereby all the untold millions of particles in its complex structure can be shaken more or less violently. The principal difficulty is that of getting at the particles in the interior. We can, by burning fuel, that is to say by utilising chemical energy, produce great heat in certain bodies such as flames or glowing coals; bodies whose particles are in very violent agitation; and by bringing such a body into contact with a cold one, we bombard the atoms on the surface of the cold one with those on the hot one, and so agitate the surface atoms, which in their turn bombard those on the layer beneath them, and so on. The agitation, *i.e.*, the heat, spreads gradually inwards, but at a pace dictated by the building up of the structure and not by the will of the operator. In other words, the rate and distribution of the heating is controlled by the thermal conductivity of the material; and when this is very low, when the structure is such that the agitation of one particle does not greatly disturb its neighbours, it may become almost impossible to heat the body throughout its bulk by ordinary methods, like those of the oven and furnace, which can operate only on the surfaces of materials. Fortunately electrical methods have solved this problem of getting, as it were, a direct grip on the particles in the interior of a body. For the particles themselves consist largely of positive and negative electrical charges, and they can be set in motion at a distance in ways somewhat resembling that in which a powerful electromagnet sets a distant piece of iron in motion, or any electrically charged body sets the pith balls of our schooldays in motion, the operating processes being those which, in Faraday's time, were always called induction, magnetic, electrostatic, or electro-magnetic. In other words, if we first put our energy into the form of an electric or magnetic field, and then insert the body to be heated in that field, the charged particles which go to build up the body become actuated by the field in various ways, and by suitable manipulation of the field it can be made to set these particles in motion in ways that will cause them to agitate the whole structure that is to make the body hot; the energy of the electric or magnetic field being partially absorbed by the body as heat, not merely at the surface, but throughout the whole volume permeated by the field.



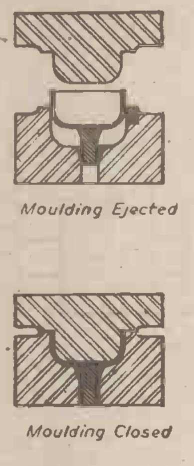


Fig. 1.—Diagrams illustrating the moulding process.

The magnetic and electric fields that can be most effectively utilised in this way are those familiar to us in high-frequency oscillators or radio-transmitters. It may be recalled that the essential features of such devices are a coil and a condenser forming an oscillatory circuit; a circuit such that if the condenser is charged to high voltage, it immediately discharges through the coil, the discharge current in the coil creating a magnetic field as it drains away the charge on the condenser and therefore its electric field. As soon as the condenser is discharged there is no more energy to maintain the current, the magnetic field collapses, and in doing so induces a reverse current in the coil which again charges the condenser, but in the opposite direction, and so on. The energy is repeatedly transformed from one form to the other. The function of the valve is to admit bursts of additional energy at appropriate instants in order to make up for any loss of electric or magnetic energy that may occur in the process. The high-frequency oscillator therefore gives us a supply of energy available as an alternating magnetic field or an alternating electric field, the frequency of the alternations depending on the time required to discharge the condenser, *i.e.*, the size of the coil and condenser. Either of these forms of energy can be used for heating purposes, and we therefore have two forms of high-frequency heating: the heating of metals by means of the magnetic field, or eddy current heating on the one hand; and the heating of non-metals by the electric field, or dielectric heating on the other. In this paper I shall consider dielectric heating only.

History

I have considered the matter so far from an atomic standpoint, for the sake of the insight which it gives into the nature of the process, but it must not be supposed that the subject developed from any such considerations. Like many other useful processes it was almost certainly discovered accidentally, and the discoverer was probably not very anxious to claim any credit for it, because it was for a long time little more than a nuisance. When the early radio engineers started to build powerful transmitters they soon found that many insulators that were quite satisfactory in ordinary electrical engineering were useless for radio work. The insulators supporting the high-voltage conductors did not break down by passing spark discharges, but they frequently became so hot as to catch fire, and much effort was directed towards the discovery of material that would not get hot under these conditions. Very surprisingly, American whitewood, which in ordinary power and lighting circuits would be regarded as being poor insulating material, was for some time one of the most satisfactory materials for high-frequency work. In order to deal with this problem engineers found it necessary to get some insight into the mechanism of the process, and to devise tests that would enable them to grade their insulating materials in respect of this objectionable tendency to become hot in the electric field. For this purpose the quality known as the power factor of a material came to be widely recognised. This requires another brief glance at the atomic, or rather, molecular, picture.

The Molecular Mechanism

Consider a body between the condenser plates of a high-frequency oscillator. When the voltage rises all the positive particles in the material are pulled one way, and all the negative particles the other. But if the material is an insulator the particles cannot move far; they are anchored by the attractive forces which they exert upon one another. There is a displacement of the charge which collapses when the voltage falls to zero, and is reversed when it rises again in the opposite direction. The structure is thrown into a state of forced elastic vibration, but this is not the same as being heated. Energy is put into the material when the charges are displaced, but when they spring back into position as the voltage falls to zero this energy is returned to its source, and there is not necessarily any net gain of energy by the material. The ideal insulator sought by the radio-engineer has just this property, but in practice his materials do not give back the electrical energy put into them with each pulse of the voltage; a certain fraction of it is retained as heat, as if the forced vibration of the charges is restrained by something equivalent to internal friction or viscosity. Although the fraction of the energy retained in each cycle may be quite small, say two or three per cent., as the frequency gets higher and higher the total energy retained per second gets steadily larger, so that the material becomes hot, and the higher the frequency the hotter it gets for a given applied voltage. The behaviour of each material is represented by two constants, the dielectric constant, which represents the total electrical energy put into the material when a given voltage is applied to it, and the power factor which indicates the fraction of that energy retained as heat when the voltage is removed. It will be clear that the heating effect for a given voltage will be greater the higher the dielectric constant, the higher the power factor and the higher the frequency, *i.e.*, the greater the electrical energy put in at each cycle, the larger the fraction of this energy retained, and the larger the number of cycles per second. The heating effect in any material will obviously also be increased by any increase of the voltage to which the material is subjected.

As these ideas became common knowledge it becomes obvious that the high-frequency electric field provides us with a means of imparting heat energy to a material at every point throughout its bulk simultaneously. It provides a method of internal heating as distinct from the older external methods, which can only operate on the surface. As a method of generating heat it is necessarily expensive because high-frequency oscillators are themselves expensive, and their efficiency is seldom greater than fifty per cent.; but for certain applications the advantages obtained fully justify the increased expense. More important still, certain operations that are quite impossible by previous methods become possible by high-frequency heating. A few examples will illustrate these points.

Rapid and Uniform Heating

No materials are more characteristic of our present stage of industrial development than the laminated materials obtained by bonding together thin sheets of either wood or a textile fabric with synthetic resins. The so-called improved woods, plywoods, and materials like laminated bakelite have provided us with materials which rival the metals in strength while retaining the virtues of the non-metals for certain purposes. In order to make these materials, a stack of many layers of wood, paper or fabric, interleaved with thin layers of a synthetic resin in some form or other, must be brought under pressure and then heated throughout to the point at which the resin becomes "cured" and sets to a hard, vitreous solid. This operation is usually performed in presses with steam-heated platens, but since the material is of very low thermal conductivity, a considerable time must elapse before the heat can reach the centre of a thick pile, so that the operation is necessarily slow except for very thin sheets, and there is considerable danger of either the centre being under-cured, or the outer faces being over-heated. This is an obvious case of dielectric heating. In an American plant used for the purpose, the press makes two stacks of plywood, each one foot thick, in one operation. Between the two stacks is a metal sheet forming the high-voltage electrode; the two platens, which are, of course, connected together by the framework of the press, form the other electrode, so that the press, the two stacks and the central metal plate form a large condenser. The coil to which it is connected and the valve equipment stand on the floor immediately over the press. When the high-frequency power is switched on the temperature of this 50 or more cubic feet of wood is raised by 160 deg. F. in less than five minutes. For this application the advantage of high-frequency heating lies in the fact that the output of the press is greatly increased, and this is important, since it is much the most costly item in the whole plant. A similar advantage occurs in the manufacture of laminated paper and fabric boards, when it is made in thin sheets like plywood; but the fabric material such as is used for gear wheels is required in thick sheets as well as thin, and high-frequency heating then confers the additional advantage that it makes possible the manufacture of boards in thicknesses that would be impracticable by platen heating.

Laminated wood is also required in thicknesses of several inches for aircraft construction, and for this work it has been necessary to bond the laminations with cold-setting glues. An interesting example is to be found in the long curved spars forming part of the wing structure of aeroplanes, like the Mosquito. The laminations coated with a synthetic resin glue are assembled in a jig which gives them the form required and on which they can be maintained under pressure until the glue has hardened. This process may take about eight hours at normal room temperatures. At a temperature of, say, 250 deg. F., the same process occurs in a few minutes. The spar can easily be raised to this temperature by means of dielectric heating in, say, twenty minutes, and the whole operation completed in half an hour.

Another example of the way in which dielectric heating can be applied in order to improve the product and increase the output of very costly plant is provided by the plastic moulding industry. Mouldings are commonly made by placing just the right quantity of the basic material in the mould and applying heat and pressure in the manner suggested by the illustration (Fig. 1). The heat first softens the material, which is then squeezed to the shape of the interior of the mould by the pressure, a further period of heating under the pressure causes the material to be set into its final vitreous form, when it can be removed from the mould. The heat has usually been imparted to the material by heating the two parts of the mould either by steam or electric power. The actual moulding operation then cannot begin until heat sufficient to soften the material has passed from the heated mould into the material, and this initial period of heating may form a considerable part of the complete cycle of operation for a large moulding. By means of dielectric heating the bulk of the heat required to soften the material can be imparted to it in a very few minutes. For convenience in handling, the material is cold-pressed into pellets or preforms. These are placed between the condenser plates of the high-frequency oscillator, and the power switched on for the time required to heat it to the softening temperature. In this way, not only is the time required in the mould greatly shortened and the output of the press increased, but the material is far more uniformly heated than it can ever be by surface methods. It therefore flows better within the mould, is far less likely to distort or break any small metal parts within it, and gives a more homogeneous product. For this work the high-frequency oscillator is a separate unit of about 2 kv output power, which stands alongside the press which it serves.

Drying

The fact that the electric field produces internal heating as well as surface heating soon attracted the attention of those concerned with industrial drying operations. The seasoning of timber immediately leaps to the mind, but in cases like this where great masses have to be heated for rather long periods—that is to say, where energy in very large quantities is the chief requirement—it seems very doubtful whether the process could ever be economical, owing to the relatively high cost of high-frequency energy. However, cases do arise in which the cost of the energy is only a secondary consideration. Examples are the drying of tobacco and artificial sponges. For example, by means of dielectric heating the moisture content of tobacco, which is packed in casks, can be reduced without unpacking it. At least there is a patent covering this operation, and I see no reason to doubt its practicability. The cask can be placed between two condenser plates and heated throughout by means of a high-frequency field, and this operation can be performed inside an enclosure to which a rough vacuum pump is applied. At the low pressure and the high temperature the water evaporates very quickly and condenses on the sides of the enclosure which remain cold. The operation can be stopped as soon as the desired amount of water has been removed.

Surface drying in ovens and kilns always dries the outer layers of a material far more than the inner ones, and the result is that spongy materials tend to become distorted in shape and to form crusts on the surface. This difficulty can obviously be overcome by dielectric heating, which heats the inner layers at least as much as, and usually more than, the outer ones, since there is always some loss of heat at the surface due either

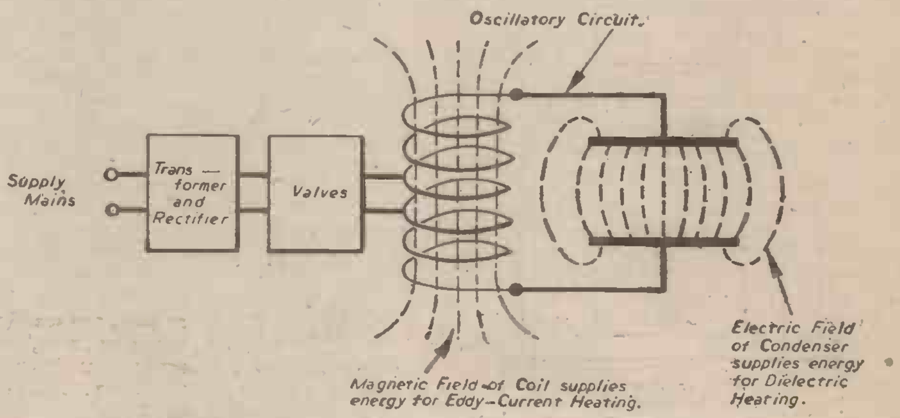


Fig. 2.—Diagram illustrating the generation of radio-frequency energy.

to the surrounding air or the electrodes, and this cannot occur in the interior.

Dielectric heating also promises to serve a useful purpose in scientific work when it is desired to remove the last traces of water from organic materials, as in moisture determination. The most effective method of drawing off the water is to heat the material in a vacuum, but since a vacuum provides the best possible thermal insulation it prevents the heat from reaching the material from an external source. Dielectric heating completely overcomes the difficulty by generating the heat within the material.

Localised Heating

In the examples so far considered, the whole of the material has been uniformly heated. Sometimes this is not necessary or desirable: we may need to heat only one particular spot as in many jointing operations. With dielectric heating this is a very simple matter, since heat is only generated in the part of the material which lies in the electric field, and this field is confined to the immediate neighbourhood of the gap between the two electrodes. Thus it is only necessary to use two small electrodes and to place them one on either side of the spot to be heated. In this way welded structures can be built up from pieces of Perspex or other thermoplastics. By using strip electrodes lying along the whole length of the joint the whole joint can be heated at the same time. Alternatively, two small electrodes mounted on a handle can be used rather like a soldering iron, the gap between the electrodes acting as the bit and being slowly drawn along the length of the joint. In order to make seamed joints between thin sheets of thermoplastic material, electrodes in the form of two small rollers between which the material is passed have been used. The material softens the instant it passes through the intense field in the gap between the rollers, the pressure of the rollers forms the welded joint, which is cooled by the air the instant it leaves the rollers. There is no appreciable heat anywhere except in the minute gap between the rollers, so that very little power is required. The device is operated just like a sewing-machine and, of course, can be used for jointing any fabric, provided a thin strip of a suitable thermoplastic material is fed into the seam as it passes between the roller electrodes.

Another application of this kind is spot glueing, used in assembling the complex wood structures found in aircraft, and the equivalent of the spot welding of metals. The structures frequently consist of thin skins of plywood moulded to the desired stream-line contours, and supported and made rigid by girders or bulkheads, also of wood. The very thin veneers from which the plywood is built up and also the various members of the supporting structures are bonded with synthetic resin glues, which, when set, form a joint stronger than the wood itself, but some means must be provided for temporarily taking the various parts into their proper positions while the structure is being built up into a form to which the pressure necessary for the formation of good glued joints can be applied. Metal screws, pins, or staples are often used for this purpose, but they are undesirable since they necessarily weaken the wood at the point at which they pierce it. If, instead of driving in a screw or pin at some particular spot we press a pair of small electrodes on to it, a high-frequency electric field applied between the electrodes can be made to heat up the glue-film at the spot and to cause it to set in a few seconds. In this way the structure can be tacked together quickly and without weakening the wood at any point. For working on vertical or inclined surfaces the electrodes are sometimes mounted into the form of a short gun, the pistol grip being the most handy one for a tool of this kind. For working on horizontal surfaces the form of the flat iron is perhaps more convenient. Essentially, however, the two are the same thing; simply two small electrodes connected by a flexible cable to a high-frequency oscillator so as to provide a highly localised electric field.

Selective Heating

One of the most important features of dielectric heating still remains to be considered: we can sometimes arrange to supply heat to a mixture of two substances in such a way that nearly all the heat is generated within one of them, and very little in the other. It has been mentioned earlier that each material is characterised by two dielectric properties; the one, dielectric constant or permittivity, being an index of the electrical energy put into a material when a given field is applied: and the other, power factor, being an index of the fraction of this energy retained as heat when the field is removed. These properties have been studied in great detail and more curious facts than those shown in Fig. 2 have frequently been observed. Note that plate glass has a power factor that is less than one per cent., and almost independent of frequency over a great range. On the other hand, the power factors of the transparent plastics cellulose acetate and celluloid vary greatly with frequency reaching a maximum value of nearly ten per cent. in a certain frequency band. The dielectric constants of these materials are not very different. It follows that if we place a sandwich of alternate layers of plate glass and plastic in an electric field of this frequency, heat will be generated in the plastic at a much greater rate than in the glass. Thus the plastic can be brought to softening point without any risk of damaging the glass, and in this way the manufacture of safety glass may be greatly facilitated. The attractive point is that heat can be generated just where it is wanted and nowhere else.

This feature of dielectric heating has been one of its most powerful attractions, though most of the work on it does not appear to have got beyond the experimental stage. Consider for example its bearing on the sterilisation of food products and biological materials generally. If only we can find a frequency at which the power factor of the organism we want to get rid of is high and that of the material to be sterilised is low, we may have an ideal sterilising process. The appropriate electric field applied for a very short time would heat the organism to the point of destruction without any excessive heating of the bulk of the material. A process for killing insect pests in plant bulbs was the subject of one of the earliest patents dealing with high-frequency heating. When the bulk material is dry, for example grain, there is good reason to expect the power factor of insect pests to be much higher than that of the surrounding material, but if this material contains much water its power factor is likely to be high, and the desired selective heating seems not very probable. Nevertheless, the fact that the heat is produced simultaneously throughout the whole bulk of the material will always give the process some advantages for work of this kind.

Radio-therapy is simply dielectric heating applied to the human body. Two electrodes are placed in such a position that a high-frequency field is established in the region of the body to be treated. A local rise of temperature, an artificial fever, occurs with beneficial results in some circumstances. It has sometimes been claimed that at certain frequencies disease-producing organisms are killed by selective action of the kind just described. It must, however, be confessed that to a physicist this appears to be very improbable in a material containing as much water as the human body. The heating will undoubtedly be different in, say, the fat and lean portions, since their power factors and dielectric constants differ, and to this extent the heating is selective, and the relative rates of heating of the various portions can be varied by altering the frequency. Nevertheless it seems most probable that it is the general heating which is effective and that the frequency is of no importance except that the higher the frequency the lower the voltage for a given heating effect; and low voltages are always preferable as a precaution against accidental sparks and shocks.

Some Difficulties

Before leaving the subject it is necessary to mention some of the difficulties that are encountered in the use of dielectric heating. They arise from those very features that make the process so attractive. In the first flush of their enthusiasm over a successful experiment, the spectators, if not the experimenters, have sometimes had visions of dielectric heating for every purpose in every home. No waste heat, no mess, the largest joint cooked right through in two minutes, and so on. But consider how awkward this selective heating could be. The fat may heat more than the lean, or the lean more than the fat, depending on the frequency and the moisture content, and the cook must be something of a radio-engineer and biochemist to know what to do about it. Again, heat will certainly be generated throughout the whole joint however big it is and the centre will almost certainly be hotter than the outside because it has less means of losing heat. Thus, the centre might get burnt while there was still nothing to show on the outside, and moreover, it is extremely difficult to measure the temperature and to know what is happening inside. If you are using steam heating or an oven you know that the inside temperature will at the worst not exceed that of the steam or the oven, but with dielectric heating there is no such limit. Sometimes it happens that the power factor of the material increases with rise of temperature, and then the hotter the material gets the more rapidly it heats until it chars. This fanciful illustration admittedly over-emphasises the difficulties, but one or other of them appears to some extent in most applications of the process. It is only suitable for repetition work in which the material to be treated can be standardised so as to have dielectric properties within certain known limits. Much careful development work is always necessary in order to arrive at the proper working conditions; but once this has been done the whole operation can be made almost automatic, the pressing of a button starting the operation, and time switches doing the rest. Enough has been said to show that the process offers great possibilities for future industrial development, but it is no maid-of-all-work and must be treated with respect.

