THE HELICOPTER

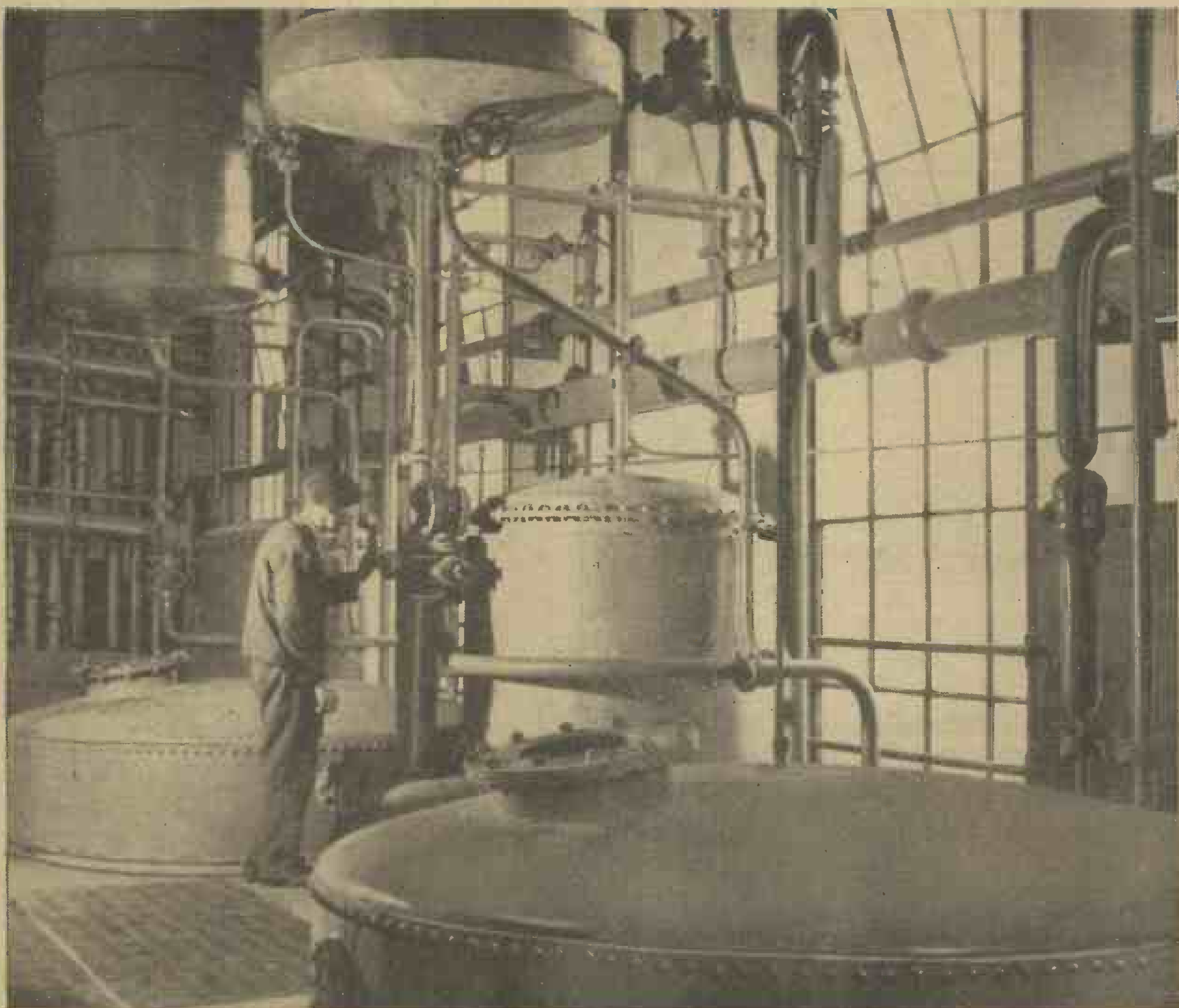
NEWNES

PRACTICAL MECHANICS

9D.

EDITOR: F. J. CAMM

JUNE 1946



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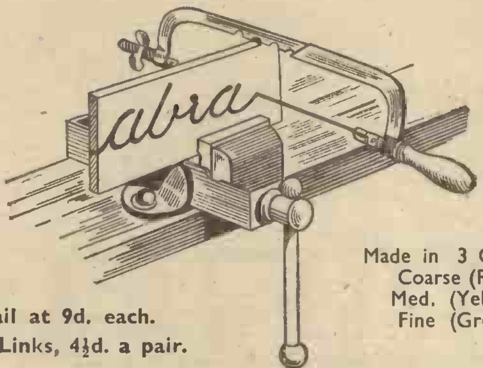

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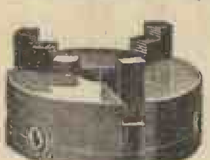

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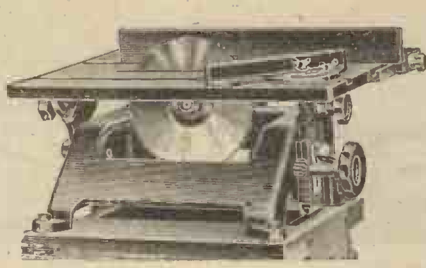

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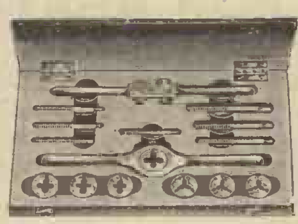

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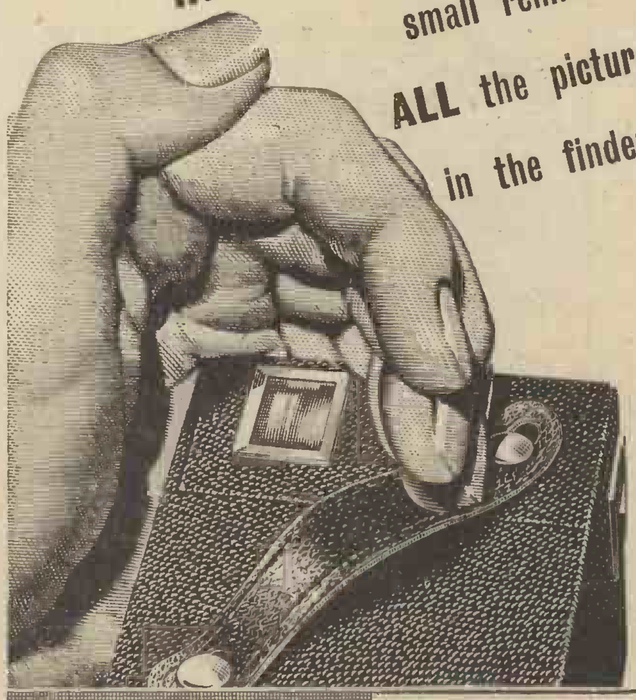

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor: F. J. CAMM

VOL. XIII JUNE, 1946 No. 153

FAIR COMMENT—BY THE EDITOR

Units and Standards

UNITS and standards were recently discussed at a meeting at the Royal Society. Members of the staff of the National Physical Laboratory, Department of Scientific and Industrial Research, contributed papers on the measurement of length, mass, temperature and electric quantities. Sir Charles Darwin was in the chair.

Length

MR. J. E. SEARS dealt with the standards of length in the British and metric systems, giving an account of their history and development, and describing present-day technique in their use. The current standards, the Imperial Standard Yard and the International Prototype Metre, are line-standards, the unit in each case being defined by the distance between a pair of fine graduation lines on the bar when the bar is at a prescribed temperature —62 deg F. for the Yard and 0 deg. C. for the Metre. The primary standards are compared with their copies in specially designed comparators fitted with micrometer microscopes; an accuracy of about 0.5 part per million is attained in comparing the British standards and about 0.2 part per million in comparing the metric standards which have rather better graduations. Discussing the stability of the primary standards, Mr. Sears said that since they were first determined in 1852, the British standards, which are bronze bars, have retained a relative constancy to within 0.00005in., but there was evidence suggesting that *all* the original bars may have shortened by about 0.0002in. since they were first made. It was of interest to note that two earlier British Standard Yards, those of Henry VII and Elizabeth, were still in existence at the South Kensington Museum and that they agreed with the current Standard to within 1/32 and 1/100in. respectively. The stability of the Metre Standards, which are of platinum-iridium, was very satisfactory; 20 of the national copies, namely copies held in various countries which participated in the founding of the international metric system of standards in 1875, when compared again in 1919 with the standards held at the Bureau International were found to be in agreement with their original values, obtained in 1889, to within ±0.001 mm.

The earlier standards, both British and Metric, were end-standards, the Yard or Metre being simply defined as the distance at the prescribed temperature between the terminal faces of the bars. The development of high quality microscopes enabled a better accuracy to be achieved by using graduation lines to define the unit; hence the change to line-standards. Improvement in the technique of manufacturing end-bars has, however, again altered the position. Such bars can now be made with their end-faces very accurately plane and parallel, and in this form they are extremely valuable in industry. Furthermore, the end-faces can be given a finish of such perfection that the bars can be measured in wave-lengths of light by direct interferometry.