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The Story of Chemical Discovery

Problems of Future Chemistry

Some Chemical Conundrums for the Coming Generation of Scientists

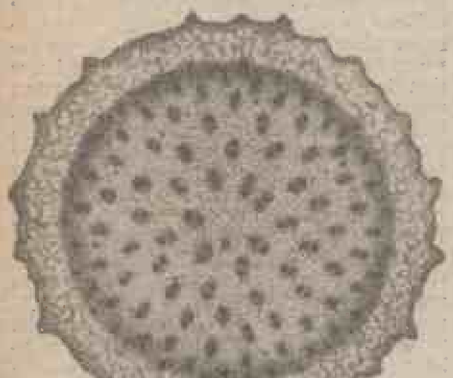
NOT infrequently, the enthusiastic chemical devotee, be he advanced student or ardent amateur, is apt to look up from his experiments, and in those spare moments to wonder what still remains to be discovered in the realm of chemistry.

"A century ago," the remark is often heard, "it must have been almost enjoyably easy to make even spectacular discoveries in chemistry, but nowadays, when the fundamental basis of chemical science has been so minutely gone over and mapped out time and time again, radical discoveries in this engrossing science become more and more difficult, and even wholly unlikely."

One sympathises with the viewpoint expressed above, for there is a certain amount of truth in it. During the last 150 years an enormous mass of basic discoveries has been made by all varieties of chemical workers the world over. Gigantic industries have been brought into being as a result of this veritable mountain of new experimental knowledge and, in many respects, civilisation has been totally revolutionised as a result of it.

It *is* difficult for even the experienced chemical worker to make first-rate discoveries nowadays, because chemical thought and chemical technique have been so greatly standardised. True enough, there are at the present time hoards of white-coated scientific research workers who, in the employment of various industrial concerns, strive daily to devise improvements in industrial processes, to bring out new ways and methods of cheapening production, and of attaining pre-conceived requirements. Theirs is a vitally necessary and a highly skilled job, but, in the best sense of the term, they are not research workers. They practise an economic chemistry rather than a "pure" one. Although their chemical knowledge is profound, they have neither the time nor the facilities for prosecuting their own individual investigations into the fundamentals of chemistry. Mostly, they are, in a sense, "directed" workers.

This is just one point which the ordinary individual, and possibly the lone chemical experimenter, should bear in mind. Research "teams" do not generally make fundamental discoveries. Indeed, they do not aim at so doing. Theirs is the utilitarian side of the chemical game, the shaping into commercial or industrial importance of previously acquired knowledge and discovery. Thus it is that, in many respects, the serious single-handed worker has equally as many chances—if not more—of bringing off a great chemical discovery as have the professional and industrial chemists in their works laboratories.



A microscope view of a cross-section of the stem of a common weed (butcher's broom), showing the individual plant cells and the numerous channels through which the sap flows. No chemist has yet succeeded in building up shemical substances in the quiet manner in which the plant carries out this task.

Dr. F. Haber, the German chemist, who, before his expulsion by the Nazis, grappled with the problem of extracting gold from seawater.

Lone Discoverers

Consider, too, the general history of chemical discovery. Almost all the way along through these amazingly fascinating annals the rich prizes of discovery have gone to the lone and even the lowly workers. John Dalton, the chemist and the founder of the present Atomic Theory, made his experiments with ink-bottles for flasks, and with an ordinary kitchen fire as a source of heat. Robert Bunsen, a renowned chemical investigator, worked single-handed in a cellar. Joseph Priestley, "the chemical parson," utilised his own drawing-room as a laboratory, Scheele, one of the first of the scientific chemists, used the back of his shop for his experiments, and even in our own times one famous individual chemical discoverer has habitually conducted his chemical experiments in the bathroom of his London flat.

It is, in reality, the man who counts—not his apparatus or the facilities which he has available. The first-rate chemical discoverer is born, not made. Training is valuable, and, in some instances, indispensable, but without inborn spark of originality, all the University study in the world will not make a successful discoverer.

Considerations such as the above should be dwelled upon by any individual chemical enthusiast who is inclined to lament his own circumstances, lack of training and the present-day "difficulty" of finding subjects for original chemical discovery. While chemical science in our modern times has advanced phenomenally as regards the myriads of its utilitarian applications, the stream of fundamental chemical discoveries is certainly thinner and slower than it was during the last century. It would almost seem as if chemistry had become too busy in earning dividends to be able to give much time to its own extension, and to the elucidation of many of its inner problems.

What Are Plastics?

Much work, for instance, is at present being done on the improvement of synthetic plastics and in extending the field of application of these remarkable products. But do we understand exactly what these modern synthetic resinous products consist of? Have we any exact knowledge of the number and arrangement of the atoms in the finished products? Very little, is the answer—for this part of the business does not concern the chemical industrialists.

In a large number of cases, we can imitate the products of Nature and, sometimes, even improve on them. For instance, the chemist is able to build up synthetically various atoms into, say, one or other of the many flavouring and odiferous principles of plants. The chemist can manufacture on a vast scale the indigo dye which was formerly extracted from Indian plants by native labour. He can make cocaine and nicotine artificially, to mention only a pair of important drug principles. But in all these instances, the chemist achieves his aims with a truly enormous amount of effort and energy expenditure. His method is to process certain materials by treating them with strong acids, often hot and boiling under pressure, to indulge in high-temperature distillations, treatments with lime, soda, powerful solvents,

Growing giant crystals from a solution. Strange as it may appear, forces which are as yet unknown preside over the crystallisation of solids from liquids.

vacuum boiling and to give rise, at the same time, to a greater or less number of subsidiary products which have usually to be worked up into other materials if the process is to be in any way economic.

The Plant Laboratory

Not so, however, the simple plant, whose chemical product the modern chemist endeavours to copy. Given a reasonable amount of moisture, some iron, a little nitrogen, a modicum of carbon dioxide gas, together with a fair proportion of ultra-violet light in the form of sunlight, the plant, quietly, ceaselessly, silently, odourlessly, and without any fuss whatever miraculously changes its raw materials into the valuable product which the chemist copies in his manufacturing processes.

The plant is a living laboratory. But it constitutes a highly secret laboratory across the portal of which no one has as yet successfully passed.

Here, therefore, is a first-rate problem for the young and aspiring individual chemist. Devise some principle whereby the plant products of Nature may be made simply and quietly and at ordinary temperatures with the aid of ultra-violet light as an outside source of energy. Cut out all the high-temperature acid and alkali treatments of raw materials. Find out Nature's own method of synthesis. Adopt it, and then improve upon it—if you can.

Another chemical problem of the very greatest importance concerns the extraction of metals from their ores. Our present-day methods of ore extraction and utilisation are very limited. We can only economically make use of relatively "rich" ores. The utilisation of "low-content" ores is economically impossible.

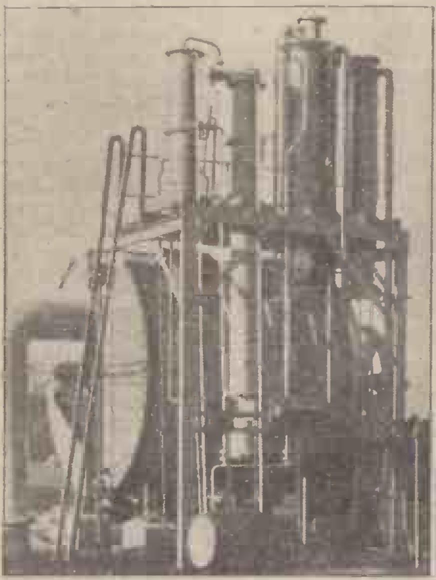
Take the aluminium industry for one example. The basic ore of that vital industry is *bauxite*, which consists of aluminium oxide mixed with iron oxide. Now, bauxite is not the easiest mineral to obtain, particularly in wartime, when the difficulties of its supply become very great. Yet around us, as an integral ingredient of common clay, and as a constituent of many common rocks, the vital aluminium exists in almost unlimited amounts.

The trouble, however, is that it is present in clays and common rocks in too low a proportion to admit of economic extraction. The same applies to magnesium, a constituent of a large number of silicate rocks. Could some chemical method be devised of profitably extracting metals from their abundant but nevertheless *low-content* sources, the mineral industry and the metallurgical trades would wellnigh be revolutionised. Even radium might in such circumstances become tolerably common, for this rare element is widely dispersed through the natural rocks.

The whole problem is fundamentally a chemical one, and it is the chemist who will solve it, rather than his confrere the engineer or the geologist.

Seawater Gold

The oceans of the world function as a vast reservoir of chemical materials which await the discovery of suitable extraction processes. Practically every metal known is present in traces of seawater. Fritz Haber, the famous German chemist, who was ultimately expelled from his country by the Nazis, worked for a considerable time on the extraction of gold from seawater, his aim at that time being to finance the reparations debt of the last war, to which his country was committed. But while Haber was able to show once and for all that gold does exist in minute yet measurable amounts in the world's oceans, he was not able to suggest any practical method of extracting this portion of the sea's wealth.



A fuel-distillation plant, designed and erected according to strict chemical principles.

Nevertheless, Fritz Haber set the ball rolling in this department of practical chemistry. Some years afterwards, the Dow Company, of America, came out with a highly successful process for winning bromine, a valuable red liquid element, from seawater. Bromine was at that time in great demand as a raw material in the manufacture of lead tetra-ethyl for the treatment of anti-knock petrols. This famous pioneer concern still functions highly successfully as a bromine extractor.

More Magnesium

Experiments have shown that it is within the bounds of economic possibility to extract magnesium from seawater, the magnesium content of the water being concentrated as magnesium chloride, which latter salt is then electrolysed for the production of the metal. Seawater magnesium has not yet appeared on the market. Nevertheless, it seems to be well on the way to so doing, and thereby proving to be another triumph of this novel yet highly important branch of chemical technology.

In the course of time other substances will no doubt be forthcoming from the world's oceans, for, when dealing with chemical extraction problems such as these, it is not the actual proportion of the material present in the sea which is of importance. Rather it is the ease with which its continuous concentration and extraction may be carried out which is of prior import.

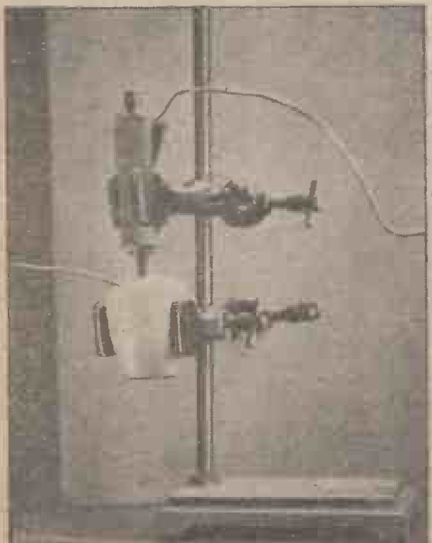
Phenomenon of Solution

The subject of dissolved substances leads us at once to another branch of chemical knowledge which is, as yet, somewhat nebulous and uncertain.

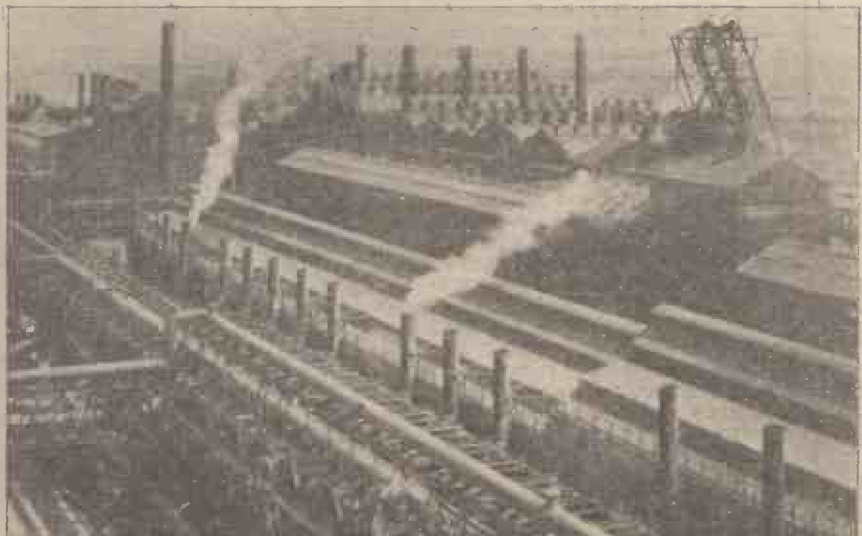
What are your opinions on the phenomenon of solution ?

You throw a quantity of salt or of soda into water, stir the liquid a little, and within a minute or two you observe that the salt is no longer to be seen. "It has dissolved," you say, and so, too, have said three or four generations of scientific chemists, but they have all little understood the real nature of dissolving and of the dissolved state.

You know that the salt is present in the water because you can taste it and because, if you do the job carefully, you will find that the liquid has increased in weight exactly according to the amount of salt which you have dissolved in it. Also, when you evaporate the water you get back the same quantity



A laboratory preparation of metallic magnesium by the electrolysis of magnesium.



A large-scale chemical plant. It is upon laboratory discoveries that all such plant is fundamentally based.

of salt which you put in. None is lost; none is wasted.

On the other hand, if you attempt to perform the same trick with an organic liquid such as petrol, or benzene, or aniline, you find that the salt just will not dissolve and disappear, despite the fact that many of these organic liquids will dissolve things such as grease and fats, which water refuses to make disappear.

Here is a basic, a fundamental and a highly important problem in "pure" chemistry, or, rather, in the subject of physical chemistry, which no one yet has really been able to solve.


Bakelite powder made from carbolic acid and formalin. Chemica fame awaits the discoverer of its exact composition.

Why do liquids dissolve one substance and not others? Why are liquids capable of taking up only definite maximum amounts of the things which they dissolve? Why, usually, do hot liquids dissolve more material than cold liquids? And, most important of all, what happens to a solid when, before our very eyes, it is mysteriously whisked away from our ken by the medium in which it dissolves?

Various theories are extant for explaining this common group of phenomena, but none of them is really satisfactory. They all seem to keep one guessing.

Question of "Valency"

Then, too, in the realm of "pure" chemistry, there is the very vexed question of "valency," which may be described as the combining capacity of an element. Valency has been a chemical bone of contention ever since its conception was first originated. The valency of a chemical element rules its power of entering into chemical union in a compound. Thus, for example, the elements chlorine, iodine, and bromine can only combine with one single atom of hydrogen, whilst an element such as boron is able to combine with four hydrogen atoms. Carbon atoms, again, are seemingly able to link themselves up into chains and closed rings and so to produce the almost illimitable array of "organic" chemical compounds, both natural and synthetic.

For all that, the precise nature of this property of "valency," of combining capacity is all but unknown. It is undoubtedly of an electrical nature, but precisely how this characteristic and inherent attractive force possessed by nearly all the chemical atoms comes into being and operates continuously is still a problem for the new generation of chemists.

Chemical Coloration

What is the underlying nature of chemical coloration? When you dissolve copper oxide in sulphuric acid you obtain a beautiful blue solution of copper sulphate. Nickel or nickel oxide similarly dissolved produces green nickel sulphate, while zinc treated in like manner gives colourless zinc sulphate.

If you take copper sulphate crystals and heat them carefully at the temperature of boiling water for some time, the crystals lose all their constituent water and crumble up into a white powder which again turns blue on adding the merest drop of water to it. So that *pure* copper sulphate is white, whilst in combination with water it is blue. Why is this?

And, again, what is the underlying means by which the various chemical dyestuffs exhibit their powerful and pronounced colours? Why should not ordinary aspirin (a synthetic product) be green or scarlet, and why should not indigo be red instead of blue?

Similarly, what underlying property of atomic combination imparts to rancid butter or putrifying meat its bad odour; and why, on the other hand, should the natural balsams, the plant perfumes and the various essential oils exhibit their characteristic and individual masterpieces for the delectation of nose and palate?

Chemistry, so far, has its various theories of colour groups among atoms, and of "olfactory assemblies," but it has advanced little more than that. There is still little definite knowledge on the subject.

Why do metals conduct heat and electricity? Why do insulators insulate? Are electrical conduction and, likewise, electrical insulation, primarily chemical or physical problems? Will we ever be able to produce a super-conducting metal and a super-insulating insulator? Already steps are being taken with a view to devising better insulators, but the perfect non-conductor of heat and electricity is still a long way off. Will the chemist ever realise it?

When will the practical chemist solve the problem of making sugar and starch from carbon dioxide gas, water and a little ultra-violet light in the continuous manner in which plants so successfully effect this operation? Shall we ever obtain a positive *chemical* cure for cancer and for other major diseases? Is it within the bounds of the chemical art to keep old age and bodily deterioration at bay, if not permanently, at least for a few decades of years?

Will the chemical researcher ever succeed in creating large molecules which will have, at least in some respects, the powers of life? Such a feat would at once open up new worlds of speculation, for, at present, so far as our knowledge is concerned, there is a definite and a wholly impassable division between life and non-life.

Chemical Engines

Finally, shall we ever be able to create motive power by purely chemical means alone? Our bodies manage this feat very successfully every time we contract a muscle, for, after all, the muscles by which we move our bodies are nothing more nor less than chemical engines, deriving their motive power by chemical action? Could we but produce such a chemical engine on a large scale many strange things might become possible.

The possibilities of chemistry are still illimitable. Discoveries may be difficult, but then, of course, discoveries always *were* difficult. "It's simple when you know how!" It is merely the knowing how which produces the difficulty.

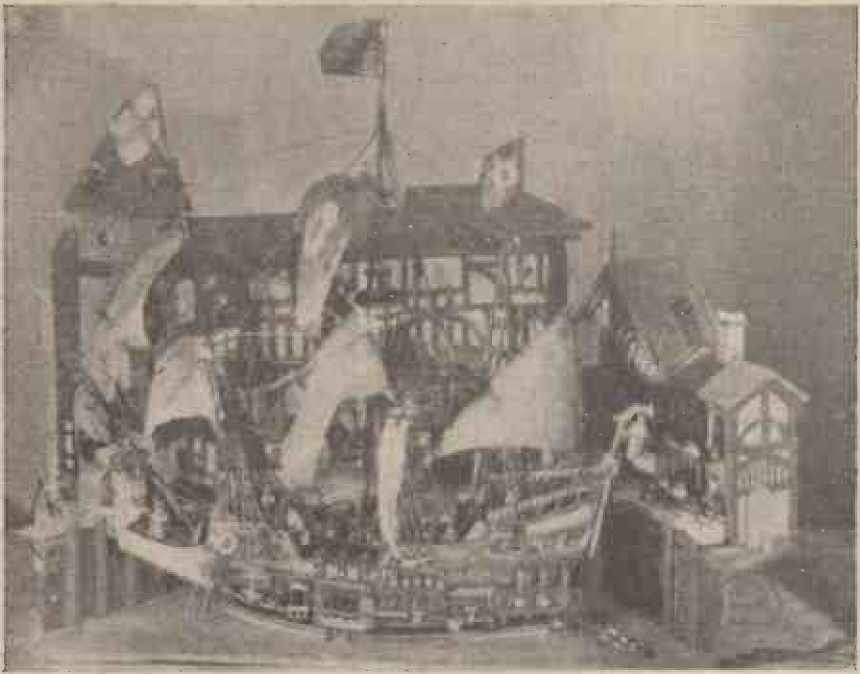
And so, by the method of patient individual trial and error, experiment and hypothesis, must scientific chemistry tread the uphill path which leads to future discoveries. Usually, the individual enthusiast has made a better job of discovery than has the organised team of workers, and it is mainly upon the work of the former enthusiasts that the present science of chemistry has, through the last two centuries, been reared. Let the young chemical aspirant take heart at such facts and refuse to be discouraged by the seeming difficulties which necessarily surround all endeavours towards further chemical discovery.


R.A.F. cooks of the 2nd Tactical Air Force improvised a first class kitchen with disused petrol cans and oil drums. An ingenious chimney of petrol cans takes the smoke from the field kitchen into the nearby trees.

THE WORLD OF MODELS

By "MOTILUS"

An Interesting Model Galleon : A Famous "Old-timer" Model Locomotive



Mr. H. M. Sankey's model "La Bonna Esperanto" with imaginary harbour background surrounded by building in the style of the Old London Bridge, including the historic public house "Ye Old Seven Stars." When illuminated in its setting in an old 17th century room, where Mr. Sankey keeps it on display, it makes a very fine spectacle.

MANY readers will be conversant with the work of Mr. H. M. Sankey, especially as regards Pyruma modelling, which I have described in previous issues of this magazine. Knowing his aptitude for novelty, I was more than interested when invited to see his latest masterpiece of modelling, which is illustrated on this page.

Mr. Sankey is an experienced and enthusiastic model maker, who has a leaning to the ancient rather than to the modern, and to celebrate the anniversary of his silver wedding he decided to model an old galleon to present to his wife. In this miniature he has endeavoured to create something different in the way of galleons. He has brought together interesting features of his favourite ships and embodied the characteristic features in the one model. For instance, expert ship lovers will find there is something reminding of the "Revenge" in the taffrail, the beak is similar to "The Golden Hind," and there is a little bit of the "Mayflower," in fact, Mr. Sankey calls the little ship "La Bonna Esperanto"—the embodiment of all the other galleons he has made.

He started on the keel on February 1st, 1944, and as a matter of interest has kept a time sheet, which shows he has put in just on 600 working hours. And he says, "I do not think anything in my life has given me so much pleasure as the construction of this old galleon. As it is to a scale of 4ft. to the inch, I can include bags of dubloons and 'pieces of eight.'"

The conventional decorations of the model are all cut out separately and fixed with glue and this has added to the general effect and has simplified the painting part of it.

"Tiluma" is used for the raised filigree work, although there is not very much of this. The sails were not always embellished, but Mr. Sankey has chosen one or two of the most interesting designs, particularly his favourite—the "Santa Maria."

Interior Decoration

Perhaps the most interesting feature is the interior decoration. The stateroom is complete with four-poster bed, small chairs of the period, a refectory table and a carpet which was woven by the builder himself—a surprising effort for one of the masculine sex! The lamp on the table, which, incidentally, is set for a meal, is to scale and represents one of the old horn lanterns. The whole is lit by small pea bulbs—there are twenty lights in all and they come off the main through one of the Trix transformers.

The stained glass in each of the cabins is effective, yet is very simply produced by means of gauze and "Durofix" glue and finally tinted with artist's ink.

Another of the model's features is the set of models of the crew. One of the first Mr. Sankey made was supposed to represent the foreman, and he has stood by the whole time the other members were being constructed. Another of the figures is a tame baboon, which the crew often had on board in those times, and he has caused his constructor much amusement!

But the foreman has disappeared, which means Mr. Sankey will have to organise a very complete tidy-up in his workshop to find him, but he says this will be just as well, because he can then put the finishing touches in. "I should not like to say how many blitzes 'La Bonna Esperanto' has come through," her justly proud owner adds, "but the bad one we had when my house was nearly destroyed, almost wrecked her, but she happened to be with her bows towards the blast and this, I think, is the reason why she came through the storm safely. Also, from a therapeutic point of view, a lot of the delicate work was done with only one hand, and I found after a little while that I did better work than I did with two, as I had to take more care."

As a background for this unusual model, Mr. Sankey has used a model he made some time back of Old London Bridge. With the representation of a quayside the ship appears as if she is in still water. He has arranged it almost as a little stage of its own, where by turning a switch the vessel will come out slowly and, with only one light on her, will swivel round. The only lights

A view of the background with the model ship removed, giving an idea of the excellent detail obtained with Pyruma and Tiluma cement and other improvised materials.

showing are those in the cabins, and so the effect is that of her making her way out to sea.

Lady of the Lake

Turning to model railway models, I have just heard from Mr. Victor B. Harrison that his old "Lady of the Lake" is still doing well. He has made a new fixing for the lamp, and has added a displacement lubricator, and has also put in two new pistons of white metal in place of the brass ones, which, probably due to the higher steam pressure generated, threatened to seize up. The "Lady of the Lake" is one of the famous "old timers," introduced by Messrs. Bassett-Lowke in the year 1905. The price in those days was thirty-four shillings, and the model was fitted with an ordinary pot boiler and oscillating cylinders. Victor Harrison says she has now more than doubled her efficiency, hauling three wooden coaches for many laps in frequent non-stop runs of twenty minutes.

Mr. Victor B. Harrison's famous "old timer," "Lady of the Lake."

Bow and stern views of "La Bonna Esperanto," which is approximately 24 ins. overall and 40 ins. high. The embodiment of features of many vessels of the period welded into a most harmonious whole.

Model News from the Continent

One of the most enthusiastic model-makers in France in pre-war days was Monsieur J. Fournereau, who lived at Montchauvet (S-et-O), near Paris. I am pleased to say I have just had word from him that he is quite well, that his village did not suffer during the German occupation, and he was able to keep on with his modelling. He says that French enthusiasts in railway modelling is growing fast, and they can now be counted in thousands instead of by hundreds before the war. This he suggests has been due partly to the black-out evenings, and the lack of organised sport and travel. He is starting up again this year with his monthly magazine, "Loco-Revue," and is most anxious to contact model makers and enthusiasts in this country again. The editor will be pleased to furnish Monsr. Fournereau's address to any reader.

School for Master Bombers

SOMEWHERE in England the Pathfinders Force of R.A.F. Bomber Command has a school for master bombers. Each candidate undergoes a severe test before he is allowed to control an attack over an enemy target.

Like actors, the R.A.F.'s master bombers must learn their technique and carry out many rehearsals before the opening night. In their Lancasters and Halifaxes, they fly up and down over a range by day and night, making dummy runs and repeatedly giving their instructions over the radio telephone.

A whole attack is staged for their instructions. Target indicators are dropped; the master bomber flies over to see whether they fall on the bullseye, and then he tells an imaginary main force how they are to attack.

At this school, the men who are learning to become master bombers are drawn from the most experienced pilots in the Pathfinder Force—men who have already proved themselves masters of bombing by bringing back photograph after photograph of the aiming point in many German cities.

The present method of teaching has been worked out after more than a year's experience, ever since the plan was devised for the attack on the German V weapon experimental station at Peenemude, when the main force was put under the direction of a Pathfinder pilot who was then known as the master of ceremonies.

More About the V-2

Further Notes on its Scientific Possibilities

JUDGING from recent correspondence it would seem that quite an amount of interest has been aroused by the statement made in the article, "All About the V-2" (PRACTICAL MECHANICS, January, 1945, p. 114) to the effect that a "step" development of the V-2 could be projected beyond the earth's gravitational influence.

In order to make the matter quite clear, the following summary of the original calculations may be of interest; but first, for the benefit of any who missed the article, let us reiterate briefly the basis of the statement.

Performance Calculations

For the purposes of calculation, the initial mass of the projectile was taken to be 15 tons, and the propellent, liquid oxygen with ethyl alcohol. In place of the 1 ton explosive head, (actual 1,900 lbs.) a rocket of similar fuel/mass ratio was assumed to be fitted. This would be so designed as to discharge from the carrier projectile at the latter's greatest acceleration. The large carrier rocket, having served its purpose, would then drop back to earth under gravity, and in order to minimise risk to life and property—and indeed, to make the project an economic proposition—it would be necessary to employ a parachute, or similar alighting gear.

The final velocity V of a rocket is given by the relation:

$$V = v \log_e R$$

where v is the exhaust velocity and R is the ratio of original mass to final mass. v is of the order of 3 km./sec. for liquid propellent, and an R of 7 was assumed (14 tons at take-off; dead mass, plus load 2 tons). We thus derive a final velocity of 3 log 7, or 6 km./sec. Air resistance and the gravitational loss due to finite acceleration might reduce this to 5 km./sec. (3 m.p.s.), but the former force would only be operative for a short time.

Payload

We now have our payload—a 1 ton rocket; prior to its release from the carrier projectile —travelling with a velocity of 5 km./sec. For it to escape from the earth it must reach the parabolic velocity which is 11.2 km./sec. (7 m.p.s.). It must therefore be capable of increasing its speed by 6.2 km./sec.; and this implies an R of 8. In practice, this figure might have to be increased to 10 in order to overcome gravitational losses. These, however, could be quite small as the small carrier-borne rocket could use a much higher acceleration than the earlier component. There would, of course, be no air resistance.

Assuming, therefore, that it is possible to construct a smaller component of mass 2,000 lb., and R of 10 (i.e., final mass of 200 lb.), it would be possible to project a payload of something a little less than 100 lb., beyond the gravitational influence of the earth. Projected thus far, the 1 ton rocket could be so directed as to crash on the moon.

These figures are, of course, approximate and it might be necessary to increase the overall mass to 20-30 tons; but the order of magnitude is correct.

It is of interest to point out that if the 1 ton rocket were designed to reach the orbital velocity of 5 m.p.s. in horizontal flight outside the atmosphere, it would circle the earth for all time. Indeed, this is a far simpler proposition than the actual escape from the earth, and for many scientific purposes it would be a good deal more beneficial.

Acceleration

Finally, there is the question of acceleration. This is a point which has resulted in more controversy than any other; chiefly through the belief that a rocket must necessarily travel at accelerations prohibitive to the carriage of living beings.

A rocket would not exceed 3 g in the atmosphere, and V-2 does only 1 g. Unfortunately, this rather important point was not brought out in my previous article because of the omission of about five lines, due to an error in re-typing from the original manuscript. As this may have caused confusion, let it be stated that the thrust reaction of the V-2 in practice is 26 tons. Its acceleration is therefore 1 g, but this factor would be almost doubled toward the end of the powered flight because of the progressively improved fuel/mass ratio, due primarily to the consumption of propellent, and the lessening atmospheric resistance with altitude.

A well-protected man in good physical condition can withstand an acceleration of 6 g for prolonged periods, as centrifuge tests have shown. With special suits and drugs it should be possible to better even this figure, but it is unlikely that rockets would ever be operated at more than about 5 g.

Modelling in Pyruma

A New Medium for the Home Craftsman

THERE is a peculiar fascination in making models of various kinds with Pyruma Plastic Cement. The material is ready for use straight from the tin, and it is easily moulded into any shape, producing solid, sectional, or hollow models.

When moulded the plastic cement sets stone-hard on exposure to the air: in an ordinary room interior atmosphere this takes from 24 to 48 hours. Thorough drying is completed by the application of slow heat by baking the model in an oven or placing it in front of a fire, or over a radiator or domestic boiler. Afterwards the model is given a coating of size, and then painted with poster colours, oil-paints, lacquers, etc.

Example of a building modelled by the "hollow" method in Pyruma and Tiluma—"The Bell Inn," Molesey, famed for its crazy windows and centuries-old oddities in architecture. This picture gives a good idea of the modeller's skill.

Only a few simple home-made tools are needed to work Pyruma, and these tools are easily shaped from odd pieces of wood, wire, and strips of tin.

Easily Moulded

As sold, Pyruma can be readily moulded with the fingers to any shape. It can be cut with a penknife or modelling tool; rolled into sheets and then scored to represent brick-work, tiles, slates, weatherboarding or thatch. When dry and stone hard, Pyruma can still be worked upon with a polishing tool, drill, file, or hacksaw.

Hardened sections of Pyruma can be efficiently jointed with Sankey's Tiluma, a semi-liquid, non-inflammable jointing cement.

As examples of the wide scope of Pyruma for modelling purposes it is interesting to note that such widely differing subjects as battle areas, cottages and bungalows, ships, railway accessories, towns, and animals, etc., have been successfully reproduced in miniature in this handy material.

Instructions Leaflet

A new leaflet "Instructions for Modelling in Pyruma Plastic Cement," containing useful hints and many examples of Pyruma modelling, will be forwarded to any reader enclosing a penny stamp to J. H. Sankey and Son, Ltd., Refractories Dept., Ilford, Essex.

Seeing Blast: A Correction

IN the article on Seeing "Blast," by Professor A. M. Low, which appeared in our January issue, it is stated on page 123, that the speed of light is "186,000ft. per second." This, of course, should read "186,000 miles per second.

Masters of Mechanics—100

William Chapman

A Glimpse at a Little-known Engineering Personality

THERE were two Chapmans, engineers, of the early nineteenth century. They were brothers, William and Edward, and they were the sons of another William Chapman, a resident of Whitby, Yorks, who also styled himself an engineer. But since William Chapman (junior) was the inventive brother as distinct from Edward, who was more of a worker-out of William's ideas rather than an engineering inventor himself, it is to this William Chapman that some merit of fame must be given as one of the first pioneers of the railroad, and the locomotive.

Some half-dozen inventors, all contemporaries, were responsible for the early beginnings of the locomotive and the railway. Richard Trevithick, the Cornishman, originally pioneered the locomotive, for it was he who conclusively proved its possibility. George Stephenson, as is well known, attained the greatest degree of railway fame, to say nothing of commercial success, although, of course, his work was fundamentally based upon the previous trials and experiments of others.

It is, however, between Trevithick and Stephenson that there enters into the historical picture of locomotive design and invention a handful of other creative engineering minds and personalities who might, in some respects, be termed "lesser characters" in the sequence of locomotive invention, but who, nevertheless, played a vital and indispensable part in the evolution of the railway engine.

Of these, William Chapman was one of the first of that little band of inventive pioneers whose names, apart from the technical story of mechanical invention, have been allowed to grow so very dim in these modern times of ours.

The Rope Locomotive

Chapman's locomotive invention can only be considered to have been a freak, despite the fact that it actually worked for a short period. Briefly, it was this: a low-built wooden undercarriage was constructed for the purpose of carrying a steam engine of the early oscillating-beam type. The carriage also bore a large horizontally-placed grooved drum around which was wound a length of rope, the free end of the rope being fixed securely at the distant end of the iron rail track on which the carriage ran.

The steam engine mounted on the truck revolved the rope drum, and thus, by winding in the rope, caused the machine to be dragged along the rail track towards the distant end of the rope.

A more extraordinary and remarkable mode of mechanical progress might be difficult to imagine in actual practice, and it is no wonder that contemporary reports dubbed Chapman's contrivance "clumsy" and inefficient in operation. Yet the fact remains that it did actually work, and that it constituted one of the first practical attempts (after Trevithick's historic locomotive which he exhibited as a side-show in London in 1808) at the development of a serviceable railroad for the transport of goods and commodities.

Not much is known about the early history of William Chapman. He was born in Whitby in 1749, the son of an engineer and mechanic of the same name. The elder William Chapman must have been an individual of some substance and commercial success, for he was able to give his sons a good education and a training in mechanics and engineering.

Birmingham Monopolists

The younger William Chapman seems to have created for himself a successful practice as a consulting structural and mechanical engineer. To this end, he was careful to get into the "right set" in the engineering circles of his day; and the "right set" at that time was, of course, presided over by Messrs. Boulton and Watt, the Birmingham monopolists and monarchs of the steam-engine world. If, in those days, you were friendly and paid tribute to this powerful partnership, you had a reasonable chance of success in life as an engineer, but if you once got at loggerheads with either Boulton or Watt, then Heaven defend you, for either of these scoundrels was capable of devoting his energies, his influence and his "graft" to attain your own commercial dissolution.

So that William Chapman, wise man, perhaps, as he was, satisfactorily worked his way into the aforesaid circle and became a "friend" of the Watt-Boulton concern. According to published accounts of his life, he became an eminent structural engineer, a harbour constructor, and an active designer of canals. He engineered the South Dock and Basin at Hull, and his name was associated in a similar capacity in connection with the harbour works at Scarborough, Leith, and Seaham. As an associate of John Rennie, the famous Scottish constructional engineer, he worked for a time on the design and construction of the London Docks towards the East End of the city.

In the realm of canal design and construction, Chapman made a reputation for himself as the engineer of the Kildare canal in Ireland. He was engaged, too, as consulting engineer for the building of the Grand Canal of Ireland.

"Aeriel's Girdle"—an early locomotive with carriage attached.

Had William Chapman confined himself strictly to his harbour construction and to his canal cutting, the present-day world would never have heard of him. But Chapman had a spark of constructive originality in him, which inborn trait at once lifted him somewhat above the level of many of his contemporary engineers and designers.

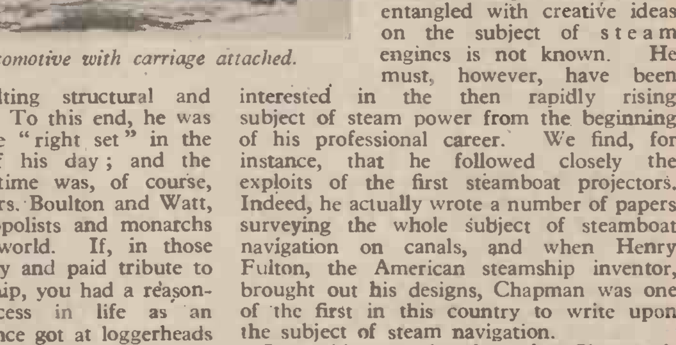
Steamboat Interests

How Chapman first got entangled with creative ideas on the subject of steam engines is not known. He must, however, have been interested in the then rapidly rising subject of steam power from the beginning of his professional career. We find, for instance, that he followed closely the exploits of the first steamboat projectors. Indeed, he actually wrote a number of papers surveying the whole subject of steamboat navigation on canals, and when Henry Fulton, the American steamship inventor, brought out his designs, Chapman was one of the first in this country to write upon the subject of steam navigation.

It would seem, therefore, that Chapman's first steam interests (from a practical standpoint) turned in the direction of steam-power navigation. Nevertheless, the necessary facilities for practical experiment in this direction were not within his reach. Steam-power traction on a railroad was, however, within the bounds of practical possibility for him, and to this then entirely novel subject he turned his attentions with much enthusiasm.

Early Railroads

The principle of the railroad had been



A "horse locomotive." One of the most curious contraptions of early railway carriage inventors. It comprised an endless platform operated by a horse. The walking movement of the horse communicated motion to the track wheels and propelled the machine at about 6 m.p.h.

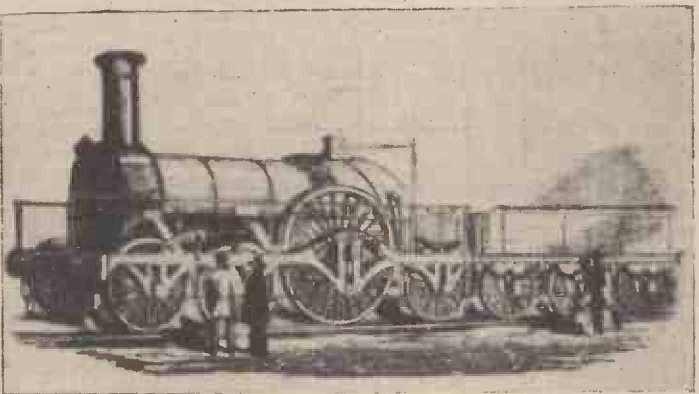
known and made use of since the beginning of the 17th century. Through the ensuing two centuries, wooden rails had been laid down in certain mining districts for the purpose of facilitating the passage of wooden trucks over them. The Coalbrookdale Iron Works, in Shropshire, was the first to employ iron rails for this purpose about the year 1767, thick lacing-plates being laid on existing wooden rails in order to minimise wear and tear on the latter.

Gradually, the use of the iron railroad for the transport of horse-drawn or gravity-operated trucks spread throughout the mining districts of Britain until, at last, at the beginning of the 19th century the employment of wooden rails had been almost entirely superseded everywhere.