The researches made into the measurement of length in terms of wave-lengths of light were mentioned by Mr. H. Barrell. Since the first historic determination of the length of the metre in terms of the red radiation of cadmium by Michelson and Benoit, eight separate determinations have been made. The results are in very good agreement and the latest researches at the N.P.L. and in Germany indicate that the metre can be independently established in the two countries on a wave-length basis with a precision of ±0.0003 mm., which is about 10 times the precision attainable through the current material standards. The technique of the wave-length work is now so well developed as to make it desirable to replace the red radiation of cadmium, which has been the approved standard for 50 years, by a still more monochromatic radiation; the advances recently made in separating isotopes bring within the bounds of possibility the construction of a source employing a single, even-number isotope of a heavy atom, e.g., mercury, excited at the temperature of liquid air. If such a source proves to be as ideal as expected, it should be possible to reach an accuracy of 1 part in 10^8 in establishing the metre or yard, through the agency of end-standards, in terms of wave-lengths of light. The idea of measuring length by reference to a natural standard has attracted scientific attention for more than a century; the practicability of doing so is now established and there is every indication that a selected wave-length of monochromatic light will be universally adopted in the near future as the fundamental standard for length measurement.

Mass

MR. F. A. GOULD dealt with the standards of mass in the British and metric systems. The fundamental British standard, the Imperial Standard Pound, is of platinum and takes the form of a cylinder with height approximately equal to diameter; the metric standard, the International Prototype Kilogramme, is of similar form, but is made of platinum-iridium. It is of interest to note that the earlier kilogramme standard, the Kilogramme des Archives, was originally defined by reference to the mass of the cubic decimetre of water, but the practical difficulties associated with this definition led to its abandonment and to the adoption instead of the material standard itself.

Standards of mass are compared by weighing them in a knife-edge balance, due allowance being made for buoyancy effects which are computed from a knowledge of the actual volumes of the standards and the air density during the weighings. It has always been possible to achieve a high order of accuracy in the comparison of masses by means of a knife-edge balance of good quality. In recent years, a further gain in accuracy has been realised at the N.P.L. by the use of a balance designed and constructed at the laboratory. This balance is installed in a closed vault and is operated by external controls. It has a number of special features, one important feature being the provision made so that a complete double-weighing can be conducted without separating the knife-edges from their bearing planes.

The evidence available as to the stability of the British standards is limited, but suggests that the Imperial Standard Pound decreased in mass in relation to its Parliamentary copies by about 1 part in 3½ million between 1846 and 1883, although subsequently it has remained constant to within 1 part in 10^7. The metric standards show a very satisfactory constancy, of the order 1 in 10^8. With regard to the choice of materials for constructing secondary standards and good quality analytical weights, Mr. Gould indicated that the choice is largely restricted to nickel-chromium, stainless steel (25 per cent. chromium, 20 per cent. nickel) and plated brass.

Electricity

THE Electrical Standards were discussed by Dr. L. Hartshorn, who described the methods used for establishing the theoretical units. The purely electrical comparisons of resistances, currents and potential differences can be fairly readily made to 1 part in 10^6, but the realisation of the corresponding units in terms of the fundamental quantities—mass, length and time—is a much more difficult task. In recent years, however, it has been shown that the theoretical ohm and ampere of the electro-magnetic system can be established to about 1 part in 10^5, and the present specified units, which are defined in terms of a mercury column (ohm) and the silver voltameter (ampere), will probably be superseded in the near future by the theoretical units.

To establish the theoretical units it is necessary to link the electrical quantities with the mechanical quantities through an apparatus which will satisfy the theoretical conditions and allow both quantities to be measured precisely.

The Helicopter—1

Its Early History and Development: The Helicopter of the Future.

By L. H. HAYWARD

A Sikorsky two-seater helicopter hovering to discharge a passenger.

FROM ancient legends and historical records it is apparent that man has always been envious of the power possessed by birds which enabled them to fly. A machine which is able to take off and land in small spaces, hover at will, and fly sideways or backwards, has ever been the problem before inventors and designers. Such a machine is the helicopter, which obtains its lifting power from a mechanically-driven rotor horizontally mounted on a vertical shaft. Fundamentally, the rotor acts like a very large propeller, but instead of pulling the machine forward as on orthodox aircraft it screws its way upward into the air. A more complete description of how the machine operates will be given later.

Possibly the ancient Chinese toy still being sold to-day was the inspiration for early helicopter pioneers. The toy consisted of a miniature propeller blade pushed up a threaded stick so that it rotated at high speed when coming off the end. The propeller continued to screw itself up in the air until its speed of rotation decreased and then it slowly windmilled down to the ground. In the fifteenth century the eminent Italian artist and scientist Leonardo da Vinci made drawings showing the principle of the helicopter and reports on his investigations into the effect of air upon rotating and flapping wings. Models which have been made from da Vinci's drawings may be seen in the Science Museum. Undoubtedly, inventors all over the world have made models of machines incorporating the helicopter principle of flight.

We in Great Britain should be proud that it was Sir George Cayley (1773-1857), the "Father of British Aeronautics," who is universally accredited with drawing up plans for the first full-size helicopter. Although the machine was never built a model of the design is reported to have made flights varying from 3 to 40 seconds. The model illustrated in Fig. 1 was built in 1843, and shows a steam engine installed in a hull-shaped fuselage mounted on four wheels, and is probably the first amphibian design to be produced. Two superimposed chain-driven eight-bladed rotors were mounted on either side of the fuselage, one pair turning in the opposite direction to the other so as to balance out torque on the machine. Two small four-bladed pusher type propellers were provided for forward flight.

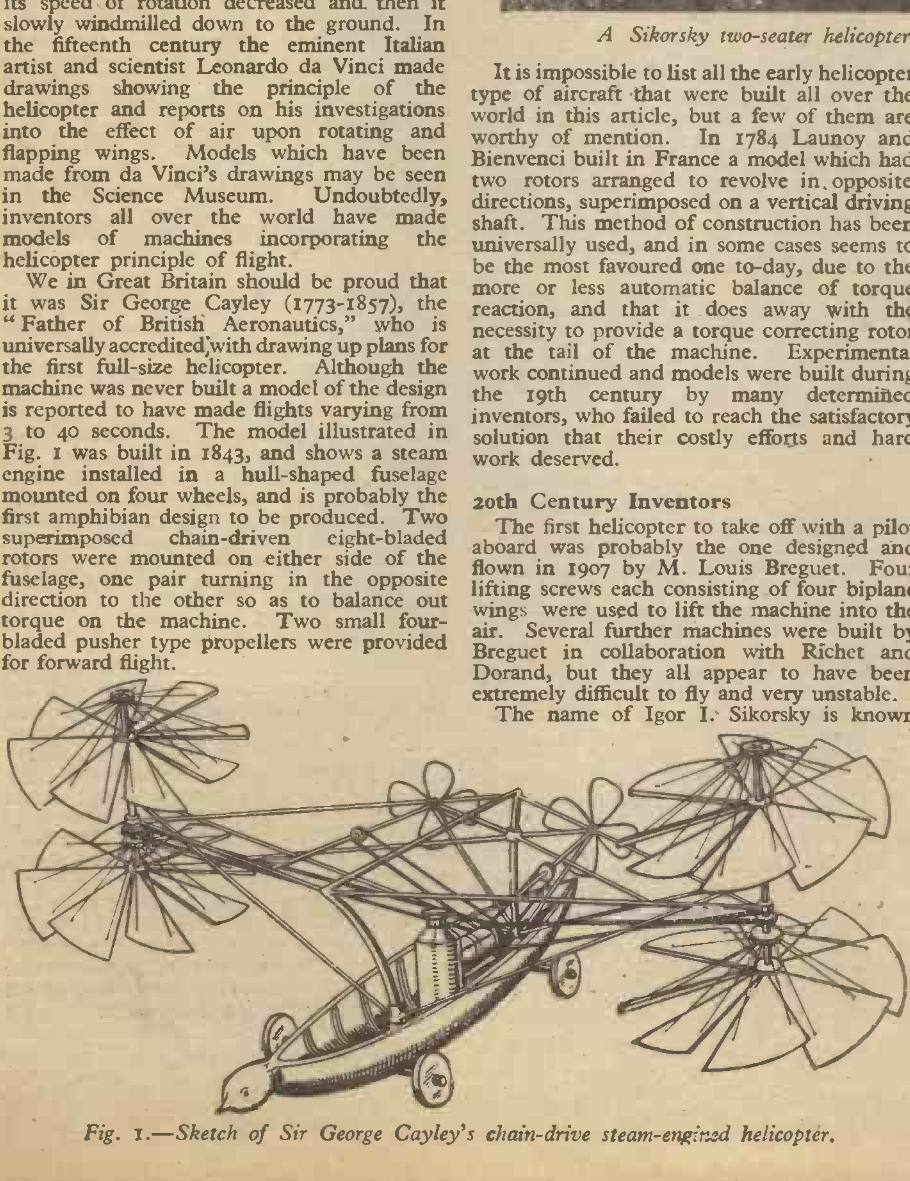


Fig. 1.—Sketch of Sir George Cayley's chain-drive steam-engined helicopter.

It is impossible to list all the early helicopter type of aircraft that were built all over the world in this article, but a few of them are worthy of mention. In 1784 Launoy and Bienvenci built in France a model which had two rotors arranged to revolve in opposite directions, superimposed on a vertical driving shaft. This method of construction has been universally used, and in some cases seems to be the most favoured one to-day, due to the more or less automatic balance of torque reaction, and that it does away with the necessity to provide a torque correcting rotor at the tail of the machine. Experimental work continued and models were built during the 19th century by many determined inventors, who failed to reach the satisfactory solution that their costly efforts and hard work deserved.

20th Century Inventors

The first helicopter to take off with a pilot aboard was probably the one designed and flown in 1907 by M. Louis Breguet. Four lifting screws each consisting of four biplane wings were used to lift the machine into the air. Several further machines were built by Breguet in collaboration with Richet and Dorand, but they all appear to have been extremely difficult to fly and very unstable.

The name of Igor I. Sikorsky is known wherever helicopters are flown, for he has become a leader in the modern race of development. More will be said about him later, but it is fitting that he should take his place in this brief chronological survey. Using a 25 h.p. Anzani engine to drive two contra-rotating rotors Sikorsky built his first machine in 1909, but it failed to leave the ground. He re-designed and lightened the aircraft, and in 1910 had the satisfaction of seeing it leave the ground.

An interesting attempt to overcome the torque effect of a machine with a single rotor is shown in Fig. 2. In 1925 an American, H. F. Pitcairn, proposed a helicopter with two rotor blades that automatically obtained torque reaction due to a portion of the air displaced by the rotor blades being forced through a number of adjustable vanes situated at the rear of the machine, just inside the circle swept by the rotor blades. The inclination of the vanes was adjustable by the pilot to produce the necessary anti-torque required in any condition of flight.

A helicopter that had four-bladed airscrews installed about one-third of the way along the leading edge of each of the four rotor blades was designed by M. B. Bleecker and developed by the Curtiss-Wright Aeronautical Company in America. The rotor blades, mounted on a common vertical shaft, were 47ft. 4in. in diameter, very wide at their roots, and tapering off sharply towards the tips. A structure hanging from the underside of each rotor blade carried a small auxiliary surface that could be operated as an aileron or elevator to aid in the control of the machine. A rudder at the rear of the fuselage provided directional control, and the machine, which weighed roughly 1½ tons, made several very short "hops" during 1930.

Only 16 years ago the altitude record for a helicopter was claimed by d'Ascanio, an Italian, who constructed a machine with four rotors mounted in pairs, and revolving in opposite directions on a common vertical shaft. This helicopter weighed approximately 17,650lb. and succeeded in reaching a height of 59ft. during a flight of 8½ minutes' duration.

At Brussels, on October 25th, 1933,

M. Nicholas Florine, a Russian born engineer who had acquired Belgian nationality, established a world-wide endurance record by hovering for 9 minutes 50 seconds at a distance of 18ft. from the ground. His machine was financed by the Belgian National Fund for Scientific Research and had a

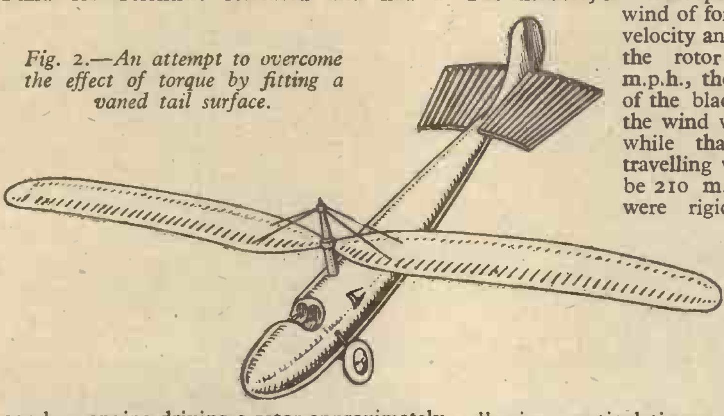


Fig. 2.—An attempt to overcome the effect of torque by fitting a vaned tail surface.

200 h.p. engine driving a rotor approximately 25ft. in diameter at the front and rear of the fuselage. A mechanism was provided that increased or decreased the angle of incidence of all the rotor blades by the same amount for ascending and descending, it increased the incidence angle of the blades moving with the wind, and decreased it for the blades moving against the wind for sideways movement. The angle of incidence of the blades of the front rotor was increased over that of the rear rotor for forward flight and that of the rear rotor over the front rotor for backward flight. Instead of the usual type of landing gear inflated footballs were fitted over the lower ends of four struts that served to support the helicopter on the ground.

A German—Professor H. Focke—built several models powered with half horse-power engines during 1932, and obtained very good results. A full-size machine which had a three-bladed rotor mounted on a structure each side of the fuselage was flown in June, 1937, and set up many world records. The Focke helicopter, known as the FW 61, flew in a straight line for ten miles, made a duration flight of one hour twenty minutes, averaged a speed of seventy-six miles per hour over a distance of twelve and a half miles, and reached a height of nearly eight thousand feet. A year later this machine performed the then amazing feat of flying on a dead straight course for a hundred and forty-three miles.

How it Flies

The power-driven rotor, which may be made up of any number of airfoil section blades, screws its way upward into the air and therefore lifts the machine. In the conventional type of aeroplane, the wings are of airfoil section—that is, they are of such a shape that when the aeroplane is pulled forward at increasing speed the flow of air over the wings produces the necessary forces to lift the machine into the air. By turning the rotor blades of a helicopter the flow of air passing over the airfoil section of its blades creates the necessary forces to lift the aircraft vertically into the air. The pitch or angle at which the rotor blades bite into the air can be manually adjusted by the pilot, or automatically adjusted so that the pitch of the blades is correct for all conditions of flight and the number of rotor revolutions per minute. If the helicopter rotor is revolving and the machine is stationary on the ground, the pilot will open the engine throttle and increase the power being delivered to the rotor. Centrifugal force and an increase in pitch will cause the blades to assume a new position, and the machine will ascend vertically. The blades are secured to the rotor hub by large hinges, which permit them to flap up and down and move backwards or forwards through predetermined ranges of movement. This is necessary to make the helicopter stable in flight, as when a rotor blade is coming forward into the wind it has a relatively higher speed than when it is travelling back with the wind. For instance, if a helicopter is hovering in a wind of forty miles per hour velocity and the tip speed of the rotor blades is 250 m.p.h., the relative tip speed of the blades advancing into the wind will be 290 m.p.h., while that of the blade travelling with the wind will be 210 m.p.h. If the blades were rigidly fixed to the rotor hub, the lift forces would be larger on one side of the machine than on the other and would result in very unstable aircraft. By allowing articulation or flapping and dragging of the blades, the lift forces are balanced throughout the area swept by the rotor.

Directional Propulsion

It has already been stated how the rotor blades provide the lift necessary to raise the helicopter vertically. It is the same blades which cause the aircraft to fly in any desired direction; in fact, the rotor provides lift, motion and directional propulsion. The lift developed by the rotor blades is in a vertical direction, and if the rotor assembly is tilted forward of its rotating axis part of the lift will be used to pull the helicopter forward. It is obvious then that the machine is capable of flying in any direction simply by tilting the rotor head in that direction and utilising a part of the total lift force for forward motion. Until the rotor head is tilted from a vertical position, the machine will hover in any position provided that the pitch of the blades and the power delivered by the engine to the rotor is correctly adjusted. Fig. 3 illustrates in diagrammatic form the various forces acting upon a helicopter under different conditions of flight, and shows how a column of air being pushed downwards supports the machine. Most designers appear to prefer tilting the entire rotor assembly so that the fuselage will remain horizontal, but machines have been produced—notably the Sikorsky designs—in which the entire machine is tilted in the desired direction of flight. In the event of engine failure the rotor blade assembly will automatically rotate as the machine glides down to land, and air will be flowing up through the rotor. A point which is not usually considered is that the rotor blades do not rotate in a perfect circle. Due to the flapping and drag allowed on each blade, they sweep an area during one complete revolution which has a perimeter like a very thin figure eight laid on its side.