The reader who has followed this series of articles will be aware of the fact that when inventors began to plan-out the running of steam locomotives over iron rails, they all seem to have been curiously smitten with the ineradicable notion that a steam locomotive having "plain" wheels and running over a smooth-rail track would not progress satisfactorily in consequence of its supposed inability to hold itself on the smooth-faced rails.

This is the idea which so enormously held up the development of steam locomotives and which, indeed, constituted the basic idea underlying William Chapman's strange and remarkable "rope railway."

John Blenkinsop, the Leeds engineer, constructed, in 1811, a "rack-rail," or a "cog-wheel road," as it has been termed. His loco had a toothed driving wheel which engaged with a rackwork rail laid within the smooth-rail track, this latter being provided for the smooth running-wheels of the loco undercarriage.



"Lord of the Isles"—an early Victorian locomotive.

The Chapman Patent

It was in an endeavour to go one better than Blenkinsop that Chapman in the following year (1812) patented what may now be termed his "rope engine."

The patent was taken out in the joint names of William and Edward Chapman, but there is little doubt that the notion was William's in every respect.

The undercarriage of the Chapman "locomotive" had eight wheels, instead of the usual four. This was a distinct advantage inasmuch as it allowed the loco's weight to be borne on eight points, thus affording a better distribution.

As we have before explained, the Chapman locomotive embodied a beam engine, in which two vibrating or oscillating beams were worked by a couple of piston rods. It was in all respects a stationary engine which, so to speak, had walked out of its engine house.

The rope (in practice, it became a light chain) of the engine was wound round a grooved barrel or drum, and, since the rope or chain was attached firmly at its distant end and ran along the centre of the track thereto, the engine laboriously dragged its way along the track under the chain-winding activity of the engine.

The Chapman loco was tried out on a straight length of track at Heaton, near Newcastle-upon-Tyne.

Samuel Smiles, in his well-known "Lives of George and Robert Stephenson," gives a brief account of it, from which one concludes that the rope or chain loco must have been a rather gloriously unsuccessful affair. As Smiles says, "it was so clumsy in its action, there was so great a loss of power by friction, and it was found to be so expensive and difficult to keep in repair, that it was very soon abandoned."

The Chapman chain locomotive had a few months of uncertain and precarious existence, and that was the last the world saw of it.

At our distance in history from this famous and pioneer locomotive contraption, we find it somewhat difficult to comprehend why its inherent and fundamental impracticability did not at once strike the enterprising Chapman brothers even before they had entered on to the constructional part of their venture. If only the Chapmans had realised it, they had in their loco the fundamentals of a perfectly satisfactory self-propelling engine, provided that they had eliminated from their design the central drum and rope or chain business, and had provided the engine with a direct wheel drive.

A Gigantic Delusion

Had they done that, they might have evolved a serviceable locomotive ten or a dozen years before such a self-propelling engine actually materialised at the hands of others. As it was, however, so firmly had the Chapman brothers got it into their heads that an ordinary "plain wheel" locomotive would never hold itself on to smooth rails that, like others of their day, they expended (and wasted) much of their ingenuity in devising an impracticable means of overcoming a difficulty which did not exist!

Disappointment with the revealed impracticability of their engine seems to have resulted in the Chapmans giving up all further inventive attempts at locomotive construction. After all, engine construction was then (as it is now), not exactly an inexpensive procedure. Added to which, a patent in their days cost about £140 to take out. So that a steam engine inventor had to be well financed in order to make a success of his would-be inventions.

Treatise on Timber Preservation

The rope or chain engine is the last we hear of William Chapman and his brother in the realm of engineering invention. The brother Edward appears to have relapsed into complete obscurity. Not so William, however. He still continued to function as an engineering consultant. A goodly amount of his time, too, seems to have been occupied in literary work. He compiled many technical reports for various bodies. He was a notable contributor to Thomson's "Annals of Philosophy," a scientific publication which had much success in the early years of the last century, and he wrote a "Treatise on the Preservation of Timber from Premature Decay." Creosote and similar materials were unknown then. Coal tar had not yet been utilised. Consequently, the timber preservation problem was even more acute than it is at the present day. Whether, however, William Chapman's "Treatise" on the subject led the way to better preservation methods is a question which must remain unanswered.

William Chapman lived sufficiently long enough to witness the growing numbers of pioneering locomotives which were constructed as the 19th century wore on. It was his lot to witness the increasing success of George Stephenson and his locomotives, and to live to the day when locomotive construction was becoming an everyday industry of Britain, for he died, after a short retirement, on May 19th, 1832.

William Chapman, of course, contributed little of importance to locomotive development. Yet his was an early, albeit a somewhat misguided attempt to solve the then pressing problem of steam-power locomotion. That his name as an early inventor should be forgotten is unthinkable. It is, indeed, the minor lights in the world of invention which contribute to the glory of the first-class luminaries therein.

Books Received

Aircraft of the Fighting Powers. Compiled by H. J. Cooper and O. G. Thetford. Edited by D. A. Russell, M.I.Mech.E. Published by The Harborough Publishing Co., Ltd.

THIS book, which is Volume 5 of the series, includes every type of aeroplane engaged in the Second Front operations in 1944. Each volume of this work includes drawings, photographs and particulars of all the new types introduced in the year under review, and all the modified versions of the older types. Many new British types have been released in 1944, and among those described in this volume are four new Spitfires, the Barracuda, the Albemarle, the Warwick, the York and the Hamilcar. The Hawker Tornado, Miles M-20 and Gloster F9/37 fighters are also included.

The British Dominions are represented by the Commonwealth Boomerang fighter, designed and built entirely in Australia. Amongst the German aircraft included are F.W. 190, the Me. 410 (which is the latest version of the Me. 210), the Me. 323 and the Bv. 222. Several types of Japanese aircraft are also covered in the book, which should prove an invaluable work of reference to anyone interested in the subject.

Twist Drills. By B. H. Chambers Published by George Newnes, Ltd. 112 pages. Price 12s. 6d. net.

THIS book, which is a fourth edition, deals with the manufacture and uses of modern twist drills and the problems which arise in drilling practice. Besides dealing with the diversity of materials which are met with in the workshop, the author discusses in a practical way such important points as drilling with perfect alignment, the grinding of twist drills, etc. The book also contains an excellent series of graphs which give a valuable guide to drill performance and indicate the probable effects of change of design. A large number of illustrations and tables of sizes of standard twist drills completes what is a useful handbook for the engineering workshop.

Modifying Car Dynamos and Starters—4

Modification for Use on A.C. Supplies

By D. E. BARBER

(*Continued from page 98, December issue*)

ALTERNATING current mains supply being so universal these days, it is quite natural that one of the most common of all queries relating to automobile machine conversions is "How can I make it run as an A.C. motor?" Many suggestions have been put forward by experimenters from time to time, some being well thought out, whilst others were quite impractical and many keen amateurs must have been both bewildered and disappointed at the results obtained.

The subject is an interesting one and the writer has carried out a good deal of experimental work with a view to the compilation of data, and whilst it is not claimed that all the suggestions are original, it is hoped that the discussion and comments may prove helpful to those about to undertake this type of modification. It should be made clear from the outset that, with the exception of the synchronous motor (to be described in the next article of this series), the resulting machine is unlikely to be entirely satisfactory, being extremely wasteful and suitable only for driving low power apparatus such as small tool grinders and the like.

The Influence of the Solid Yoke

Reference to Fig. 2 in part 1 of this series shows that under operating conditions, the magnetic lines of force or flux pass through a magnetic circuit consisting of the armature, the poles and the yoke. As long as this flux is constant in magnitude and direction, as in the case of D.C. excitation, all will be well, but immediately the iron circuit is subjected to rapidly changing values of flux, as with A.C. excitation, heating commences and the solid iron becomes the nucleus of a large waste of power. The cause of this phenomena will be apparent if it is remembered that any conductor, if placed under the influence of a changing magnetic field, will have an e.m.f. induced in it, and that furthermore, if the electric circuit round the conductor is complete, a current will flow. In the case of the solid yoke carrying an alternating flux, it follows that the flux will induce circulating currents in the iron path which is of low resistance. Because of this low resistance, these "eddy currents," as they are called, reach very high values, so that in a very short time the yoke will become extremely hot.

The only cure lies in completely laminating the magnetic circuit of the machine, that is, by building up the yoke and poles with thin sheet iron with each lamination effectively insulated from its immediate neighbours. This has the effect of reducing the iron section in the direction of the eddy current path so that, although no *magnetic* difference will be noticed, the resistance to *electric* currents will be increased with a consequent big reduction in the eddy currents. Eddy currents are partly responsible for the iron losses occurring in armatures and it is because of this fact that armature cores are constructed of sheet iron punchings.

As in the case of armature iron losses, the iron losses set up in a solid yoke by an alternating field are enormously increased by higher values of flux density or by an increased frequency of flux alternations. Fig. 13 illustrates this point in a very marked manner; it gives in graphical form the results of tests taken on the four-pole car dynamo already mentioned in an earlier article. This machine had a solid yoke and also solid poles so that, as would be expected, the iron losses are very high. Fig. 13a shows how the total iron losses vary with frequency for different values of flux density, whilst Fig. 13b gives their

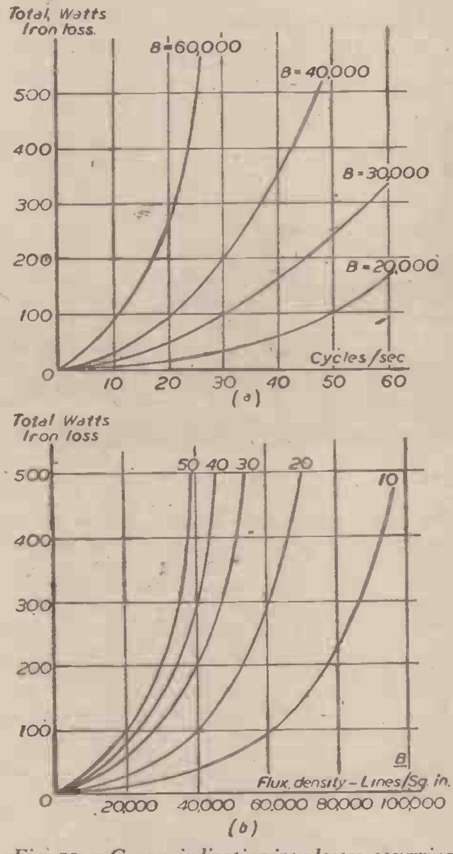


Fig. 13.—Curves indicating iron losses occurring in a 4-pole car dynamo with A.C. excitation and solid yoke.

variation with flux density for different frequencies. In both cases the steeply rising nature of the curves is very apparent.

From the foregoing remarks it will be appreciated that to operate a solid yoke machine on an A.C. supply, it is essential that low values of flux density and frequency be used. In the usual case, the frequency being fixed, a further reduction in flux density is necessary to keep the losses within reasonable limits and as the h.p. output of a machine is proportional to the flux, this means that only a very small amount of power is finally available at the shaft. To aggravate matters still further, the yoke iron losses, although reduced, are still high and must be supplied from the mains, so that the final outcome is a machine giving only a low power output for a very large power input. In other words, the efficiency is very low and, in fact, will seldom exceed 20 per cent. If this inefficiency is permissible, the flux density may be limited only by the resultant heating of the field system so that the problem then becomes one of providing adequate cooling. As even an approximate calculation of the probable loss is very difficult, due to many diverse influences, each case is best taken on its own merits and, with a little experimenting, a fairly satisfactory compromise can usually be made.

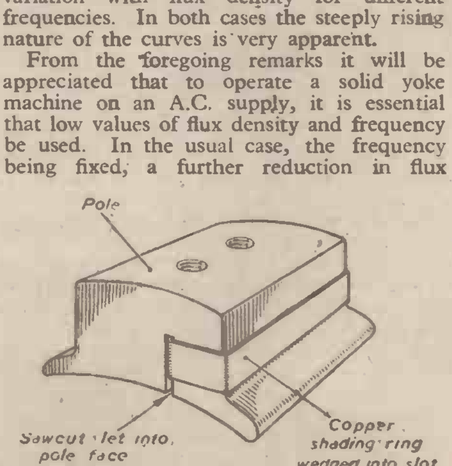


Fig. 14.—Method of fitting shading rings.

Operation as Induction Motors

The main essentials of an induction motor are the field system, or stator, and the armature, or rotor which carries heavy copper bars shorted together by means of end rings. The field system is energised with A.C. so as to induce currents in the rotor winding and it is the interaction between the stator and rotor currents which produces the rotation. Since the rotor windings are normally of heavy gauge, it follows that the starter motor is the best automobile machine to modify as the armature winding can then be used without alteration.

It is required that this winding be short-circuited at either end of the core, and this is accomplished fairly easily; all the commutator bars should be tinned for about half of their length and tinned copper wire should then be bound tightly round the commutator and sweated up so as to connect all the bars together. At the opposite end, the wire end connections should be scraped to remove the insulation and these conductors can then be joined using the same method; no brushes are required for induction motor operation.

No mechanical alteration to the field is necessary except that the air gap should be made as short as possible by the fitting of liners. The field windings cannot readily be calculated and the best plan is to wind on as many turns as can be accommodated in the space available. The gauge of wire to use will depend on the size of the machine, the following sizes being suggested (for the usual 50 cycle, 200/250 volt supply): Small machines, No. 26 s.w.g.; medium machines, No. 22 s.w.g.; large machines, No. 19 or 20 s.w.g. The coils should be connected in series to produce alternate north and south polarities of the poles, and these can be checked by passing a small D.C. current through the coils and testing for polarity with a compass needle. The induction motor as described above is not self-starting, so that some means must be devised to bring it up to speed. One way is to wind some string round the shaft and give it a smart pull, at the same time switching on the supply to the stator windings. This is undoubtedly the surest way, as the second method is much reduced in efficiency by the presence of the solid poles and yoke so that very uncertain results will be obtained. Method 2 is known as "pole shading," and consists of embracing about a third of the pole area with a heavy copper band as shown in Fig. 14. The purpose of this "shading ring" is to cause the flux in the enclosed area of the pole to lag behind the rest of the pole flux; this causes in effect a continuous "sweeping round" flux movement which can be said to draw the rotor and thus bring it up to speed. Fig. 14 illustrates the method of fitting the ring by means of a sawcut in the pole face, but it should be pointed out that much of the effectiveness of this method depends on how good an electrical conductor the shading ring is, so that any joint in the band must be exceptionally sound.

The speed at which an induction motor will operate depends on the supply frequency and on the number of poles on the machine. It varies directly with frequency and inversely with the number of poles. For the usual case—that is, a four-pole machine running from a 50 cycle supply—the speed will be a little under 1,500 r.p.m.

Operation as Repulsion Motor

Repulsion motor operation will probably be found to give slightly better results than the induction motor, and although the field windings can be made identical with those described under the previous sub-heading, the rotor windings are not short-circuited and it will be found that the original starter motor armature can be used without modification. This class of machine requires a set of brushes which are all solidly connected together and are thus not included in the input circuit. This is because here again the rotor currents are *induced* from the stator currents as in the case of the induction motor.

Thus the procedure to be followed when modifying should be to first re-wind the field coils as outlined previously and then short-circuit all the brush arms with a heavy copper conductor. As the brush gear of a repulsion motor should be set a little off neutral, a slight rocking from the original position will probably be necessary, and it should be noted that the direction in which the machine will ultimately run will be governed by the direction in which the brushes are moved off neutral. As in the case of the induction motor, the air gap should be made as small as possible by inserting suitable liners.

The best way to try out the modified machine is to set up the circuit as shown in Fig. 15a, that is with the mains supply connected across the stator winding and to rock the brushes until the best running condition is located.

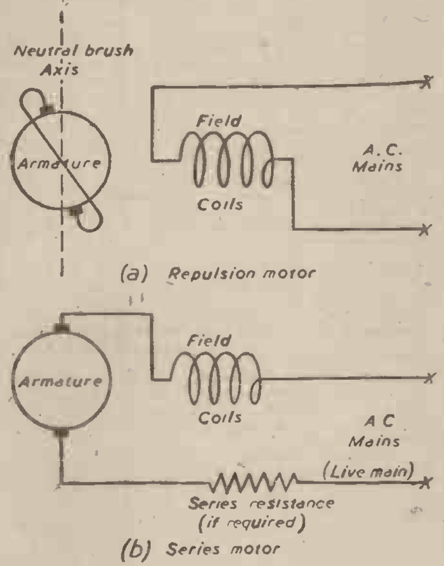


Fig. 15.—Diagrams of connections.

Operation as Series Motor

Unless a heavy current low voltage A.C. supply is available the starter motor is excluded for modification as a series motor on account of its very low number of armature turns; therefore, since starter armatures are not suitable for re-winding, dynamos will be found to be most adaptable for this type of operation. A machine with as many commutator bars as possible should be used for the job, otherwise sparking will be very bad since poor commutation is stimulated by the high speeds at which series motors run when on no load.

The armature will not normally require any change, but the dynamo field coils will be unsuitable in their original connection. Experiments with combinations of series and parallel connection of these coils may, however, produce an arrangement which will give fairly good results. As a general rule, unless the experimenter is prepared to re-wind completely both armature and field, the final modified machine will be unsuitable for mains voltages higher than, say, 110. For the usual 200/250 volt supply a series resistance such as an electric fire should be connected in the motor line. Fig. 15b shows the circuit arrangement of a series motor, and it will be seen that the series resistance, if used, is inserted in the live line of the supply; this is so as not to overstress the insulation of the dynamo windings which is not really adequate for mains voltages.

Discussion on the Three Methods

Having briefly covered the necessary changes to the original machines to get them to function as A.C. motors, it is as well to sum up their various operating characteristics before closing. Taking the induction motor first, providing the load is light, this machine will run at a fairly constant speed, but if overloaded it will pull "out of step" and will have to be restarted again. For this reason it will be found most useful for driving small fans where the load is constant.

The repulsion motor has a very different speed characteristic, and it will be found that as the load is increased the speed will drop appreciably, until finally, if very heavily loaded, the rotor will stall altogether. Due to its self-starting capacity, however, this is not serious, and if the offending load is removed the machine will once more run up to speed.

(*To be concluded.*)

Letters from Readers

Engineer-built Houses

SIR,—Your correspondent, Mr. A. H. Bentley, asks some very pertinent questions in the December issue, and I take this opportunity to answer them very briefly.

First—the size of bricks. To unload a lorry takes only a short time, and the labourers can work at high pressure, but when it comes to laying the bricks, this is an all-day job, and a man, not being a machine, can only efficiently dispose of a given weight of material over such a period, and it is fallacious to suppose that approximately the same number of big bricks can be laid in a given time as small bricks. There are two standard sizes of bricks in use in Britain, the "London" brick being rather smaller than the "Midlands," and it is my experience that a given area of walling is slightly more expensive in the larger Midlands brick. From an engineering viewpoint also, there are reasons why the brick cannot be varied greatly in size.

Second—plaster. The interior finish of a room is required to do more than look pretty, one of its chief requirements is the ability to absorb moisture, and, so far as I am aware, there is no other material which will absorb condensation and, at the same time, lend itself to decoration.

Third—painting doors. There is no objection to painting doors in the factory so long as the manufacturer knows—(a) The precise size to make the door, (b) the hinges on which it is to be hung, (c) the lock and furniture, (d) the colour scheme of the room. This explanation speaks for itself.

By the way—may I point out that that much maligned man, the "speculative builder," has usually been in the forefront in the use of new methods and materials? He has to be to keep his costs down.

DERBIAN (Mansfield Woodhouse).