Anti-torque Rotor

Most helicopters have a torque correcting rotor revolving in a vertical plane at the rear of the fuselage. This rotor serves two purposes—it prevents the fuselage of the machine revolving in an opposite direction to that of the main rotor, and also acts as a rudder so that the pilot can have directional control. If the main rotor is rotating clockwise, a mechanical force known as torque will turn the fuselage in the opposite direction of rotation. It is necessary, therefore, to prevent this happening by installing an anti-torque rotor that exerts a side pressure against the air to keep the machine on a straight course. The pitch of the blades of the anti-torque rotor may be adjusted by the pilot so that the torque is just balanced and the machine will fly on a straight course, or it may be adjusted so that the blades do not exert sufficient side pressure on the air to overcome torque, and in this case the machine will turn in the opposite direction to which the main rotor is revolving. If, on the other hand, the blades are adjusted so that they exert sufficient pressure to overcome the torque of the main rotor, the helicopter will turn in the same direction as the main rotor. It will be obvious from what has been said before that the anti-torque rotor does not play any part in the forward propulsion of a helicopter.

Single- and Twin-rotor Machines

It is not proposed to open an argument for or against the single- or twin-rotor types of helicopter, but to state the advantages and disadvantages of each type. For simplicity

Airmail history was made in the United States during the autumn of 1939 when the world's first regularly scheduled autogiro mail delivery service was inaugurated. The service operated between Camden Airport, New Jersey, and Philadelphia, Pennsylvania. The illustration shows one of the autogiros just after landing on the roof of the Philadelphia Post Office building.

of construction the single rotor offers the best solution, and, of course, it keeps down the weight of the machine. The big disadvantage of this type of helicopter is that approximately ten to fifteen per cent. of the engine power has to be transmitted through gearing and long shafts to drive the anti-torque rotor. Many methods of overcoming this loss of power are believed to be under consideration, including the utilisation of engine exhaust gases to provide a torque reacting thrust, a gyroscopic transmission system and jet-propelled rotor blades. The twin-rotor helicopter eliminates the necessity for an anti-torque rotor, as the two sets of blades rotate in opposite directions, and the torque is automatically balanced out. Increased weight and drag, the complication of controls and double the possibility of mechanical failure, are disadvantages that weigh heavily against this design. Furthermore, with concentric contra-rotating rotor blades, the efficiency of the lower set of blades is somewhat impaired, due to the slipstream from the top set of blades.

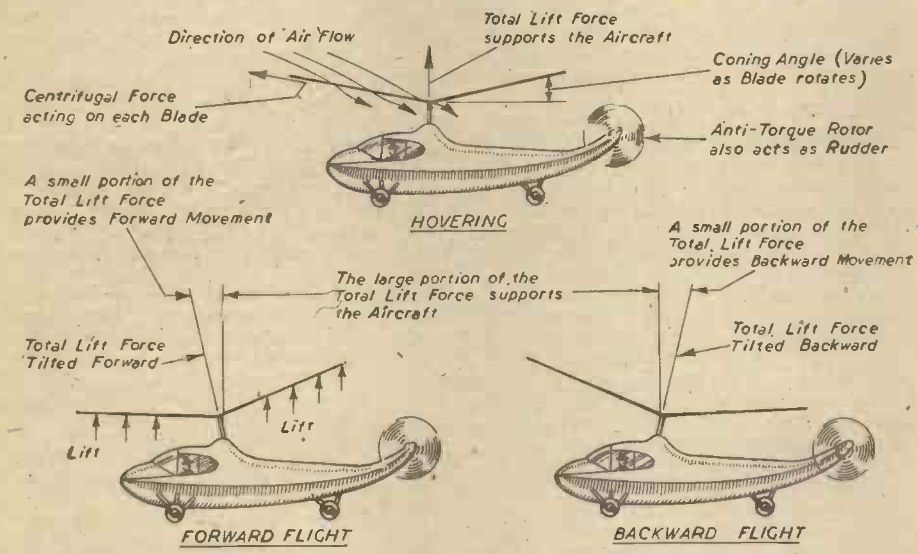


Fig. 3.—Diagram indicating various forces acting upon a helicopter under different conditions of flight.

Other rotor arrangements have been tried out; for instance a rotor supported on a structure each side of the fuselage and turning in opposite directions of rotation to balance out torque. With this arrangement the rotors may be clear of each other or they may intersect over the centre of the fuselage. Two rotors have been tried in tandem and again they may be entirely clear of each other or have a certain amount of overlap. This type of helicopter may have both rotors revolving in the same direction but inclined at different angles to each other or they may revolve in opposite directions. A large number of rotor configurations have been experimented with and it is hoped to describe these at a later date.

Reaction Driven Rotors

In 1920 R. P. Pescara, a citizen of the Argentine Republic, designed and patented a helicopter that had two jet-driven contra-rotating rotors superimposed on a single vertical shaft. The rotors were driven by gas jets issuing from the trailing edges of the rotor blades. A mechanism was provided that governed the pressure or volume of the escaping gas, so that unequal reactions could be balanced out and the machine could be directionally controlled. It is interesting to note that Pescara held over thirty British Patents appertaining to helicopters.

It is not strictly correct to speak of a jet-propelled helicopter, as in most designs which have appeared the gases are led up to the main rotor hub and through passages in the rotor blades to reaction type nozzles at the blade tips. The stream of escaping gas reacts to rotate the rotor which propels the machine in any desired direction, and as the force that causes the rotor to turn is reacting against the air the torque reaction between the rotor and the fuselage is eliminated. In a multi-bladed rotor it is not necessary that all the individual blades should be driven on the reaction principle. Three blades of a six-blade rotor may be driven blades and the other three could be rotated through a mechanical connection to the driven blades. As the driven blades would need to have a thicker cross section than the follower blades, an automatic pitch control between the two sets of blades would be necessary. In order that the rotor blades may articulate, and have pitch changes made as described earlier on, a gas tight joint and seal at the rotor hub is one of the problems that the designer of a jet-driven helicopter rotor must solve.

The reaction nozzles at the tips of the blades may be capable of being rotated in a vertical plane, so that the direction of flow of the escaping gas can be controlled through each revolution of the rotor to maintain the equilibrium of the helicopter. Furthermore, if the reaction nozzles are turned through 180 degrees it would have a braking effect on the rotor. A control should be provided for automatically balancing the lift of the rotor and capable of being manually adjusted by the pilot as and when necessary.

The exhaust gases of an ordinary reciprocating engine can be mixed with air that has become heated in cooling the engine, and then compressed by an auxiliary blower before being delivered to the reaction nozzles in the rotor blades. To provide torque correction for a mechanically driven rotor, the waste heat energy contained in the air used to cool an engine, exhaust manifolds and oil cooler, can be ducted so that it is connected to the engine exhaust gases and auxiliary air intakes in the fuselage before entering a compressor which delivers the air and gases to reaction nozzles in the rear of the fuselage.

General Construction

The fuselage of a helicopter may be of wooden or all metal construction and is usually quite orthodox in design. The capability of hovering makes this aircraft a most valuable aerial observatory, and large perspex cockpit covers are always provided. Emergency stretchers enclosed in light metal containers can usually be attached to the sides of the fuselage for evacuating and transporting the wounded or sick.

Rotor blades may be all metal, wood and metal or all wooden with a fabric covering. They may be hollow shells that twist about a main spar or a solid blade that twists at the root. A certain degree of flexibility in the blades is essential so that the centrifugal and lift forces can be balanced out, and to allow for droop when the rotor is stationary.

Various types of undercarriage and landing equipment may be fitted—wheels, skids, floats, skis and inflated bags have all been tried. Castoring types of landing gear equipment, able to be locked for towing purposes, have considerable advantages for ground handling a machine in confined spaces. Brakes are not usually provided as power travel along the ground is not required.

Power from the engine is transmitted to the rotors in many different ways, and it is hoped to describe some of the more interesting transmission systems at a later date.

Sikorsky Helicopters

The only helicopters to take an active part in the war of 1939-1945 were designed and produced by Sikorsky in the United States of America. These aircraft had a single three-bladed lifting rotor, and a three-bladed torque correction rotor. The entire machine is tilted in the direction of flight. Sikorsky helicopters saw active service in India, and during the invasion of Burma a large number of injured troops were successfully evacuated from almost inaccessible places behind the Japanese lines. Anti-submarine patrol was an easy task for a machine able to hover in the same place for a considerable time, and the depth charges which were attached to both sides of the fuselage were dropped with deadly accuracy. A Sikorsky machine was the first helicopter to land on and take off from the deck of an ordinary cargo ship.

The Uses of the Helicopter

In addition to the needs of business executives and private owners, the helicopter has the widest range of usefulness that any flying machine possesses. It can fly forwards, backwards, sideways, straight up, straight down, hover at will, land and take-off in confined spaces, and is able to fly when the weather conditions would keep an orthodox aircraft grounded. Commercial adaptations are numerous, and include pipe line and overhead cable inspection, cable laying overland or at sea, forest fire control, traffic control, deliveries of urgent mail and goods from large department stores, geological survey where the nature of the ground makes approach difficult or impossible on foot, hospital emergency service, crop dusting, disaster and flood relief and inter town and airport passenger services. The excellent work that an American helicopter did in rescuing survivors from a distressed ship has been told in the daily press, and seen on news reel films in this country. An American company has declared its intention of using helicopters for transporting the general public between large towns, and a large airline concern is seeking official approval of its scheme to provide an airport to town helicopter taxi service.