SIR,—Having worked in the building trade I have read with interest your correspondent's letter on "Engineer-built Houses." I would like to point out, however, that an average brick weighs 7lb., and to expect bricklayers to use bricks five times as large is, I think, asking too much. Also in using bricks of this size you would surely lose the bonding you get with normal size bricks. Further, to paint-spray doors at the factory would mean, in order to get perfect matching of the paint, that other woodwork would have to be sprayed at the factory. This would then undoubtedly be spoilt in cutting to the various sizes at the job.

However, I agree with your correspondent that a substitute should be used for plaster ceilings. It would also be an improvement to run hot-water pipes near enough to the cold ones, where possible, to prevent freezing in winter.

S. PEARSON (Dartford).

Ladder Problem

SIR,—There is a solution to your ladder problem which avoids the nasty quartic—the method of two quadratics, viz.:

$(x+a)^2+(y+a)^2=e^2$

$\therefore x^2+y^2+2a(x+y)+2a^2-e^2=0$

but $xy=a^3$

$\therefore$ substitute

$x^2+2xy+y^2+2a(x+y)-c^2=0$

$\therefore (x+y)^2+2a(x+y)-e^2=0$

$\therefore x+y=\left.-2a\pm\frac{\sqrt{4a^2+4e^2}}{2}\right\}$

$xy=a^2$

The answer given on page 127, January issue, is also a little incorrect. We have:

$x+y=-6\pm\frac{\sqrt{36+1600}}{2}=17.22$

$xy=9$

$\therefore x^2-17.22x+9=0$

$x=+17.22\pm\frac{\sqrt{296.5-36}}{2}=16.68$

(not 16.14)

or .54

S. H. JOHNSON (London, W.).

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back of cover, 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.

Silver Plating : Rhodium Plating

IN attempting to renew the silver plating on some electric switches, the only result I obtained was the blackening of the metal, and if left in the solution for 10 minutes or so they would gradually be dissolved. I was using a silver nitrate solution, approximately 200 to 1, i.e., distilled water to silver nitrate. Voltage used was 3 volts and current 1 amp. Could you tell me where I have gone wrong ; also, is there a better alternative for silver plating ?—A. E. Cain (Bristol).

YOU cannot plate satisfactorily from a silver nitrate solution, since, with this solution, the metal deposits in a black, powdery form. Silver is commercially plated from cyanide solutions, of which there are very many different formulæ, each electro-plater having his own. The following is an average all-round formula for silver plating :—

Silver nitrate	4 ozs.
Sodium cyanide	4 ozs.
Potassium nitrate	16 ozs.
Distilled water	1 gallon.

Operate the above bath at a temperature of 75–80 deg. F. Use 2 to 4 volts E.M.F. and a current density of from 6 to 10 amperes per square foot of surface to be plated. It is always advisable to stir the bath continuously during the actual plating.

Owing to its excessively poisonous nature, you will probably be unable to purchase sodium cyanide. If this proves to be the case, we understand that you will find no difficulty in purchasing a small amount of a ready-made silver plating solution from Messrs. W. Canning and Co., Ltd., Great Hampton Street, Birmingham, 18. Messrs. Johnson, Matthay and Co., Ltd., Hatton Garden, London, E.C., also supply silver plating solutions.

Regarding your inquiry for an alternative to silver-plating, there is no doubt that for the finest and the most corrosion-resistant finish to small parts there is nothing to excel rhodium plating, particulars concerning which will be supplied by Messrs. Johnson, Matthay and Co., Ltd. This firm will also undertake actual plating jobs with this rare, uncorrodible, silver, white metal. Silver plating is always liable to blacken in impure atmospheres. In this respect it is excelled by chromium plating, which is considerably more resistant, although its bluish tint is objected to by many. For a first-class job, it might be advisable to have the parts rhodium-plated by the above-named firm, the cost of which would not be at all excessive.

Eradicating Wood Worms

I HAVE to renovate a piano which I find is worm-holed in places. I have taken out the worst of the wood from the back and should like to know the best way of killing any worms in the other parts, and what to use for filling the holes.—H. Simpkins (Worcester).

IT is a difficult matter to guarantee the complete eradication of living worms from a piece of furniture which they have attacked. The task of eradicating these pests is one which calls for persistence and patience.

In the first place, it is always advisable to remove as much of the worm-attacked wood as possible, but, in the instance of a piano, you cannot remove any of the soundboard or of its glued back-bracings, otherwise the tone of the instrument will deteriorate. Fortunately, however, the worms are not likely to have attacked the soundboard of the instrument, since this will be of spruce and (if the piano has been used) it will have been in frequent vibration. We presume, therefore, that it is merely the case of the instrument which has been attacked by the worms, in which instance, you are well advised to remove as much of the affected wood as possible.

As regards the remaining areas, these should be painted liberally with *hot* paraffin, white spirit or any other kind of light, non-staining oil, used HOT. A good substance for killing worms in woodwork is ortho-dichlorbenzene, which is normally obtainable from large paint stores, but this is, at present, in short supply, and you may probably find yourself unable to obtain it. If, however, you can procure this liquid (costing about 2s. 6d. per lb.), mix one part of it with two or three parts of paraffin, and either inject the liquid into the woodworm holes by means of a small syringe, or, alternatively, brush the liquid over the woodwork surface. Preferably use the liquid HOT, since it penetrates better when heated than it does when cold.

The whole success of your task of eradication will depend upon the degree to which the liquid penetrates the wood. When, in the wintertime, the worms are in the deeper layers of the woodwork, it is more difficult to get a liquid which will penetrate down to them. The whole question, therefore, is one of effectively penetrating the wood with the liquid which you apply. Provided that the liquid will effectively penetrate to the living worms, even ordinary paraffin is sufficient to kill them. It is always advisable to give several applications of the penetrating liquid at intervals of a day.

Regarding fillers for the remaining wormholes, plastic wood (plain or coloured) makes an excellent filler. So, also, does fine sawdust made into a paste with glue, and pressed into the holes. After setting in the holes, the filler should be smoothed off with very fine glasspaper, and the whole area repolished, with or without staining.

Do not put any oil or other liquid on the piano soundboard or upon its wooden bracings at the back. Also do not on any account allow oil or other liquid to make contact with the "plank" of the instrument, that is to say the wooden member in which the tuning pins are driven. If you do, the instrument will be ruined, since, with oil in the wood, the tuning pins will lose their grip, with the result that the instrument will refuse to stand in tune.

Staining Wooden Ashtrays

I AM making wooden ashtrays (with a fretsaw), and would be glad if you could tell me what I should use to colour them with, which would not show up burns too badly.—W. Williamson (Perranporth).

YOUR best plan will be to stain your wooden ashtrays with a spirit stain and afterwards to oil them up with a little raw linseed oil well rubbed into them. Finally, give them a very thin coat of a light-coloured bakelite varnish. This treatment will render them as "burn-proof" as can be obtained when given a polished surface.

Sodium silicate treatment is not likely to be satisfactory. If, however, you wish for a matt ebony surface, you can obtain this in the following way.

Make up two solutions, as below :—

Solution A.

Copper sulphate	12 parts.
Potassium chlorate	12 ,,
Water	100 ,,

Solution B.

Aniline	15 parts.
Hydrochloric acid	18 ,,
Water	100 ,,

Give the wood two coats of Solution A, used hot. After drying, do the same with Solution B. Finally, wash well with soap and water. Dry and wipe over with an oily rag. This treatment will give the wood a black appearance, which is burn-proof.

In place of aniline and hydrochloric acid in Solution B, you can use 12 parts of aniline hydrochloride dissolved in about 90 parts of hot water. Aniline and aniline hydrochloride can be obtained from any large wholesale chemical supply firm.

Jointing Compound

COULD you please inform me how liquid jointing is made ? The jointing is for use on gas, steam, and water joints.

I find I cannot buy it now, and when I last used it, it appeared to contain shellac, possibly dissolved in a drying oil.

I have a stock of orange shellac (flaked) on hand, gold size, linseed oil and boiled linseed oil, also methylated spirit, so I was wondering as to whether any of these could be used in the making of it.—H. H. Grey (Cheam).

AN excellent jointing compound of the type you mention can be made according to the following formula :—

Shellac	2 parts (by wt.).
Rosin	0.5 ,, ,,
Methylated spirit ..	1.5 ,, ,,
Castor oil	0.1 ,, ,,

This compound, when thoroughly set, is fairly heat-resisting. It is elastic and resilient, and is uninfluenced by water, gas or oil.

In view of the scarcity of the above materials at the present time, another type of jointing compound which has been recommended is the following :

Flour	66 parts (by wt.).
Portland cement ..	25 ,, ,,
Talc	3 ,, ,,
Dropblack or lamp-black	3 ,, ,,
Fine sand	3 ,, ,,

The above ingredients are intimately mixed together. In the dry state they will keep indefinitely. For use, moisten a quantity of the powder with water so as to form a paste and apply to the joint.

Rubber Solvents !

I HAVE read in many books of chemicals which will dissolve rubber. I have tried them all, but none of them worked satisfactorily. The chemicals I tried were carbon disulphide, petrol and mineral naphtha. My intentions were to dissolve old rubber tubing and make it into rubber corks, which are very hard to get and very expensive. So could you please tell me if there are any chemicals which will dissolve rubber into a liquid ?—J. Slome (Willesden).

THERE is no real solvent for rubber, and it will be absolutely impossible for you to take old scrap rubber and to dissolve it up into a clear solution on the lines which you indicate.

It is, indeed, a fact, as you point out, that many present-day chemical textbooks, each copying the other, still persist in referring to the solubility of rubber in carbon disulphide and other organic solvents as if rubber dissolved perfectly easily in such solutions. It is true that raw and untreated rubber dissolves partially in some of these solutions, but the usual run of hardened, semi-vulcanised waste and scrap rubber, which is filled with various inorganic materials, such as carbon and slate, will never dissolve in these solutions.

On the large scale, scrap rubber can be got into a condition of a paste by prolonged mechanical maceration with "solvents" such as petrol, naphtha, benzol, turpentine, carbon disulphide and carbon tetrachloride, but such solutions are never complete ones, and, moreover, the process of producing such "solutions" is definitely impossible to imitate on the small scale.

You can, therefore, take it from us that there are no chemicals which will dissolve scrap rubber "into a liquid" in the manner which you indicate.

Making Glazed Pottery

ASSUMING that I have a supply of clay and am able to make the necessary moulds, fit up an oven, and raise a temperature of, say, 3,000 deg. C., what should I require further for making some white glazed tea cups ? Also, if I succeed in making pottery from clay, how can I glaze it white ?—J. Wood (London, N.).

YOU will find it very difficult to make satisfactory glazed pottery unless you have had much experience in the art. However, assuming, as you say, that you are able to make the necessary unglazed material from china clay and that you are able to provide a high-temperature oven, you would then be able to glaze the material by means of a "slip" make up according to the following formula :—

Quartz	50 parts.
Borax	50 ,,
Feldspar	75 ,,
Cryolite	20 ,,
Soda ash	10 ,,
Saltpetre	6 ,,
Tin oxide	21 ,,
China clay	12 ,,

The above materials are very finely powdered to the fineness of flour. They are then intimately mixed together in the above proportions by weight, after which they are ground up with 40-45 per cent. of their weight of water. This makes a kind of cream or "slip," which is applied to the base pottery either by spraying or by actually dipping the pottery in the slip.

The pottery so treated is then fired in an oven for four or five hours at a temperature of between 1,250 and 1,300 deg. C., after which it is allowed to cool down slowly. A white enamel-like glaze will be produced on the pottery if the process has been carried out rightly. We again repeat, however, that it is a difficult matter to give good glazes to base pottery on a small scale and without adequate experience. Furthermore, many of the pottery-glazing details and the "slip" compositions which are used in the pottery trades are more or less technical secrets.

Before commencing your experiments, we would advise you to get a good practical textbook on the subject and to study it thoroughly. A suitable book is "The Potter's Craft : A Practical Guide for the Studio and the Workshop," by C. F. Binns (14s. 6d. net). This book might possibly be obtained through your local library.

Faulty Commutator

I AM constantly having trouble with a 10 h.p. electric fan. It is American pattern, 230 v. 38.4 amp. D.C. compound wound with interpoles.

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The brush holders, four in number, are solid with the brush gear and the brushes burn rapidly through sparking on one set, in spite of adjustments to the neutral axis. The commutator burns badly and deeply on one patch of about eight or nine segments, but when skimmed, under cut (not deeply) and with brushes bedded down it runs perfectly for a few days, and then starts burning again.

The fields all balance correctly with each other and are of the right polarity. The armature has been drop-tested and is correct.

When started the armature slides forward about ⅜in. into its magnetic centre and runs there fairly steady. As there are no thrust bearings, could this have any effect on the brushes ?—R. R. Greby (London, W.).

THE burning of eight or nine commutator segments appears to indicate an armature defect. Assuming that these segments are all together, it may be that there is a batch of soft copper segments there, that the segments are loose, intersegment micas carbonised, micas not recessed for their full thickness, or that there is a high resistance at some of the connections.

On the other hand, the reported sparking at one set of brushes only appears to indicate magnetic or electrical unbalance of the field system. Assuming the polarities of the shunt and series field coils and interpoles are correct, the trouble may be due to a short circuit on the shunt or series field coils, which may be detected by volt drop tests; short circuit between shunt and series field coils, which may be detected by insulation test set after disconnecting these coils; uneven air gap between field poles and armature, possibly due to wear of the bearings. We presume the insulation of the armature has been tested for earth fault.

Other possible causes of the trouble are brushes of wrong grade or of different grades; brush pressures unequal; brush position incorrect; interpoles too strong or too weak; faulty connections between brushes; spacing between sets of brushes or brush spindles being unequal. The axial movement of the armature should not cause the trouble referred to.

Vitreous Enamelling

I SHOULD be grateful if you would inform me as to the method of obtaining a vitreous enamel finish upon articles of mild steel, and of any publications dealing with that subject ?—R. M. Richards (Ryde).

IT is a very difficult task for any amateur to undertake vitreous enamelling. Essentially, the process consists in brushing or spraying the articles to be enamelled with a paint or "slip" of special composition. The articles are then heated for several hours at white heat in a muffle-furnace. During this period, the ingredients of the "slip" actually fuse together and form a glass-like covering, which is coloured by any special pigments which may be present in the "slip." The articles are then slowly cooled and finally withdrawn from the furnace.

There are literally hundreds of different formulæ for the preparation of enamel "slips." Many of them are maintained secret by the enamellers. Here are two such formulæ for producing a white enamel on iron or steel :—

Borax	240 parts (by weight).
Feldspar	410 „ „
Saltpetre	30 „ „
Sodium carbonate	120 „ „
Calcite	30 „ „
Quartz	170 „ „
Zirconium oxide	30 „ „
Sodium silicate	68 „ „

Aluminium oxide	5 parts (by weight).
Borax	13 „ „
Sodium antimonate	12 „ „
Cryolite	6 „ „
Barium oxide	8 „ „

In either of the above instances, the necessary ingredients are ground as finely as possible and then intimately mixed together. Sufficient water is added to get them into the state of a thin cream or "slip." This is then brushed or sprayed on to the perfectly clean iron or steel articles, which latter are fired at a temperature of about 1,200 deg. C. for six or seven hours. Two or three days are allowed for the furnace to cool before removing the articles from the latter, the cooling being made as slow as possible.

There are very few books dealing with the subject of vitreous enamelling. The following, however, might be suitable for your needs: "Manufacture of Enamelled Ware," by L. R. Mernagh (18s. net). A secondhand copy of this or some other similar book might be procurable from Messrs. W. and G. Foyle, Ltd., Charing Cross Road, London, W.C.2.

Moulding Compositions

I WISH to carry out some experiments on the moulding of dolls' heads and limbs, in a composition similar to that employed in the manufacture of certain foreign dolls using gelatine moulds. I have tried plaster of paris, but find that it expands in the moulds and does not come away easily.

I should be grateful for any information you could give me on this subject ?—H. Hill (Stoke-on-Trent).

ORDINARY plaster of paris is very frequently used for the moulding purposes which you describe. It is possible, therefore, that you may be using the wrong type of mould. Have you tried hardening the gelatine mould by immersing it in a very dilute solution (say ½ per cent.) of formalin before using it ?

Another good moulding composition formula is the following :

Glue	1 part.
Glycerine	1½ „
Water	1 „
Sugar	½ „
Fine silica	1 „

The above materials are, of course, difficult to obtain, but in very small amounts you might be able to obtain them for experimental purposes only.

Apart, however, from the possibility of improving your moulds, the following plaster composition might be of interest to you :

Plaster of paris	20-40 parts.
Fine silica	60-80 „

This is slaked with water containing in solution ½ part of gum arabic.

Another interesting plaster composition can be made by incorporating short cotton fibres into ordinary plaster of paris The resulting plaster has improved resistance against mechanical strain and shocks.

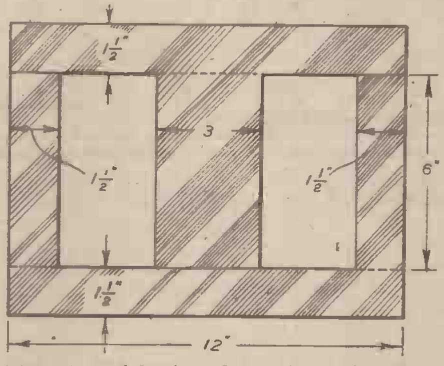
Still another plaster can be made from magnesite. Make up a 40 per cent. solution of magnesium chloride, i.e., by dissolving 40 parts of magnesium chloride in 60 parts of water, and slake powdered calcined magnesite with this solution. If necessary, the magnesite can carry up to 10 per cent. of a dry pigment, such as iron oxide, in order to colour it. This composition takes about two days to set and it expands very slightly on setting, thus giving sharp impressions. It is strong, but somewhat heavy. Its mechanical properties are improved by incorporating up to 15 per cent. of powdered asbestos with the magnesite before slaking.

Windings for Mains Choke

I WISH to make a variable choke for use with stage lighting, using the choke in series with the lights as a dimmer. I understand that by winding an A.C. coil round each of the outer limbs, and connecting them in series, and by exciting a coil wound round the centre limb with D.C. current, the desired effect can be obtained.

I believe that this principle is widely used in America. Could you tell me how to make a choke for, say, a 15 amp. lighting load, and also where I can obtain some literature on this type of dimmer for stage work ?—P. Seymour (Sheffield).

WE suggest you use two A.C. coils connected in series, one on each of the two outer limbs of a three-limb core, with a D.C. winding, controlled by



Dimensions of laminated core for mains choke. (See reply to querist P. Seymour.)

means of a variable resistance, on the centre limb. With no D.C. excitation each A.C. coil will create A.C. magnetism in the core, and the maximum choking effect will be obtained. We do not know of any literature which deals with this subject, and you will probably have to do a certain amount of experimenting in order to obtain best results.

As a basis for such experiments we suggest you build up a laminated core to the dimensions given in the accompanying diagram, using about 8,000 amp. turns for the D.C. coil and 80 turns of 11 s.w.g. on each of the two outer limbs. The core stampings should be built up to a thickness of 3in. The ampere turns on the D.C. winding can be worked out to suit the D.C. supply available, using a current density of about 1,500 amps. per square inch of conductor.

Fluorescent Dyes

CAN you tell me the name and address of any firm who can supply the special dyes or paints which fluoresce when exposed to ultra-violet rays ?

Failing that, can you give me the names of the chemicals which fluoresce, and where same can be obtained ?—J. Potter (Manchester).

DYESTUFFS whose solutions fluoresce under ultra-violet ray activation are: eosin, fluorescein, acridine yellow. These, in your instance, could be obtained in small amounts from Messrs. Towers and Co., Ltd. (late Frederick Jackson and Co.), Chapel Street, Salford (near to Victoria Bridge, Manchester).

However, you have no need to purchase dyes in order to demonstrate fluorescence. A solution of Vaseline in paraffin or petrol will fluoresce vividly when exposed to ultra-violet rays.