Constructors

Several British firms are reported to be designing helicopters, and it will be interesting to watch the trend of development in this country. It is believed that Messrs. G. & J. Weir, Ltd., The Bristol Aeroplane Co., Ltd., and The Fairey Aviation Co., all intend to build general-purpose, two- to six-seat machines in the near future. In addition to Sikorsky, a large number of American concerns have been concentrating on helicopter design and production—Bell Aviation, Bendix Helicopter Inc., Hartwig Aircraft Corp., Higgins Industries Inc., Piasecki, and Landgraf being some of the more well known.

The Helicopter of the Future

It is difficult to forecast how the helicopter will be developed during the next ten years, but it is certain that the essential features of controllability, safety and a high degree of efficiency which must be built into any aircraft to make it a commercial proposition are being carefully considered. The mass-produced, low-priced machine will only become available after a long and intensive development programme has been carried out by manufacturers in general, and it seems reasonable to suppose that industrial and commercial undertakings will absorb a large percentage of the helicopters produced in the next three or four years. Their requirements will probably be a general-purpose machine, capable of landing in very confined spaces, and enabling executive staff to be transported quickly and safely in any weather conditions for business purposes. The cruising speed will probably advance to around one hundred and twenty-five to one hundred and fifty miles per hour, and the maximum speed is expected to be approximately twenty to thirty miles per hour in excess of this speed.

Development will bring about fuel economy both in the reciprocating engined helicopter and the jet-driven types of machine. Controls must be simplified—the engine oil cooler shutters should be thermostatically controlled, and one single control column should govern the engine air intake, speed of the main rotor, the inclination of the rotor assembly from the horizontal, the pitch of the rotor blades and at the same time obtain automatic control of the anti-torque rotor. The rotor clutch control and free-wheeling device should also be incorporated in the single control column, and if possible the clutch should be automatically operated so that the lifting rotor revolves only after the engine has attained a predetermined number of revolutions and power output. Weight must be kept down to a minimum, but at the same time it will probably be necessary to provide general radio equipment, sound-proofed heated cabins, adjustable seats, rotor blade and windscreen de-icing equipment, and quickly-interchangeable landing gear so that a machine may alight on water, mud, snow, ice, sand or land.

Folding rotors should be an optional feature, as many private owners would possibly be deterred from purchasing a helicopter that required a large storage space. Incidentally, this must be accomplished in such a way that it is not necessary to have a Government A.I.D. inspector to pass the aircraft for flight each time the rotor blades are unfolded. Retractable landing gear may be provided, but the additional complication and expense hardly justifies the increase in speed and improved manœuvrability that would be attained. Jet-actuated helicopters will be developed, and it is expected that machines with rotors driven on the reaction principle, and a propulsive jet in the rear of the fuselage, will soon make an appearance.

When the helicopter eventually replaces the automobile, as it most surely will, an efficient and comprehensive service and spares organisation will be a deciding factor in the selling power of a machine. It will be imperative that spare parts are available quickly and easily, and repair personnel must be capable of flying and testing machines. Many products to-day have a limited appeal to the public in general through badly organised service departments, and it will not do to make helicopters available to large numbers of people until repair organisations are ready to deal with every eventuality at very short notice. It is the writer's belief that this is one of the main factors which will decide the success of a manufacturer's product. If it should be found to be possible to swing the main rotor to an approximately vertical plane, and be able to fly on it, the helicopter would become the fastest and safest aircraft in the world.

The autogiro, invented by Don Juan de la Cierva. This machine was the forerunner of the helicopter, but unlike the latter machine it cannot hover, as the rotor is not power-driven. Our illustration shows a "Direct Control" autogiro ready for a demonstration flight at the London Air Park, Hanworth, Middlesex, in April, 1933.

Stratosphere Rocket Tests

THE British Interplanetary Society have recently released details of a test rocket, to be followed by a 15ft. rocket intended to reach a height of 100 miles—nearly twice the height reached by a German V2.

It is planned that both rockets shall radio to earth reports of meteorological and other conditions encountered. Both are to descend to earth by parachute, and the reports will be submitted to scientific institutions. The duralumin test rocket, 6ft. 2in. tall, is to use kerosene instead of the alcohol fuel of the V2. Its target will be 60,000ft., but it will be fired merely to test construction and general design. Opportunity will be taken to try out the short-wave radio-reporting apparatus, which the designers are confident will withstand the initial "take-off." The cost of the first rocket will probably be only a few hundred pounds, but the full-size edition will cost about £15,000.

Sherman Tank Carried in a Bag

MANY strange devices to deceive the enemy were produced at the Camouflage Development and Training Centre during the war. One of the most successful was the mimic Sherman tank that can be inflated like a barrage balloon.

Twelve men and three trucks can, within half an hour, erect 360 tanks, carry them into position and draw the enemy fire from the real armament. When deflated these mock Shermans can be packed in a valise little larger than a cricket bag. They weigh only 170lb. against the 35 tons of the real article, and can be pumped up by a tiny and easily-carried petrol motor.

The dummy tanks were used with great success in the fighting in the Middle East, in Italy and in Germany, and were designed to deceive the enemy at a distance as short as 500 yards.

Our illustration shows how four men can easily place one of these dummy tanks into battle position.

A Spanish-Hawaiian Guitar—2

The Finger-board, Nut and Pegs

By "HOBBYIST"

(*Continued from page 274, May issue*)

In last month's issue construction of the main bodywork of the instrument was covered. To complete the construction, the finger-board, nut and pegs have to be made and fitted.

The finger-board, shown in Fig. 7, is cut from, preferably, $\frac{1}{8}$in. thick walnut (or mahogany) fretwood. Plywood could be used as an alternative.

Prior to tapering the sides of the wood, the fret positions must be carefully set out with pencil and set-square to the dimensions shown. A great deal depends on the fret positions being accurately marked out. No matter how neatly made and finished, the instrument will be practically worthless if some of the frets are out of true. Being out of true, obviously, the notes will be out of tune.

Therefore, take special care when marking the positions of the frets. The writer used a small metal set-square and a sharp-pointed, hard pencil. He then scribed the lines with the tip of a penknife, using the same set-square as a guide. A tiny V-groove was then made with the corner of a chisel at one side of each score to make a "rut" for the teeth of a small tenon saw. Cuts were made to a depth of 1/16in., following which the finger-board was shaped at the bottom end with a fretsaw and the sides planed to taper towards the top end, the wood being supported on a shooting-board.

Fitting the Spots

The prepared finger-board is glued on the surface of the handle, level with the neck joint, then bound with fine twine to hold it down until the glue sets. It will be noticed that the bottom end of the finger-board extends over the front of the body a short distance; this helps to make the shoulder joint stronger, so see that the finger-board is well glued down upon the front.

The inlaid spots on the finger-board of most stringed musical instruments are not there merely for ornamentation. The spots mark certain octave positions, and four of these spots are needed upon the guitar finger-board.

The spots are $\frac{3}{8}$in. discs of mother-o'-pearl or white celluloid, such as Ivorine. Having neither mother-o'-pearl nor a piece of white celluloid, the writer searched around the house and found four $\frac{3}{8}$in. diam. light-coloured blouse buttons, these having a threading "eye" at the back.

It is only necessary to bore $\frac{3}{8}$in. diam. holes for these buttons in the finger-board, using a $\frac{3}{8}$in. dowel bit, and press the buttons in firmly with a spot of glue to secure them to the wood. The buttons, light brown in colour, showed up well on the light walnut polished finger-board.

However, if you have a suitable piece of walnut or mahogany fretwood for making the finger-board and white celluloid for the spots, there will be no necessity for polishing the surface of the finger-board. This is only necessary if you have resorted to birch plywood, the polish darkening it to a light walnut shade.

The view at Fig. 8 shows how the spots are fitted. When glued into their recesses, the surface of the finger-board is glasspapered smooth, this helping to level the spots.

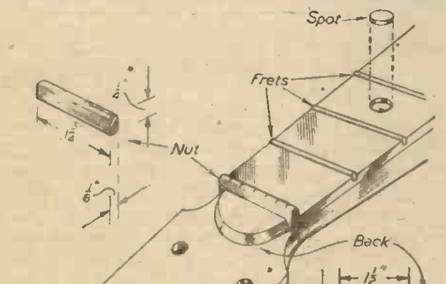


Fig. 8.—How the nut is fitted in place.

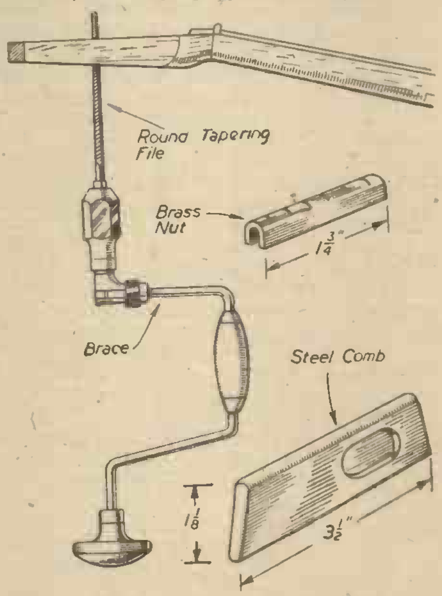


Fig. 9.—How to taper the holes for pegs.

The Nuts and Frets

The nut is made from a piece of hardwood, bone, comb or celluloid $1\frac{3}{4}$in. long by $\frac{1}{4}$in. wide by $\frac{1}{8}$in. thick. The top edge is rounded over, then divided for six string grooves, the latter being made with a triangular file. The nut fits upright, close against the end of the finger-board, as shown at Fig. 8.

It will be necessary to bevel the underside edge to suit the angle of the head. The nut is then "backed" with a semi-circular piece of wood which is glued behind it, as detailed. The string grooves on the nut should be about $\frac{1}{4}$in. apart—not less—otherwise the strings will be too close together for the fingers. Allow for the thickness of the heavier bass strings.

The frets, since proper fret wire is rather scarce, can be made from 1/16in. sheet brass, cutting off strips $\frac{1}{8}$in. wide. The strips should be a force fit in the fret saw cuts. Tap them in with a light hammer, i.e., when cut to length, applying a trace of glue to the saw cuts beforehand.

View showing the finger-board.

When all the frets have been embedded, level off the tops with a flat file. It is essential that the frets sit up all level with each other, so test with a straight-edged piece of wood. The frets should sit up about 1/16in. high.

To partly round over the top, go over the frets with a piece of folded emery cloth. The ends of the frets will need to be filed flush with the sides of the finger-board. Remove the sharpness from the top corners of the frets with the file, as any sharpness there is liable to tear the skin of the hand.

The Pegs

The pegs are first cut to shape from $\frac{3}{8}$in. hardwood, such as birch, the size and shape being provided at Fig. 7. The stems are pared and rounded, then the finger-grips shaped, as shown. Small holes for the strings are bored in the stems about $\frac{1}{8}$in. from the top. The stems taper from $\frac{1}{4}$in. to 5/16in. at the grips. If you possess a wood-turning lathe, the pegs can be made with a minimum of bother, using lengths of 1in. diam. dowelling, the grips being turned as a 1in. diam. ball, then pared flat, as shown.

Now it is a wrong thing to merely bore $\frac{1}{4}$in. holes for the pegs in the handle head and force the pegs into them. Such holes, being straight, spoil the taper on the peg stems, with the result that the pegs keep slipping, and it soon becomes almost impossible to have them forced in properly.

To prevent much of the trouble arising, the peg holes must be bored to a taper suiting the peg stems. This is best done by means of a tapering round file of adequate diameter, its tang being fitted in the chuck of a hand brace, as shown at Fig. 9.

The round file is the best implement to use, as reamers are likely to "ruffle" the walls of the holes rather badly. When the holes are filed, the rims should be lightly chamfered with a rose-head countersink bit at both sides.

Close-up of the instrument, showing the simple design on the front.

A Decorative Design

When the entire work has been smoothly glasspapered and all nail heads filed flush (meaning the heads of the gimp pins used for holding the body posts in position), the back and front of the body should be rubbed with a soft cloth bearing a trace of lino paste or cream. The latter makes the wood waterproof, so that it can be "lined" with black drawing ink and a simple decorative design drawn on, as seen in the illustration.

The black lines bordering the edges of the body back and front, including the sound hole, help to hide the nail heads. You cannot punch the nail heads for concealing with a wax cement or plastic wood. If this is attempted, one runs the risk of opening some of the joints in the side strips.

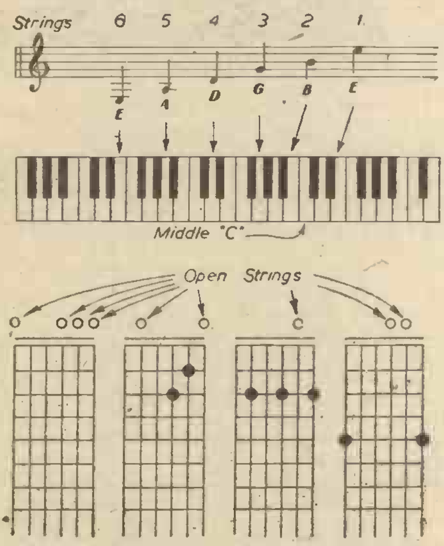


Fig. 11.—Spanish guitar tuning, and a few simple chord charts.

Applying the Finish

Having lined and decorated the work, the next step is its finish. All you need is a bottle of thin, light walnut french polish, a saucer and an old shaving brush, the latter serving as a polisher's mop if such a thing is not available.

Now, the thinner the polish, the better the finish, for the polish can be more evenly distributed with the brush. If a thick polish is used, a "skin" will form and the finish is rather uneven and streaky, for it must be remembered that the polish is being used to *stain* as well as *polish* the wood.

Shellac polish is thinned out by its solvent, which is, of course, methylated spirits. On no account, however, have the polish a "watery" nature. It will, as a result, have a poor base, and quite a number of applications will be necessary before the polish begins to produce a sheen on the wood.

Shake the bottle, pour a quantity of polish into the plate or saucer, load the brush and carefully apply the polish to the wood, working with the grain in long, gentle, even sweeps. No polish should be brushed on the walnut or mahogany finger-board. If the latter has been made from birch ply-wood, a couple of coats of the polish will suffice.

The body, handle and head are given two applications as a base. When dry, the surface is rubbed lightly with a fine grade of glasspaper, then dusted, and a third coat applied. When this dries, apply a fourth, finishing coat. If the polish is still dull, rub down again lightly and apply two more thin coats. Avoid an overloaded brush, by the way, as the polish is liable to run down the sides of the work in places where the brush becomes scraped at the edges.

While the pegs and bridge could be polished to match the rest of the work, you might prefer to ebonise them. One way is to apply black ink to the wood and apply a couple of coats of the light walnut polish. The proper way is to make up a small quantity of black polish (by adding lamp black powder stain to the light walnut polish) and apply it with the brush.

Fitting the Strings

You now need a set of steel guitar strings, same consisting of an E-string, B-string, G-string, D-string, A-string and a bass E-string, the latter being thicker than the others. Each string is supplied in a cellophane envelope, correctly marked to avoid any confusion.

The first string (E) is attached first. Insert it through the hole provided in the bridge and draw it through until its "bobbin" comes up against the bridge. Bring the string over the bridge and nut and thread it through the nearest peg; nip off any unnecessary surplus, allowing sufficient length for winding around the peg stem.

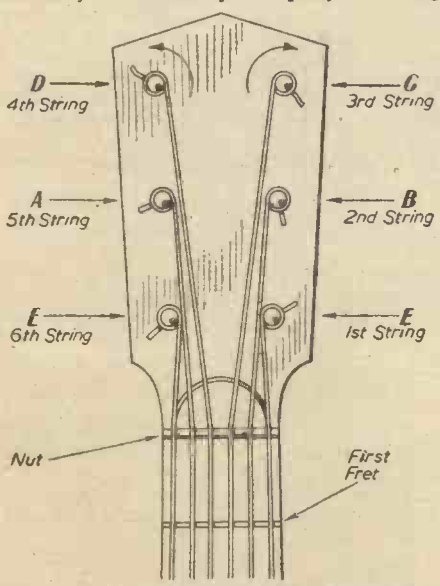


Fig. 10.—Correct order of the strings on their pegs.

The other five strings are attached similarly, in the order shown at Fig. 10. Note the winding direction of the pegs at each side of the head (see arrows).

Spanish Guitar Tuning

The strings for Spanish guitar playing are tuned as shown at Fig. 11. Part of a piano keyboard is shown to simplify matters, middle "C" being near the lid lock.

Commence tuning with the first string, then the second string, and so on until all six strings are tuned. By the time you have the sixth string tuned the others may (due to the amount of strain set up) require re-tuning again. This is usual when an instrument is being tuned for the first time.

When tuned, you can try playing some of the chords shown. The black dots represent the pads of your fingers. The dots are shown on the frets, but your finger pads should be placed a little behind the frets concerned.

Only four strings are struck for each chord. The first chord (on the right) consists of four "open" strings, which are indicated by a small white circle at the top of the nut. A chord is obtained by plucking these particular strings.

Hawaiian Guitar Tuning

To convert the instrument for playing Hawaiian music you need a special metal nut and a steel comb (see Fig. 9). The nut is made from a strip of brass. It is bent to fit over the fixed nut, notches for the strings being filed at the top.