Uranium nitrate is a well-known chemical salt which fluoresces. So, also, is quinine sulphate, although this, of course, is nowadays unobtainable.

An excellent book on fluorescent materials is: "Fluorescent Chemicals and Their Application," by J. De Ment and H. C. Dake (Chemical Publishing Co., Inc., Brooklyn, New York, U.S.A.). This volume may possibly be in the Manchester Central Reference Library in St. Peter's Square, or, if not, the librarian there may be willing to obtain it for you.

Curing Skins

I SHALL be glad of any information you can supply in connection with the home curing of light furs, e.g., squirrel, rabbit, and fox, particularly with regard to any chemical methods of finally softening the skins.—H. W. G. Brien (Bath).

THE curing of skins is rather a skilled job, and it would not be wise for a beginner to start on a valuable skin before acquiring some skill on a cheaper skin. There are several methods of skin curing, but you will find the following method as good as any: First of all, remove all flesh and fat from the skin by scraping it with a blunt knife while the skin is stretched, fur inwards, on a rounded surface, such as a baluster rail. Then steep the skin in a solution made by dissolving four parts of alum and one part of common salt in four or five parts of water. The time of immersion is usually about 48 hours.

Next make a paste of flour and water, and, having rinsed the skin, dip it for a minute or two in the flour paste. Then wash the skin thoroughly and allow it to dry in a stretched condition. When the skin is dry stretch it on a board and rub it with pumice.

Finally, soak the skin for a few days in a tan solution. This solution can be made by dissolving one part tannic acid in 50 parts of water, or, alternatively, by boiling oak bark or oak galls in water in order to dissolve the tannic acid out of them.

The tan solution is used cold, and, during the immersion of the skins, the latter are rubbed and manipulated with the hands as frequently as possible in order to work the tannic acid into them. Finally, the skins are well washed in plenty of water and stretched on a board to dry.

The skin is softened by damping it with water, and by giving it a good rubbing similar to washing clothes. This action repeated several times at intervals should adequately soften a well-cured skin. A small amount of a mixture of castor oil and neatsfoot oil (equal proportions) may be worked into the skin, but this is not essential, since the "damp-rubbing" alone should be sufficient to soften the skin and produce the desired effect.

Lead Hydrate : Lead Sulphate

(1) CAN you give me any information about lead hydrate, such as its use in accumulator manufacture, method of manufacture, from where it is obtainable, and approximate price ?

(2) Can you also give me any information as to a method (chemical or mechanical) of getting rid of the lead sulphate in litharge and red lead from old accumulator plates ?—R. Adley (Burton-on-Trent).

(1) LEAD hydrate is more correctly known as lead hydroxide. It has the chemical formula $Pb(OH)_2$. It is best made by the addition of ammonia or of a solution of caustic soda to a solution of a lead salt, such as lead acetate or lead nitrate. The white precipitate of lead hydroxide is soluble in an excess of caustic soda, forming sodium plumbite. When heated to 145 deg. C. lead hydroxide changes into lead oxide. Lead hydroxide dissolves in acids, forming lead salts. Thus lead hydroxide dissolved in nitric acid forms lead nitrate. Lead hydroxide is sometimes mixed with litharge (lead oxide, PbO), and this mixed material is packed into accumulator plates prior to their "formation." The prevailing practice in this respect, however, is not known generally, since accumulator makers tend to keep all their formulæ strictly secret. You can obtain lead hydroxide from any firm of laboratory apparatus and chemical suppliers. Your nearest suppliers, we imagine, will be Messrs. Reynolds & Branson, Leeds, or Messrs. Philip Harris & Co., Ltd., Birmingham.

(2) It is very difficult to get rid of lead sulphate on account of its insolubility. However, lead sulphate dissolves in strong solutions of ammonium acetate and sodium thiosulphate (the photographer's "hypo"). In this manner small amounts of lead sulphate may be dissolved out of red lead mixtures, but we fear that, on an economic basis, the process is not likely to be a practicable proposition.

Removing Shellac from Old Records

CAN you tell me of any simple, effective method of getting the shellac off old gramophone records for re-use—preferably some method that requires no elaborate apparatus or preparations ?—J. W. O'Brien (Ashford).

THE best method you can use to remove shellac from old gramophone records is first of all to crush up the records to the state of a coarse powder, and then to stir the powder into warm methylated spirit, which will dissolve out the shellac. Filter the solution through filter paper or blotting paper and then allow the filtered solution to evaporate.

Another method is to make up a solution of one part of ammonia in four or five parts of water and to boil the crushed records in this for about half an hour. The shellac will dissolve in the solution, which is then filtered as before.

In both the above cases some wax will be extracted along with the shellac, and this can only be removed by rather complicated chemical means. For most purposes, however, you will obtain a fairly serviceable shellac in the manner described above.

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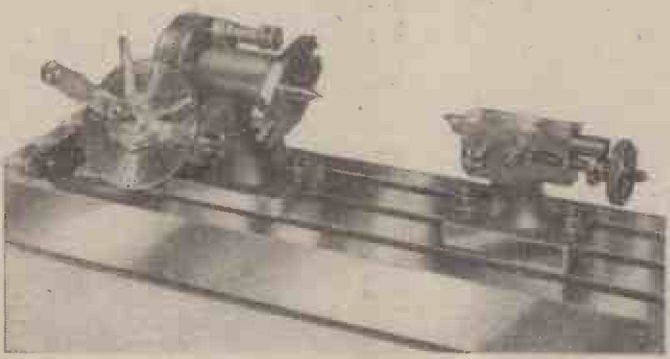

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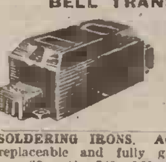

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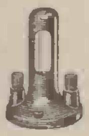

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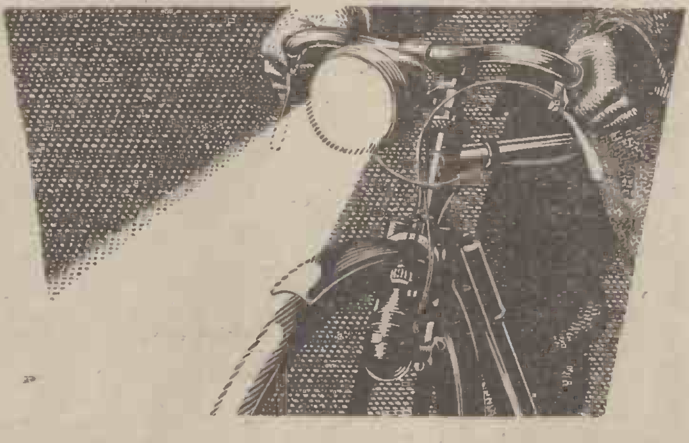

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We have published this picture in response to innumerable requests from cycling enthusiasts. It serves as a reminder of the great pre-war days and as a happy omen of the great post-war cycling days to which we can all look forward.

Richard Kemps
"Shake" Earnshaw
Marguerite Wilson
C. Riga
Cyril Heppleston

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THE Cyclist

Editor: F. J. CAMM

VOL. XIII FEBRUARY, 1945 No. 276

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Comments of the Month By F. J. C.

Rear Lights

THE Minister of Transport has introduced his Bill to make the carrying of lighted rear lamps on cycles compulsory. At present it is only a wartime emergency measure. The new Bill goes farther in that it provides for the compulsory fitting of a red rear reflector and also a white patch. In other words cyclists will be expected to carry a lighted rear lamp, a reflector, and a white patch if the Bill goes through.

Naturally the cycling organisations are opposing the Bill, although we do not support their comment that the Bill is being rushed through without their having been consulted. Every one of the cycling organisations has given its views to the House of Lords Committee on this subject, and the views of these bodies are well known to the Minister of Transport. If, after considering these views, he considers that rear lights are necessary it is another way of saying that he does not accept their views. Our own views on the subject of rear lights is well known, and there is no need to repeat them. We certainly think it unwise of the M.O.T. to introduce a Bill during the life of a Government which is in power for the sole object of winning the war and without giving the electors a chance to express their views on the matter. There seems to be an undue haste to push through a Bill which in peacetime electors might find unpalatable.

The files of our predecessor *The Hub*, and of *Bicycling News*, show that in the early part of the present century cyclists themselves were pressing for rear lights—not on bicycles, but on horse-drawn vehicles.

Apparently horse-drawn vehicles were as invisible to cyclists in those days as cyclists are to motorists nowadays.

The fact is that the main opposition to rear lights, that they cannot be kept alight (a fact not borne out by wartime experience) has caused the Minister to include rear lights and reflectors in his Bill so that if the rear light does go out there are two other warning devices. We have always considered the argument that rear lamps are difficult to keep alight unsound. It is not an argument against the *principle* of rear lamps, but upon their manufacture and installation, a matter which could have been remedied anyway as it has been with motor-cars.

Undoubtedly there will be great opposition to the Bill, but it seems likely that this will be unavailing. We notice that one argument is that there are many thousands of miles of road unprovided with footpaths, and that if a driver assumes that the absence of a rear light in such roads means that it is clear, the toll of the road will be greater than ever. This argument, of course, is specious, for pedestrians also use those roads unprovided with footpaths, and they are not equipped with rear lights. The toll of the roads is greatest amongst pedestrians, not cyclists, and many pedestrians are knocked down by cyclists. Are cyclists, therefore, in favour of rear lights on pedestrians? At least they must be consistent in their arguments—which brings us to the point—there are too many bodies existing in competition with one another, all professing to express the views of cyclists without having taken a census of cycling opinion, and whose views as expressed to officialdom do not always coincide.

The efforts of two national bodies to get massed-start racing stopped by writing letters to a Government department (we are referring to the N.C.U., and the R.T.T.C.), was on the grounds that they were interested in the safety of the roads. So is Lord Leathers, and these two bodies now find themselves in the Gilbertian position of opposing one "safety measure" (rear lights) after stating that their main objection to massed start is in the interests of road safety. These national bodies have only themselves to blame if as a result of their methods their opinions are ignored by Government departments.

Readers who care to consult our files will see the solid arguments upon which we have based our opposition to rear lights. We do not withdraw one word from those arguments.

The National Champions

THE Road Time Trials Council last month held its first dinner and it was made the occasion of honouring the champions of the past year and of the prize distribution. The meeting was under the very able chairmanship of Mr. A. E. Armstrong, chairman of the council. It was a well-attended meeting and representative of all branches of the sport. There were no less than 14 speeches, and some important announcements were made.

The toast of the Trophy Donors was proposed by Mr. M. Newton, the National Treasurer, who stressed that the Council relies upon the good will of benefactors who to date had contributed over £700. The trophies were donated by the Charlotteville, North Road, and Bath Road Club, Ltd., whilst Albert Lusty, L. F. Dixon, and W. J. Medgett had also donated trophies. The two respondents, L. Dixon and J. Beechamp respectively, paid tributes, the former to the many friends which cycling had made for him, and the latter to a late clubman, Alec. Horwood, V.C., M.M., in whose memory the cup was given.

The R.T.T.C. champions of 1944 were toasted by the chairman, who dealt with the popularity of the All-rounder competition and specially thanked the Council's officials, with a special word for T. M. Barlow, and for Mr. S. Amey, the present secretary of the R.T.T.C. The chairman announced that as from the following day the S.A.C.A. and the R.T.T.C. would go forth together as brothers. He also reviewed the performances of the various prize-winners. Responses to the toast came from J. Simpson, A. Derbyshire and Mrs. Susie Rimmington. The prizes and record certificates were then distributed by Mrs. A. E. Armstrong.

The toast of the Road Time Trials Council was proposed by H. Chamberlin, secretary of the N.C.U., and we consider it a pity that an occasion such as this, which was specially designed to honour the champions and prize-winners, should have been chosen for an attack on massed-start racing, a criticism which also applies to a later speaker, S. R. Forrest, one of the respondents to the toast.

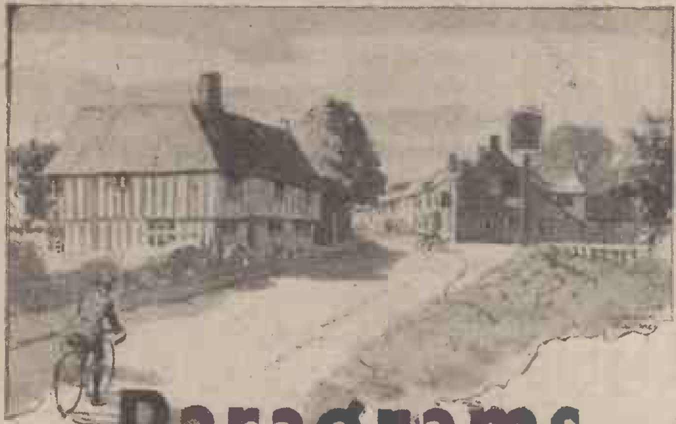
We have observed that at a large number of dinners this year the speakers have dragged in the subject of massed start by the skin of its teeth. In a long tirade against this new form of racing Mr. Chamberlin skated over the criticisms of the N.C.U. 1890 policy by stating that this was the year 1944, and promising the R.T.T.C. whole-hearted support. We can well understand that the N.C.U. will support anyone who is opposed to massed-start racing. However, the speaker merely dealt with the well-known N.C.U. point of view without adding anything new, and as everyone present was well aware of the various angles of the controversy the speech was really unnecessary. Mr. T. M. Barlow kept off controversial matters, and in an interesting speech dealt with his work in connection with the mathematical side of the sport. As expected, S. R. Forrest supported Mr. Chamberlin.

The toast of the Press was proposed by A. Lusty, who urged the press to do their utmost to popularise the sport of cycling. Mr. R. Coley, in replying, stated that it was the duty of the press to report *all* news and that it was not the duty of a paper to take sides. H. England paid tribute to the Council and to Albert Derbyshire, the all-rounder for 1944.

Time was by then getting short, so Mr. F. J. Camm had necessarily to abbreviate his speech. He did, however, state that this journal will continue to print B.L.R.C. news. One of the freedoms we were fighting for was the freedom of the press. He had been an ardent supporter of the national bodies and was supporting the new sport.

Had there been time he had some pertinent questions to ask Mr. Chamberlin, such as: Is not the N.C.U. *afraid* of massed-start racing? If the sport is to be popularised, will not massed start popularise it in a form which track racing and time trials never have been able to do, and never will do? Has the fact that there is no "gate" for massed start, whereas there is for track racing, anything to do with N.C.U. opposition? Since when has the N.C.U. been empowered to support time trials, which it abandoned in the much-quoted 1890s? Does its majority club vote against massed start really represent a minority vote if individual cyclists are taken into consideration? Were both sides of the problem put to the clubs when the vote was taken? However, the clock saved Mr. Chamberlin the task of answering these questions, which will be put on another occasion.

We should like to congratulate the R.T.T.C. on the organisation of this dinner, and to set on record our appreciation of the zeal and energy of Vic Jenner, who has worked so tirelessly for the R.T.T.C. There was excellent musical entertainment interspersed through the speeches.



Paragrams

Stratford St. Mary, Suffolk.

Van Kempen—Collaborator?
AN unconfirmed report stated that Piet Van Kempen, well-known performer in six-day races, was arrested in Belgium as a collaborator with the Nazis.

Fast Ride in Fens
J. C. OUTTRIDGE, United Doomers C.C., returned the fastest time in 1944's open events in the Fens when he won the Wisbech Wheeler's "25" in 1 hr. 5 min. 14 sec.

Youngster's Record
W. H. BATTERSBY, 19-year-old club champion of the Doncaster Wheelers, broke a nine-year-old record when he climbed Burton Stahers Hill in 1 min. 8 sec.

Trowbridge Wheelers
GERALD STRONG, former captain of the Trowbridge Wheelers, is now with the submarine service in the Far East. He had many adventures on former Malta convoys.

News of Innes
LAWRENCE INNES, joint holder of the End-to-End tandem record, was wounded while serving with the Royal Tank Regiment in Italy.

Birchfield Loss
LT. G. WALBANK, Birchfield C.C., was killed in action in Italy.

Crouch Hill Innovation
THE Crouch Hill C.C. are holding an Open tandem "30" on roads north of London during the forthcoming season.

Dual Effort
THE famous classic Balham C.C. Rough-stuff "25" will again be held this season. The event was taken over in 1943-44 by members of the Fountain C.C. owing to the depleted ranks of the Balham C.C. This year the two clubs will again combine to provide this appreciated "pipe-opener."

Finsbury Parker Decorated
W. S. EDMONDS, Finsbury Park C.C. pre-war champion who is now a Flying Officer in the Royal Air Force, has been awarded the D.F.C. He is the second club member to win this decoration.

S. R. Forrest's New Appointment
S. R. FORREST, assistant secretary of the Road Time Trials Council, will represent that organisation on the National Committee on Cycling.

Another Fixture
ABANDONED since the outbreak of the war, the successful Open "50" promoted by Preston Wheelers is to be continued.

In German Hands
L./CPL. H. TAYLOR, Rochdale Section of the National Clarion C.C., is a prisoner of war in German hands.

Killed in Action
LT. F. B. DUTTON-WALKER, former joint holder of the Liverpool-Edinburgh tandem record and the London-Liverpool tricycle record, has been killed in action. He was a member of the Palatine C.C.

Decorated
F. SISLEY, Norwood Paragon C.C., has been awarded the Military Medal. Although ordered to leave he held an observation post in Italy against heavy odds.

Civic Distinction
A. McIVER, well-known in Scottish trade and cycling circles, has been elected Provost of Huntly, Aberdeenshire. He has taken a keen interest in cycling activities for many years.

Cycling Get-a-way
MEMBERS of a pro-British Italian cycling club assisted several British soldiers to escape from German-occupied Italy into Switzerland. Machines were placed at the disposal of the fugitives, among whom was E. Lucking, of London, who has reached this country.

The Gate C.C.
FORMER motoring and old-time members of the Highgate Cycling Club formed, in 1943, the Gate C.C. which has now over 60 members, and is going strong. The parent club has also a sturdy nursery of junior riders.

Percy North in China
PERCY NORTH, one-time secretary of the Highgate C.C., and who previously spent several years in the Far East, has again taken up a civilian post in China.

Another Open "100"
THE Kentish Wheelers contemplate holding an Open "100" during the coming season.

Cumnock Reunion Dinner
THE second Cumnock reunion dinner will be held on February 25th, at the Newhouse Hotel on the Glasgow-Edinburgh road.

Muspratt Migrates
JACK MUSPRATT, noted Upper Holloway C.C. veteran, has moved to Suffolk for "the duration." Keen all-weather rider, he will be missed from his many haunts in North London.

Greenford Secretary Killed
SECRETARY of the Greenford Exiles C.C., Ronald Anthony has been killed in action. He was secretary of the club until his mobilisation in 1940.

Scottish Hostels
AT least two new Scottish Youth Hostels will be opened this year. In 1944 a new membership record of 38,000 was reached.

Hampshire's Loss
IVAN DEXTER, Hampshire Road Club, who had been awarded the Military Medal, has been killed in action in Italy where he was serving with the Royal West Kents. The club has lost seven members by death while on active service.

From Devon to Italy
FOUNDER-MEMBERS of the recently formed Adriatic C.C. (comprising Serving men in Italy) include Edward Daw, Plymouth C.C., C. Butson, Mid-Devon Road Club, and V. Dight, Somerset Road Club.

A Good Record
H. BROOM, secretary of the Mid-Devon Road Club, achieved his personal ambition in getting the club membership to 100 during 1944.

Midlander Missing
CYRIL BOOTH, Midland C. and A.C. and former member of the Golden Arrow (Rugeley C.C.), is missing following action in Holland. He was a prominent 12-hour rider.

Rankin Resigns
AFTER 17 years service as Time Trials Secretary of the Barnesbury C.C., John Rankin has resigned. Forty members were present at the club's annual general meeting: a healthy sign.

A Proud Record
HOUGHTON ITONIA C.C. (Tyneside) have 38 members serving with the Forces of whom six have made the supreme sacrifice. The club's membership was 40.

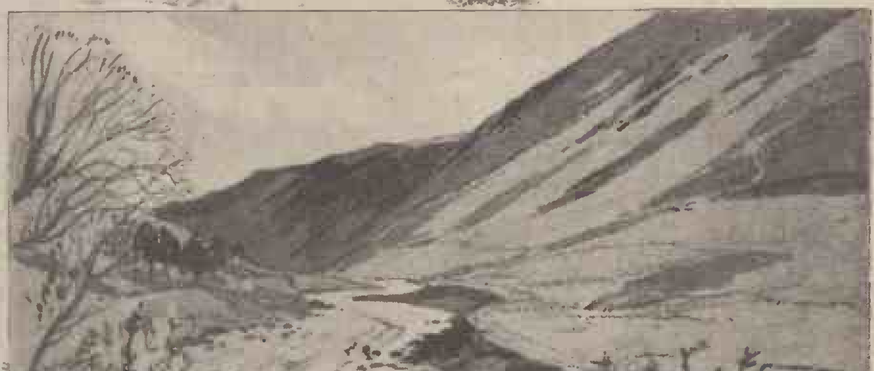
Oak C.C. Loss
EDITOR for many years of his club's monthly magazine, A. B. Gott, of the Oak C.C., has died. The club sustained also another loss with the passing of Fred Richards.

Morrison Again
WARRANT Officer Donald Morrison, R.A.F., of Glasgow, has now been awarded the D.F.C. He was previously decorated with the D.F.M. He was chosen for the 1939 Olympic team.

Aylesbury Club Bereaved
SERGEANT H. BOWLER, Aylesbury C.C., has been killed in action while serving with the R.A.F. in India.

Track for Cambridge
PLANS are afoot for a cycle track to be constructed in Cambridge.

Leith Hill
DR. RALPH VAUGHAN WILLIAMS has given the famous Sussex beauty spot, Leith Hill to the nation.



The River Awe in the wild and rugged Pass of Brander, Argyllshire, Scotland.

Around the Wheelworld

By ICARUS

Massed Start—A Parallel

IN the early days of the film industry managers of theatres opposed the new form of entertainment because they thought it would kill the theatre. When radio was introduced the gramophone companies, as well as the newspapers, opposed the new form of entertainment because they thought their respective industries would suffer. We now know that far from films damaging their competitors, the theatres have never done better—the sales of gramophone records have increased (subject to wartime restrictions, of course) by about 400 per cent. and the sales of newspapers have also vastly increased.

The opposition to massed-start racing (let us be quite frank about it) is because it is gaining publicity; it attracts larger crowds than the older time trials and track racing. Everything is being done, however, to kill it and the club dinner and the club journal are being made the medium for tiresome speeches against it without giving the facts.

I advise chairmen of annual dinners to watch the point. They should instruct proposers of, and responders to, toasts, not to use the platform of the dinner for propaganda purposes. The dirtiest page in the history of cycling sport is that which records the writing of letters to a Government Department suggesting that massed start was dangerous and should be banned. Unfortunately for the writers of those two letters —the N.C.U. and the R.T.T.C.—the present writer unearthed the damaging facts that they had been written and also elicited the fact that *those were the only letters of opposition to massed start which the Ministry had received.*

Speakers at dinners where massed start is opposed are also asking for greater publicity for cycling. Massed start will provide it.

The R.T.T.C. and the N.C.U. will find that their own events will increase in popularity as a result, and parallel the experiences of the theatre and gramophone industries.

For years the N.C.U., certain less informed members of the C.T.C. and one or two ill-informed cycle noters, have promoted the belief that racing on bicycles is illegal. It was left to the present writer to clarify that position. If it was illegal it would have been stopped years ago, and so would have massed-start racing. If it is illegal then the R.T.T.C. is acting illegally, and its opposition to massed start is merely because it does not want another "illegal" form of sport to cause the authorities to stop its own. There is no sincerity behind the opposition on the grounds of road safety. The whole situation has been badly handled by these two bodies, and they have only themselves to blame for the mess in which they now find themselves.

The new sport is not intended to compete with time trials or track events, and the unsportsmanlike actions and attitude of the two bodies concerned is deplorable.

A Misunderstanding

MR. C. J. FOX, Hon. Sec. of the British League of Racing Cyclists, wishes it to be made known that the B.L.R.C. has no official connection with the "Heal the Split Movement." The aims and activities of this body will receive sympathetic consideration from the national committee of the B.L.R.C., but it must be made clear that this well-meaning body does not take part in the deliberations of their policy which is to encourage and promote all forms of cycle racing.

For the A.G.M.s

THE Heal the Split Committee asks clubmen to place the following resolution on the Agenda for consideration at their A.G.M.:

"That in view of the present Government policy towards the future of cycling and the urgent need for concerted action to fight rearlight and other threats, this meeting is of the opinion that the N.C.U., R.T.T.C., and B.L.R.C. should meet to formulate a policy to be submitted to their membership to create unity. The Committee views with grave concern the lack of action by the cycling organisations."

In fairness to these organisations I ought to say that they have not been inactive on the question of rear lights.

B.L.R.C. London Section

THE following officers were elected for the current year, at the meeting on January 7th, 1945.

Chairman, J. Kain; Vice-Chairman, Mr. Tugwell; Hon. Gen. Sec., E. L. Lawton; Hon. Events Sec., A. H. Clark; Assistant Events Sec., V. Humphreys; Hon. Treasurer, Mrs. W. Fletcher; Hon. Social Sec., C. Owen.

Address of the Hon. Gen. Sec.: 44, Lammas Park Road, Ealing, London, W.5.

Maimed ex-Service Cyclists

THE Charles Fearnley Fund for maimed ex-Service cyclists has commenced its excellent work of providing helpful mechanical aid to wounded ex-Service cyclists who desire to continue with their chosen pastime. The secretary, Miss I. M. Pulleyn, is anxious to locate deserving cases and I shall be glad to forward names and addresses which are sent to me.

Two Dunlop O.B.E.s

TWO Dunlop men are awarded the O.B.E. in the New Year's honours—Colonel D. F. Robinson, R.A.O.C., and Commander E. F. Hingeley, R.N.V.R. In peacetime Colonel Robinson was in the sales department at Fort Dunlop and Commander Hingeley was Dunlop general manager in Sweden.

West London Road Club Annual Dinner

CRITICS of massed-start racing would not have been comforted had they been present at the second W.L.R.C. Annual Dinner, Dance, and Prize Presentation at the Park Royal Hotel, Western Avenue, on December 30th, with Mr. Willoughby Garner, M.B.E., the president, in the chair, when over 160 members and guests were present. Many of the B.L.R.C. clubs were represented, although there were numerous N.C.U. and R.T.T.C. representatives.

Frank Guy was the toast master, and there was a breezy rhythm to the affairs of the evening. The toast of the Club was proposed by Mr. F. J. Camm, who reviewed the history of massed-start racing and stated that in two years the W.L.R.C. has reached a foremost position among clubs in its area, due to the hard work of the officials, and the sporting spirit of the members. He went on to criticise the N.C.U. who retained the outlook of 1894 and will issue permits for massed-start racing on the Continent but not here. He also referred to the unsportsmanlike action of the two bodies in writing letters to a Government department. He said that the R.T.T.C. would not be in existence but for a breakaway movement from the N.C.U., yet the R.T.T.C. now opposes a body which is doing precisely the same thing, and for similar reasons. He promised them his continued support. The response came from G. E. Mansfield, who expressed satisfaction with their efforts during 1944. The toast of the visitors was proposed by V. G. Humphrey, with the response by R. Coley, who expressed pleasure that so many enthusiastic cyclists could turn up to confound the wishful thinkers in the rival camps. Mr. J. Kain followed with a tribute to the press with a neat retort from Marjorie Maunder. Mrs. Willoughby Garner presented the prizes. There can be no doubt that this Club has made history.

Restrictions Removed

SUCCESSFUL negotiations have been completed with the Board of Trade which will enable manufacturers to resume nickel plating, and recommence the manufacture and distribution of the various items which were agreed to be excluded under the austerity specification to which manufacturers have worked in recent years. In fact, all restrictions on bicycle specification are now removed except that relating to chromium plating which is to be further considered. Manufacturers can now suit themselves as to the provision both for home and export of such items as multi-speed gears, gear cases, rubber pedal treads, chain guards, coloured enamels and the like. It is hoped that chromium plating may be resumed at an early date, at least in relation to certain export markets.

B.L.R.C. Track Racing

MR. C. J. FOX, Hon. Sec. of the B.L.R.C., was instructed by his committee to approach the N.C.U. for a permit to hold track races under N.C.U. rules. The two bodies have no quarrel with one another on this matter, but the result of the correspondence has been that the permit is not granted.

Post-war Tyre Plan

A PLAN for the orderly and economic distribution of tyres, when tyre control ends, has been worked out, at the invitation of the Government, by the Tyre Manufacturers' Conference, the Motor Agents' Association, and other distribution organisations.

The plan, which has now been presented, aims at distributing tyres by the cheapest and most efficient method, so giving the public the lowest possible price level. It also ensures orderly trading to enable manufacturers to maintain a high level of employment.

New Union President

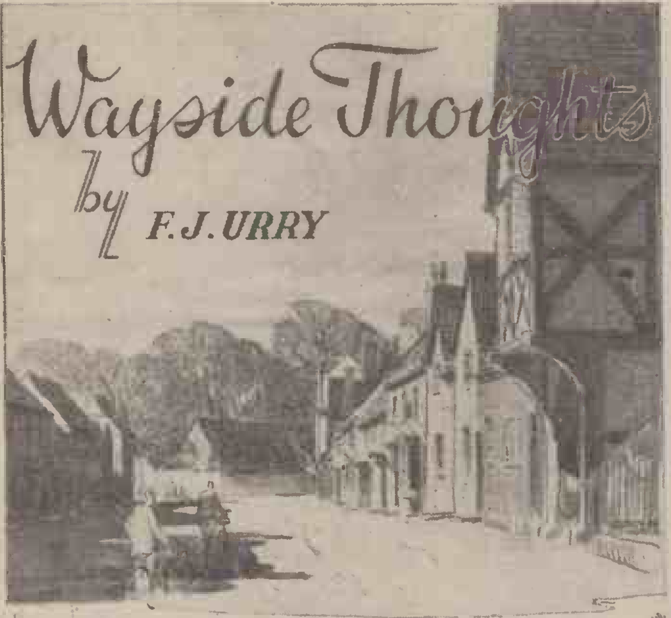
THE new president of the British Cycle and Motor Cycle Manufacturers' and Traders' Union is Mr. G. H. B. Wilson, managing director of the Raleigh Cycle Co., Ltd., Lenton, Nottingham. He was appointed in Birmingham in succession to Mr. C. Gilbert Smith, of Norton Motors, Ltd., Birmingham. The new senior vice-president is Mr. C. Douglas Terry, of Herbert Terry & Sons, Ltd., Redditch, and Mr. J. Y. Sangster, of Ariel Motors, Ltd., Selly Oak, Birmingham, is junior vice-president.

N.C.U. Diary

THE N.C.U. Diary for 1945 is now available. It contains a great deal of valuable information on touring, cycling, law, railways, roads, records, lighting-up times, etc. Copies cost 3s., or 2s. 6d. to members in the Forces serving abroad.

Wayside Thoughts

by F. J. URRY



An autumn day in the lovely village of Lacock, Wiltshire. The village contains beautiful specimens of fifteenth-century cottages, and interesting stone and half-timbered houses.

Good News

IT may be of interest to the general public to learn that the cycle trade of Great Britain consider themselves capable of an output of 6,000,000 machines a year. To me the figure seems colossal, but since they say it is a fact, who am I to deny it? I understand that for 1945 the number of bicycles allowed by Control will be 2,000,000, so there should be a better chance to obtain delivery during the next few months. The right way is to put your machine on order at once, for the waiting-list period is not yet over. My own reaction to this good news is to ask in all sincerity that if the output of bicycles is to be doubled, what about a few models of better quality? That is what we regular cyclists are waiting for; we have grown tired of war-time goods and need encouragement to buy better and be happier as a result. I hope this side of the question of manufacture has been given the attention it deserves, for in my view the raising of quality is important in a community that has money to spend on the best; and how better can it be spent than on bicycles, good bicycles? Is it possible to have better tyres, a return of speed gears, and—let me say—the smooth braking path and ever tidy appearance of rustless steel rims? These are the necessary equipment of a good quality machine for the use of the average rider, these and a good comfortable saddle, and then he has the chance of becoming a cyclist with pleasure as his main pursuit. Yes, even if he rides every day—as I do—over city and suburban roads, the pleasure of the exercise and such independence are in themselves a charm. But a good bicycle is important as part of that complete picture.

Back to the Saddle

I RECENTLY had a holiday in which cycling had no lot or part, the first of its kind for many years. It was only a short break, and because of the company and the reasons for its necessity, I thoroughly enjoyed it. But what a pleasure to climb into a saddle again at the first opportunity. It was Sunday, a wet, grey, dismal day of sad, quiet rain, when everything seemed damp to the touch. My people said, "You're surely not going out in this?" And why not? Now that's one of the values of cycling, you never need to commit other people to your actions; that is part of its freedom. I had the roads to myself except for the rare milk lorry, and tucked into my macs I was warm and dry, and saw the dim outlines of my countryside etched on a grey sky. It reminded me of that verse of Rupert Brooke:

"The white mist in the black hedge-rows,
    The slumbering Midland plain;
And silence where the clover grows,
    And dead leaves in the lane;
Certainly these remain."

Yes, they do; for all around me was the subdued loveliness of a wet day in late autumn, and an awareness that life goes on, that there are other things of value as well as the inglenook when the barometer is low, and you feel the need to stretch your limbs. For thirty miles I just strolled along the main roads and stayed nowhere; it was just a ride, a return to a well-loved habit, and as I told my people—what else should I have done with such a morning? No, I was not wet at the end of that jaunt, my toes were spotted with thin mud and a grey lock was damp; for the quiet rain had never beaten into my protection or even damped my sleeves; which is the way of quiet rain.

Why Do It?

I AM delighted with our dim streets every night when I ride home. After some weeks of their aid I still feel thankful for the glow lamps, for the kerbs and the corners are now easy to negotiate, and I can see the walker quite clearly as he steps between the little pools of light. But even this lifting of the black-out has brought its dangers, or so it seems to me, for I find, quite definitely, that the bus and truck drivers give me rather less steerage room than was the case when all was black. Why should this be? The roads have not contracted in width, and the need for care and decency of conduct is surely as great as ever? I suppose the drivers feel they can cut the safety margin a little finer without any danger—to themselves; but what about the overtaken; should not they be considered? This kind of driving is not actually careless; it is thoughtless conduct that may merge into carelessness any moment, and it is quite unnecessary. I think I am as careful of my skin as the next individual, and if the people who pass me at speed were only similarly inclined, then most of the nervous tension attached to night riding would disappear. Very many years ago I said if road manners could only be brought to the level of house manners half the road accidents would disappear, and I believe that to be true to-day. But the powers-that-be have substituted the word "conduct" for "manners," a psychological error in my opinion, for the definition "manners" touches the pride of people more closely than "conduct." In any case I wish drivers would give us a bit more elbow room o' nights, and not leave us wondering if the tail of their vehicles will sweep us into Kingdom Come.

A Good Thing

WITH two of my friends concerned with official cycling, I recently had a talk to numerous prominent members of the cycle trade, and they listened to our ideas on the political aspects of cycling with sympathetic attention. The subject discussed is not for publication at the moment, but the fact that the leaders of the industry were willing and anxious to hear the cyclists' point of view is all to the good, and I hope it will not be the last occasion when exchanges of opinion between the trade and the rider occurs. The National Committee on Cycling is, of course, part of the trade, both makers and dealers sit on it; it is doing good, quiet work now, and will I imagine in future be a power in the world of wheels. I think the trade is far more closely in touch with cyclists than has been the case for thirty years or more, ever since the time, indeed, when members of the industry held many prominent positions on wheeling associations. That these new relationships between the makers and riders can be extended and improved is worth working for, since with a big industry behind us, we riders can put our case to the powers-that-be with far more emphasis. Trade talks to-day in Government circles, and though you and I may only be little customers; in total we represent a very big volume of business, some of which depends absolutely on the retention of our present road rights. These approaches between trade and rider also deepen the sympathetic understanding of the problems confronting both parties.

Work to be Done

WHILE on matters of trade interest, I want to repeat that the industry has informed the Board of Trade that when peace arrives and controls are released, it is capable of producing 6,000,000 bicycles per annum. This is an enormous swing-up from the best output standard of pre-war years, but since it is the trade's own estimate, we have to accept it. As an individual keenly interested in the spread of cycling among all sorts and conditions of people, I wonder if this more than doubled expansion of output means the expectation of a considerable increase in the numbers of cyclists by the trade? If that surmise is right—and I hope sincerely it is—then the industry must get moving in the way of teaching the public the abiding joy of bicycle travel, how to ride, where to ride and what to ride, for it is a fact that the cycling ignorance displayed by the average adult individual is astonishing. The spread of cycling among all of us is a natural desire to travel, and so it will increase; but that increase, I am certain, can be accelerated enormously by the proper broadcast approach to the pastime through the voice and the pens of people who know this great game intimately and can put the story over. It is so good a story, and the achievement of its highest pleasures is so simple, so cheap and so delightful, that it ought to be told to the millions: and I believe if it were told then in the course of five years the cycling population of this land could be almost doubled. That desideratum would absorb much of the industry's possible output, while the rest would go for export and be the means of teaching the people of other lands what excellent things come out of Britain.

Always Interest

THESE notes seem to have resolved themselves into subjects concerning cycling rather than riding itself, but the trend of the one frequently tends to shape the future of the other, and in that sense perhaps the comments are justified. It does not mean, however, that I have done no riding during the last month, rather the contrary, for I seem to have been lucky in my outings, as well as the daily journeys. Some people look at the weather and shudder, and to be quite candid a dull, damp day in January does not seem very inviting when viewed from the inside of a cosy room. But once out in it, comfortably seated and protected from the rain, what a different kind of day it seems. Sometimes it needs a little resolution to start out in the wet when there is no special reason for your journey, and you are inclined to accept the railway slogan: "Is your journey really necessary?"—sit back and let the day go by. But if you are fit and well, what a bore those idle hours become, and at the end of them you are sorry no fresh air has been pumped through your lungs and no muscles have been stretched for the good of your body. So generally, when faced with these conditions, I go out, and as often as not find a few hours of quiet enjoyment, and frequently a fine patch of weather to show me those lovely delicate pictures of winter sunshine on hoary tree trunks, the pastel shades of misty distance, and the etched splendour of twigs against a sunset sky. And within my orbit of a quiet day's ramble I have many friends on whom I can call for refreshment and a chat; for it would be remarkable if such were not so after my wanderings in the district for over fifty years.

The old Plume and Feathers Inn, Princetown, Dartmoor. (An unusual feature is the whitewashed slating on the front of the inn.)

★ In other days this might have been a club run—to-day it's a tougher proposition. But now, as then, Firestone tyres are proved more than equal to the occasion.