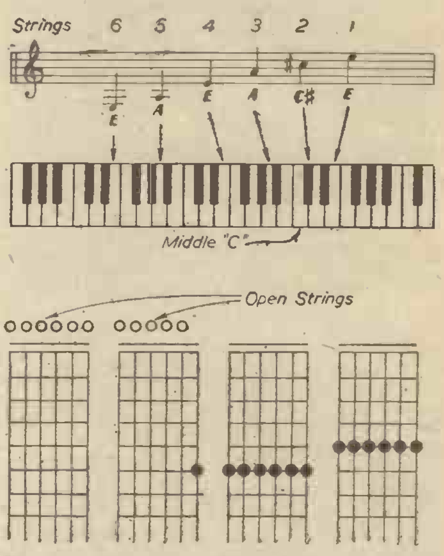


Fig. 12.—Hawaiian tuning, and a few simple chord charts.

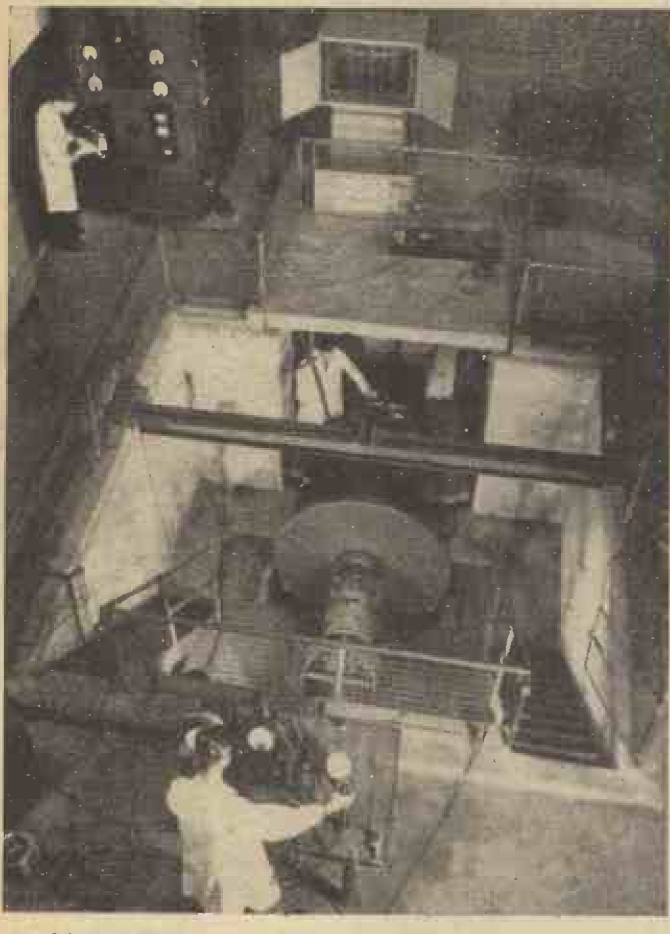
The strings are tuned to E, C-sharp, A, E, A and E on a piano, as shown at Fig. 12. Chords are obtained by placing the smooth-edged steel comb across the six strings and sliding it along, using a gentle pressure, meanwhile running your thumb (or a plectrum) across the strings. A few of the easy chord charts are illustrated.

Books on Guitar Playing

Books on Spanish guitar and Hawaiian guitar playing are obtainable in most music shops, the "First Step" series (published by Keith Prowse and Co.) being popular with beginners. A. F. Cramer deals with the subject of Spanish guitar playing in a simple, understandable way, and Lew Stern (the man of many instruments) certainly knows his Hawaiian guitar.

The "Squat" Tyre

Solving Aeroplane Streamlining Problems



Brake testing apparatus as used for squat tyres at the Foleshill Rim and Wheel Works.

A CONTRIBUTION to solving aeroplane streamlining problems is made by a new type of landing wheel and tyre which has just been demonstrated at Honiley aerodrome by the Dunlop Rubber Company, who have now brought the equipment to an advanced experimental stage.

The tyre and wheel can be tucked away without a bulge into the comparatively narrow wing section of the modern aeroplane. This fact would have added 10 m.p.h. to the speed of Lancaster bombers had the tyre been in use during the war.

Another advantage is that the "Squat" saves weight—on a new transport plane 300lb., or as much as one average passenger with average load of luggage.

The third advantage is that the increased braking power gives the shortest landing run on record for a heavy aircraft.

The tyre is known as the "Compacta" tyre (or often the "Squat") and has the particular feature of being of much smaller diameter than any other normal tyre of equivalent pressure and capacity previously produced.

With the modern aircraft the wing section is extremely thin, and owing to its high wing loading has its spars comparatively close together. The modern engine, too, is of small frontal area and the nacelle section is of shallow depth. The diameter of the standard tyre, even at modern high pressures, may still be too great to allow the tyre to be retracted into the wing without requiring the nacelle section to be bulged to enclose it completely. In some cases, the normal tyre will just not fit between the wing spars in their optimum positions.

"Wheelless Low Pressure" Type

A modern tyre of normal construction at 90lb./sq.in. pressure has a diameter/width ratio of above 3:25. Tyres of smaller diameter/width ratio have been produced in the past in the so-called "wheelless low pressure" type used principally for tail wheels; a diameter/width ratio of 2:5 is common for this type. These tyres, however, do not permit a reasonable size of wheel to be used and adequate braking is virtually impossible. One solution to the problem is to use twin tyres mounted either side of a single leg undercarriage, and this solution is attractive in many instances. Since the load carried by a tyre, other factors being equal, is proportional to (diameter)^2, the use of twin tyres reduces the diameter of the tyres by some 30 per cent.

In some undercarriage layouts, however, a single leg undercarriage is not desirable and a single wheel carried in a twin leg frame undercarriage is preferred. In other cases, even the twin tyres on a single leg may be too large in diameter.

The new tyre will provide the only answer to the problem on many new aeroplane designs because by adopting a special form of construction, the tyre is of extremely small diameter, and has a diameter/width ratio of less than 2. The flat crown space, which can be clearly seen in the illustration, is obtained by constraining the crown and preventing it extending to its natural toroidal shape. It is thus possible to offer a tyre of considerable width without the attendant disadvantage of large diameter occurring with a normal tyre.

Technical Features of the Compacta Tyre

Pressure.—The Compacta tyre, for the initial experiments, has been designed to operate at 90lb. sq. in. and all development work has been carried out at this pressure. Tyre life has been proved to be adequate and compares favourably with a normal tyre at this pressure.

Weight.—The tyre and wheel is lighter than a single tyre and wheel, but not so light as twin tyres and wheels all at the same pressure. The weight of the undercarriage must be added to that of the wheel and tyre when making a comparison, and it is certain that the undercarriage for a Compacta tyre, owing to the reduced rolling radius as compared with a single tyre, and elimination of offsets as compared with twin, will be the lightest of the three.

Wheel Size.—It has been designed with an adequate size of wheel, and braking capacity is not impaired. Tyre creep difficulties with the small wheel sizes on a "fat" tyre of normal construction are obviated.

Deflection Characteristics.—An important factor in the design of the new tyre is that it becomes fully deflected at about 2.5 times the static load (i.e., λ equals 2.5). The normal tyre has λ equals 3.0 approximately and yet many large undercarriages are only designed to give a factor of 2 or 2.5 the static load. The new tyre, therefore, is designed to suit the modern undercarriage of the large aircraft for which the tyre is most suitable, and wasted deflection capacity (and consequently weight) is eliminated. On the other hand, the tyre is obviously unsuited to high reaction fighter undercarriages.

Rolling Radius.—The reduced rolling radius of the Compacta as compared with the normal tyre has the minor advantage of increasing brake power for a given torque, and the considerable advantage in reducing the movement of the drag and side loads applied to the ground to the undercarriage moving assembly. The nearer these loads are applied to the axle the lighter will the leg be. In the case of low-built aircraft, the lowering of the axle will permit of a more reasonable undercarriage length in many cases.

Tyre Inertia.—The moment of inertia of the tyre and wheel is reduced as compared with a normal tyre and this reduces acceleration loads on the tyre and undercarriage during spinning up on landing.

A heavy bomber, the Lancaster, fitted with the "Squat" tyre.

The Mechanics of Meteorology—6

Weather Forecasting : Radio Sonde : British Forecast Districts

By G. A. T. BURDETT

(Continued from page 249, April issue.)

ALL fundamentals examined in the previous issues lead up to one thing —that is, the weather forecast.

A forecast is normally made for a period of 24 to 36 hours, but in special circumstances it may be as much as five days ahead. In the British Isles this period is rare, owing to such changeable weather, and occurs only when an anticyclone is stationed over an area. (Fig. 42.)

It is desirable to know the weather at a particular place at a specified time for the purpose of arranging a flight by air, a trip by sea, or even an excursion visit to the seaside or river. Such forecasts used by aviators are termed route forecasts, and are made practically each time a flight of any appreciable distance, viz., more than 50 miles, or less in some cases, is made.