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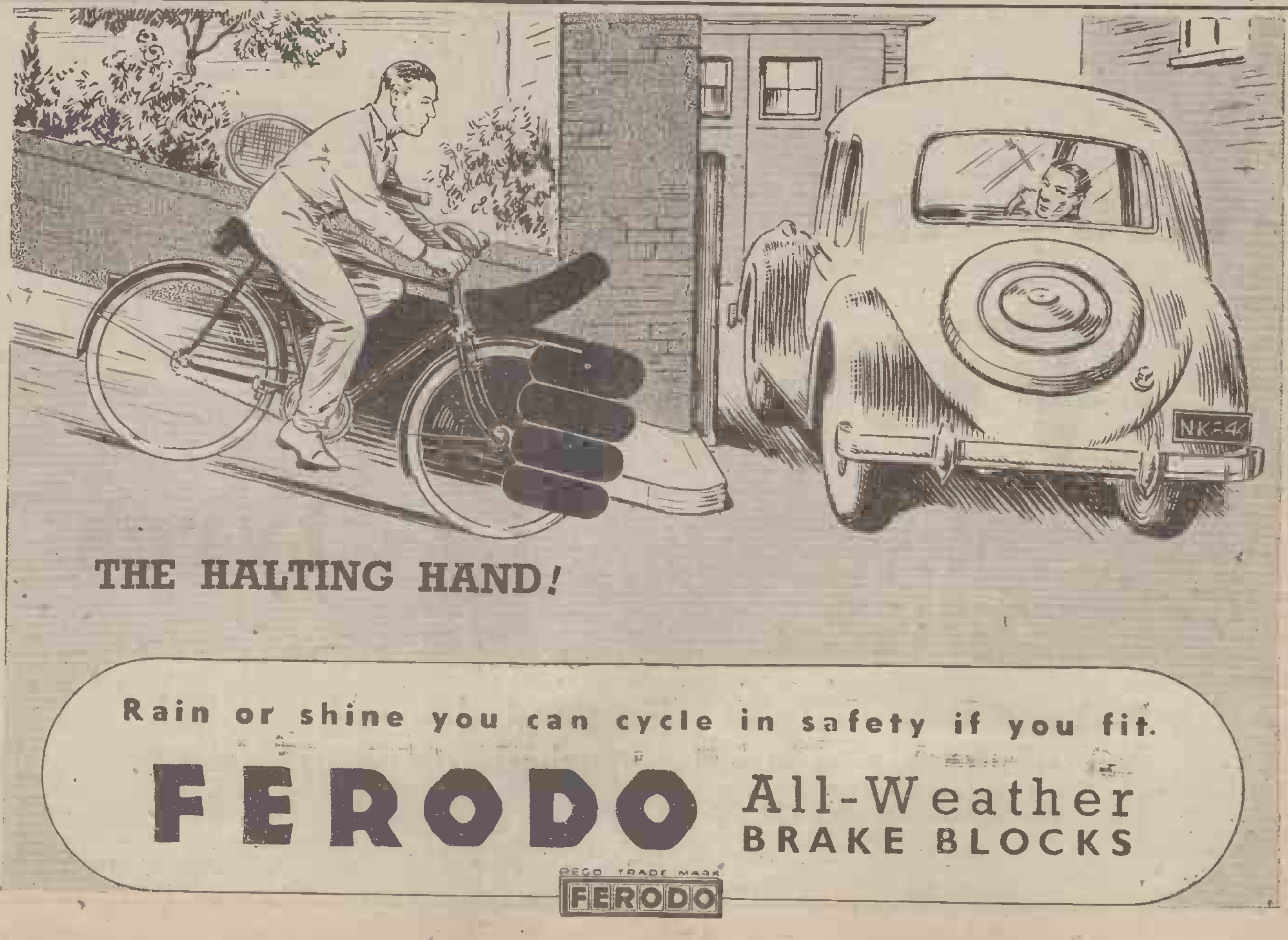
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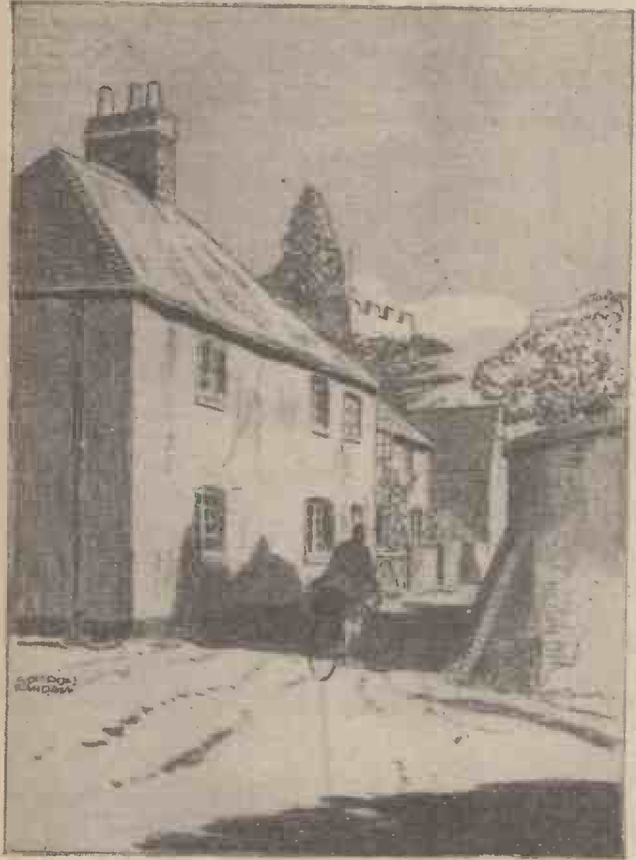
CYCLORAMA

By H. W. ELEY



A glimpse of the village church, Singleton, Sussex.

The First Snow

THERE is always something rather fascinating about the first fall of snow one sees in the season, and I have never been able to understand those to whom snow is just a "weather nuisance"; of course, I am not fond of the inevitable slush on the roads which follows the falling of the "crisp white mantle" . . . but I do still find a joy in looking out of my window on a winter's morning and finding that during the night the snowflakes have fallen silently, and completely altered my little world. It all happened the other week-end, when I was staying in the Midlands. When I turned in at night, after an enjoyable ride on hard roads, with the stars winking overhead, I thought that "snow was in the air" . . . and morning found the garden and outhouses strangely altered; gone were the sharp outlines, and the goat-house looked like some monstrous hillock in an arctic waste. In the lane there were soon boys hurling snowballs at each other, and talking excitedly of tobogganing on the slopes of the neighbouring golf links. For once my Saturday morning cycle ride was out of the question . . . but I put in a useful hour or two doing minor repairs, and attending to tyres.

The Art of "Ankling"

IT is not a little surprising how many cyclists just "tread on their pedals," and fail to get the utmost push forward which "ankling" gives. I have often explained to beginners that it is essential that the feet should perform a rotary action, and that there is something more to pedalling than merely "pushing the pedals down." Once one has learned the simple art of ankling, it is a source of surprise that one got along so well before. Only the other day, sitting in an inn and talking to a group of keen riders, this topic came up, and the "art" was demonstrated to one junior member of the party . . . I am sure to his lasting good and pleasure.

I Inspect a Veteran

A FEW weeks ago I had occasion to call upon an old friend . . . a youngster of about seventy-four, who has been cycling more or less all his life. And he still cycles . . . taking a short ride daily when the weather is fair, and never losing his enthusiasm for the "game." I looked with much interest at his photographs of wayside curiosities, old inns, village churches . . . all gathered on his varying cycling holiday tours. Then . . . he took me up into an attic of his house, and showed me an old cycle—one of his very first "loves." It was an "Osmond" . . . and I confess that I had never seen the good old make for years. Apparently the old bike had been purchased somewhere about 1904, and it was still in very fair condition. My old friend told me, with a certain wistfulness, of rides he had done on that old machine . . . gentle, ambling rides through East Anglian villages, with many stops in the Constable country around the Stour; rides in Wales . . . with especial memories of the wild, unspoilt parts of Radnor and Montgomery; rides to Northward Ho . . . to the grey walls and windswept moorlands of Derbyshire; and rides in the Home Counties, where in springtime the primroses grow profusely, and stone walls give way to soft green hedges, and all is lush and lovely. The "Osmond"—it was a famous bike in its day, and I was glad to see this old member of a distinguished family.

The Sign of the Inn

INN signs, and their derivations, are fascinating things . . . and for years I have made a study of them. I always get a thrill when I come across one of an unusual nature, and endeavour to trace its origin. Of course, even the commonplace ones, such as "The Saracen's Head," the "Angel" and the "Swan with Two Necks," have their interest, and with regard to the latter, I have been told that it should really be rendered as "The Swan with Two *Nicks*"—the allusion being to the "swan upping" which takes place, I believe, annually on the Thames, when the birds have their beaks "nicked." Over the years the matter has become confused, and the "necks" are now illustrated . . . by an ornithological monstrosity having two arched necks and heads! But I set out to mention an inn with a very unusual name . . . brought to my notice by a correspondent in the North. It is "The Mortal Man," at Troutbeck, in Westmorland. My friend tells me that the inn goes back to 1659, and bears a picturesque sign with the wording:

"O, mortal man, that lives by bread
What is it makes thy nose so red?
Thou silly fool, that look'st so pale,
'Tis drinking Sally Birkett's ale."

Now, in all my rides abroad, and in all my searches for interesting inn signs, I have never come across a "Mortal Man" before! I must add this curious sign to my collection.

There's Still Need for "Tyre Economy"

I SEE that the Ministry of Supply (Tyre Control) is still calling attention, in its publicity, to the need for care in the use of cycle tyres. The optimism about the progress of the war has, perhaps, confused the issue as regards tyres . . . and it must be remembered that not until Japan has been defeated, and our Malayan sources of raw rubber are again available, shall we be really "out of the wood." So, look after your cycle tyres . . . take those few and simple precautions which do so much to prolong life, and you will be saving your own pocket, and helping the nation, too.

Something to Look Forward to

IF there is peace in 1945, and *if* arrangements can be made, there may be a Cycle Show this year! A little bird whispered this to me. I even unearthed an old show catalogue . . . and—my word!—what a galaxy of models we had from which to choose!

Six Hundred Years Ago

FROM paragraphs in some of the trade and technical journals, I read that the Coventry Charter of Incorporation was granted to the war-scarred old city six hundred years ago! It is a long time. And Coventry has indeed seen many vicissitudes in that tremendous period. A variety of industries have been born in the city, have flourished or failed; have been reborn . . . and, through it all, Coventry has kept her fair name and fame. She will assuredly be in the news when that fine new cathedral takes shape, and her war scars are healed. But what is in mind about this is to wonder what part cyclists and cycling will play in any celebrations? For celebrations there will surely be, and in view of the unique place of Coventry in the cycle world, we must see to it that, when the time comes, cycles, cyclists, and cycling are well and truly represented.

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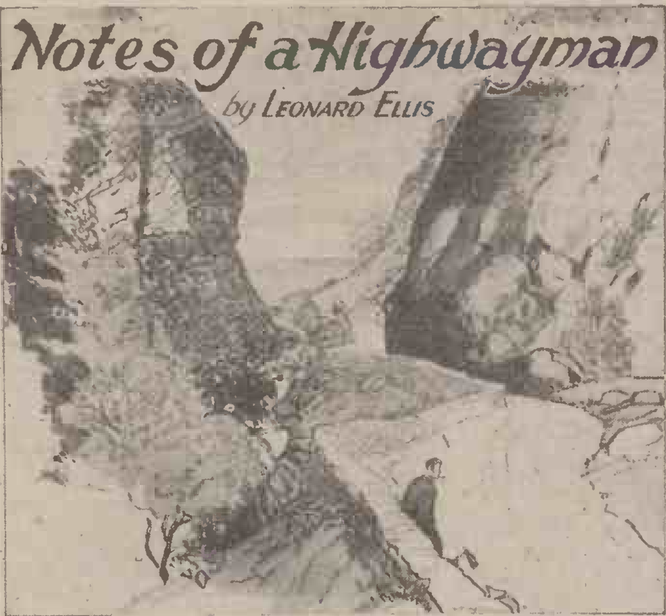
Notes of a Highwayman

by LEONARD ELLIS



The Pass of Melfort, Oban, Argyllshire, Scotland.

Britain's Touring Grounds (3)

THIRD on the list in order of popularity comes North Wales—an area well beloved of all cycling tourists. In many ways it is like Scotland, perhaps in miniature. The mountains, although grand, are not so immense as those of Scotland. Whereas we gaze in reverence at Snowdon, and realise that there are perhaps a dozen or so topping the 3,000ft. mark, some of Scotland's reach 4,000ft., and the lesser ones are legion. And so in many ways are Scotland's glories duplicated in North Wales on a slightly less impressive scale. North Wales has one great asset in that it is so compact. It is just about the right size for a comfortable tour, and yet there is ample material to last one a lifetime.

A Delightful Country

I HAVE done at least 20 tours in this delightful land, no two exactly alike, and yet I could not claim to know all the charming little spots that are calling to be visited. Whereas in Scotland first-timers often ride from south to north, and do the whole length in one fell swoop, tourists to North Wales frequently strike across the centre line and then follow the coast line to Chester. This, with several obvious detours and excursions, is an excellent way to make its acquaintance. The road westward from Shrewsbury is pleasant and interesting, and what is more is a perfect example of the crescendo tour. The scenery very gradually gets more and more beautiful, until at the last stage of the outward journey we are hurled into the sleepy little town of Dolgelly, and then beyond to the fascinating loveliness of the Mawddach Estuary between here and Barmouth.

A Glorious Road

RUSKIN once averred that there was only one road to compare with the road from Dolgelly to Barmouth—and that was the road from Barmouth to Dolgelly. One need not repeat the journey, as north and south of the estuary there is a good winding road with a bewildering succession of brilliant scenes. Dolgelly itself is an excellent centre, and whether long cycling trips or short walks are desired it will be found to fill the bill. The coast road is full of interest, and embraces Harlech, with its grand old castle and the Roman Steps away over the hills. If we omit the long journey round the Lleyn Peninsula we shall cut across the neck, and reach the glory spot of Aberglaslyn, and on to charming Beddgelert.

The Lure of Snowdonia

HERE we are in Snowdonia with its host of peaks, passes, lakes, glens, and all those things that make a cyclist realise how short a fortnight is, and how big the world is. The other great highway into North Wales leaves the east-west route beyond Shrewsbury, and proceeds north-westward through Whittington and Chirk to Llangollen. Here some time must be spent to see just a fraction of the many attractions of this land-locked little town. On again over the moorlands to Bettws-y-coed; where even more time must be given. Here are deep gorges, ravines, waterfalls, lonely lakes, rushing rivers, in fact, there is enough for a whole tour. Snowdonia is next if we push on, and beyond that the Menai Strait and Anglesey. Westward of Shrewsbury lie the Berwyn Mountains, with numerous wild and lonely tracks beloved of adventurous cyclists.

The Llanberis Pass, well known to tourists, is typical of the wild aud rugged scenery to be found in Snowdonia.

Llanberis Pass.

My Point of View

By "Wayfarer"

Steps

ONE is occasionally confronted by a friend's facetious remark, "Give me a ride on your step!" It was once possible to do this (an extremely undesirable practice, too), but steps went out of fashion a very long time ago, and non-cyclists, even if they were previously cyclists, have not moved with the times. I think it would be right to say that more than a quarter of a century has passed since I possessed a bicycle with a step, and I beg leave to doubt whether what we call the average cyclist (of modern type) knows what a step is.

The Winter Revelation

IT is now many years since I expelled from my mind the idea that the countryside in winter-time is a closed book to townsfolk—drab, miserable, and generally devoid of interest: a place to be avoided: certainly no resort for civilised beings. It was the bicycle which gave me a new orientation of the country, revealing the beauty of the scene even on a colourless day, teaching me the charm of grey, and demonstrating that the winter months provide many occasions which are anything but drab. And when first I saw "roses in December," in the open, I realised that the preconceptions of childhood were misconceptions. From the revelation of the countryside in its true colours—and "colours" is a good word to use in this connection—to indulgence in cycling week-ends during the so-called "off-season," was an easy step, though it seemed odd to be going away for the night in, say, November or February. That feeling of strangeness (sometimes spoken of as "madness") soon wore off, and the week-end habit, operable during any and every month of the twelve, has become a normal feature of my life. The habit has now endured for many years.

A Jaunt

SUCH were some of the thoughts which came trooping through my mind during a recent winter week-end. I went to a favourite resort only 50 miles from home, but, by dint of using an indirect route for the outward journey, and of obtaining a couple of "rides round" from my destination, the two days gave me a total mileage of 150—an achievement which, in my callow days, I would have deemed remarkable, but which I now view as commonplace. How striking it was, in the glory of that sunny Saturday, to look over a vast countryside from a vantage-point, and to mark the variegated colouring of the irregularly shaped fields! Here was pure green: there was a rectangle of straw, spread with heaps of fertiliser for the imminent ploughing; elsewhere one saw "the good red earth," newly turned. The stripped trees were lovely in their nakedness, and the encircling hills were a picture. The delectable countryside rose to meet me as I flew down a long hill, and, in the fullness of time, I came to one of our greater rivers, which was brimming over with the flood-waters of recent storms.

On the following day I dipped slightly into Wales during the course of a morning ride of 30 miles. This was not one of the better days, but my cape was in action for only a few minutes. When I ascended to that shelf which forms part of the Oswestry-Llanymynech road the rain had cleared, leaving a legacy of drabness. Many hills were now in the picture, despite the difficult conditions. The Breiddens looked formidable through the screen of mist, while the more distant Wrekin stood out clearly. The Shropshire plain stretched towards these and other uprisings—I think the Clee Hills were also in the picture—and the sight was a good one. Moreover, it was pleasant to recall that here I was, on a December Sunday, 60 miles or so from home, revelling in the winter aspect of the countryside—viewing that countryside with something of the understanding of those who dwell therein, and with none of the misunderstanding which possesses townsfolk. Completely vanished—thanks to the bicycle—is the old idea of the country, in winter-time, being no place for civilised people!

One other word in regard to the winter aspect of the cycling week-end habit must be set down. Certain risks in the way of climate have to be accepted. You may wake up on the Sunday morning to be confronted by such luxuries as fog, or snow, or treacherous roads—or even by all three. These are risks which must be faced if you would get the utmost out of our pastime. I, personally, have encountered the lot—my most trying experience being snow, plus treacherous roads, when I had a day's journey of just over 100 miles to tackle—and have mastered them with the weapon of philosophy and the will to conquer. Some comfort may be extracted from the thought that the fog (surely the worst of all delaying agencies!) or the snow may not be widespread: the menace of tricky road surfaces may be neutralised as the day wears on, though a return to difficult conditions when night falls is a possibility. These things are part of the pattern of the week-end aspect of winter cycling, which has so much to commend it to those of us who love a slight flavouring of adventure.

Sunday Record

IT is part of my normal practice to spend Sundays along the road, leaving home at about 10 a.m. and returning at about 8 p.m. During the morning I cycle anything from 20 to 35 miles. After a leisured lunch I do another 20 miles or so, and, following tea, I dispose of about a further score of miles. In such manner, with variations, I spent 42 of the 49 Sundays which "occurred" last year up to the beginning of December, when a veil of semi-darkness descended upon me and imposed a temporary stop on my every activity, excepting eating and sleeping.

My two longest Sunday journeys were one of 85 miles in mid-June and another of 84 miles in mid-November: my shortest Sunday journey was an evening jaunt of 40 miles at the end of a day devoted to walking and scrambling over hills. This last-named trip was one of five which yielded me less than 50 miles. The total mileage for those 42 Sundays was 2,732, giving an average of 65 miles per Sunday. That is my record for those specified Sundays of 1944. It is not a record in the other sense of the word—not by any means!—but is rather a plain tale of a year's Sunday travel which showed me the countryside in all its guises, and which afforded me a tremendous amount of pleasure, and infinite advantages. And at what a trivial cost!

Suspected

ACCORDING to a contemporary, Britain has one of the highest rainfalls in the world. We cyclists have long suspected this!

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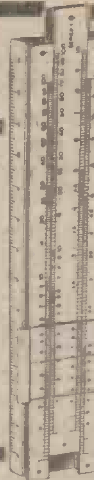

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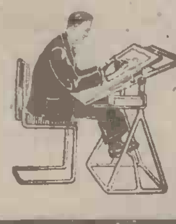

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