Hurricanes fly as high as 30,000ft. on upper-air observations, and the illustration shows one of them at work against a marvellous skyscape of rolling sunlit cumulus clouds.

Historical Weather Forecast

A forecast which may be considered as one of the most important in history, since it has transpired that history has certainly been made by its application by the relative authorities, is the forecast which was provided to the allied commanders on the eve of D-day before the invasion of the Continent on the coast of Normandy in June, 1944. This is given below as taken from a subsequent copy of *The Times*.

"Regular daily meteorological conferences by telephone were in operation two months before the provisional D-day (Monday, June 5th) and advisers attended the meetings of the Supreme Command . . . When the Commanders' final series of meetings began on Thursday, June 1st, the first indication was given that the conditions in the Channel on the Monday were unlikely to meet even the minimum requirements for beach landings because of the high winds, nor were those for airborne and heavy bomber operations on account of overcast skies with low clouds. In the early hours of Sunday morning the Supreme Commander postponed the biggest operation in history on a day-to-day basis. Late in the evening of Sunday there was fairly strong evidence that after a stormy Monday there would be a temporary improvement on Tuesday. But now the weather in the Atlantic was more like mid-Winter than early June. Any improvement on Tuesday would be short lived. . . .

"Examination of the likely weather for Wednesday night and Thursday was not reassuring, and beyond that postponement would probably have to be made for a fortnight to the next set of convenient tides. At a full meeting of the Supreme Commander and his staff late on Sunday morning his meteorological advisers presented the historical forecast.

Fig. 40.—A small parachute is tied below the balloon which expands as it rises into the rarefied upper air. In the stratosphere, at a height of ten miles or more, the balloon bursts, and the apparatus floats down on the parachute.

"An interval of fair conditions will spread throughout the Channel area on Monday and will last until at least dawn on Tuesday, June 6th. Winds will fall to force 3 or 4 on the Normandy coasts and cloud will be well broken with a base height of 3,000 ft. After that interval it will become cloudy or overcast again during Tuesday afternoon. Then, following a brief fair interval on Tuesday night or early Wednesday, conditions will continue variable with intermediate periods of overcast skies and fresh winds until Friday. Beyond that it is not practicable to go with any useful confidence.

"Shortly afterwards the Supreme Commander said that he had provisionally decided that the invasion should go forward on Tuesday morning. . . . On the morning of the assault the wind had moderated and the cloud was not only well broken, but its base was at least 4,000 ft. high ideally suited for the large-scale airborne operations. In the hour preceding the landings, when perfect conditions for pin point bombing were so essential, there were large areas of temporarily clear sky, and throughout the critical time medium and light bombers were unhampered."

Similar forecasts were made at specific periods each day during the whole period of the European war. Oft times Bomber Command operations were cancelled upon the advice of meteorological experts, while on other occasions operations were laid on and targets decided at short notice when the meteorologists considered there were good reasons to suppose that the weather would improve. Upon other occasions fighter sweeps were made when advantage could be taken of cloud cover.

During bombing operations a number of factors had to be considered. The weather over home bases at the time of the take-off; weather along the route and the state of the sky over the target area. Although bombing operations were continued with the aid of instruments when 10/10 cloud prevailed, since the introduction of the Master bomber best results were obtained with clear sky which allowed the Master bomber to descend to low level to assess the bombing and issue further orders.

Weather on the return was another important factor. If the meteorologists forecast the development of considerable low stratus cloud over widespread areas in Great Britain at the time when the aircraft were due to return, operations might have to be cancelled unless there were sufficient bases where the weather was fit for landing the large forces of aircraft.

Fig. 41.—The radio sonde ready for release.

With the expected development during the post-war years of civil aviation, meteorological forecasting will become of increasing importance, no less than during the time of war.

The Weather Map

No accurate forecast of weather can be made unless the forecaster has before him maps or synoptic charts showing what weather has passed over during the past few hours or even days. He must therefore be fully conversant with all changes in the pressure system over a wide area. If he has followed the passage of a depression from the Atlantic, he will know when it nears the coast of the British Isles, the time of its arrival, its speed and the approximate area where it will pass over and whether it will be fully developed or will be in an occluded state. No forecaster can compile a weather map solely from his own observations. A large number of observations must be made simultaneously at different points throughout the world. The greater the number of simultaneous observations made the more accurate is the forecast likely to be.

Before the war there were approximately 600 observing stations in Europe and Western Russia, each of which made one or more reports daily to its central office.

The times of the observations were fixed by international agreement, the four principal times of which were 1 a.m., 7 a.m., 1 p.m., and 6 p.m., by Greenwich Mean Time. Not every station made observations at all these times. At each time a fairly representative picture was obtained. In short, then, close co-operation of a large body of observers is the essential feature of forecasting. Speed of transmission of the observations made is also of primary importance, particularly in the British Isles where weather changes occur very rapidly. For instance, thunderstorms and gales may spring up very quickly and are likely to cause extensive damage and loss of life if the public are not notified of their imminence in time to do something about it. A forecast may be made and a current synoptic chart may be published but shortly afterwards this may have to be amended in the light of information received from an isolated meteorological station or a ship out at sea.

Often warning in the late spring and early autumn may save a considerable amount of crops. Where electricity authorities are notified of approaching thundery weather, precautions may be taken to avoid breakdowns with their resulting inconvenience, loss of revenue, and even loss of milk and its by-products, and hatching chickens where electrically operated incubators are used. It is emphasised, however, that the key to forecasting is the intelligent interpretation of the current synoptic chart. The best meteorologist can do little without this and their closer study when they are again published daily in the press is recommended to all.

Factors Which Are Observed

At the hours mentioned above an observer at a meteorological station takes note of the following:

(1) State of the sky, the type of cloud and its amount in tenths.
(2) Whether it is raining or snowing.
(3) Visibility.
(4) Direction and strength of wind.
(5) The air temperature; this from the dry bulb in the Stevenson screen.
(6) The amount of rainfall in inches; this from the rain gauge.
(7) Barograph and barometer.

Each of these observations is then converted into an international code and sent to the central meteorological office of each country in the form of a synoptic message. These are transmitted to all parts of the world, when the messages are decoded and the weather map drawn up. Similar observations are taken on board ships, which are in a position to make observations which are not possible at ground stations. In such messages the position of the ship is given as well as the time of the observation.

Since most depressions which arrive over this country are formed over the Atlantic, the weather information received from ships must be regarded as of special importance.

Development of Radio Sonde

From developments during the war, measurements of the atmospheric stability are now obtained by sending up into the stratosphere, radio sondes.

These comprise 3-valve wireless transmitter sets contained in cylindrical-shaped cases approximately 4in. in diameter and 9in. high, and weighing, complete with a small battery, only 3lb. (Figs. 40 and 41).

A balloon about 6ft. in diameter is filled with hydrogen. A small parachute is connected to the neck of the balloon and to the parachute an aerial, the other end of which is connected to the transmitter. The balloon is released, rises at about 1,000ft. per minute, and at approximately 50,000ft. the balloon bursts, due to its expansion as the outside air pressure decreases, the parachute opens and the apparatus descends to the ground. Persons finding these are rewarded a sum of five shillings upon returning them to the post office. The instruments are then reconditioned, recalibrated and used again.

The radio instrument has three elements, to measure pressure, temperature and humidity respectively. These elements are varying the inductance of the transmitter coils and are connected in turn to the sets by circuit every minute by means of a rotating switch operated by a three-core windmill.

The transmitter sends out varying audio-frequency notes which are picked up by ground operators, who match up the signals with a cathode ray oscillograph to ensure they read the correct signals for pressure, temperature and humidity. The results are then interpreted and broadcast by teleprinter to all forecasting meteorological stations. These are used for upper wind forecasts for forecasting approaching weather and for thunderstorms.

Forecasters can then state whether thunderstorms on a particular day will be numerous and widespread, whether only local, or whether there is just a chance thunderstorms will occur. Radio sondes are sent up four times a day from six different stations.

The use of radio sondes for the measurement of the upper atmosphere is expected to revolutionise weather forecasts as we knew them before the war, when they could only be taken by instruments carried in aircraft and not a series of readings every minute for an hour. Steady readings taken over a period of an hour during the balloon's ascent are worth much more to meteorologists than erratic readings during an aircraft's flight.

Passing Information to the Public

Upon receipt of the observations, the complete, or almost complete weather picture is then formed, from which a synoptic chart is drawn. A copy of this, together with a brief summary of conditions, is presented to the press and then to the public. Some newspapers publish only a short summary of the forecast, while others, such as the

By courtesy of Controller, H.M.S.O.

Fig. 42.—Anticyclone over British Isles on October 12th, 1937, at 7 a.m. Note few isobars and light wind—almost calm conditions.

Times and *Daily Telegraph*, daily print a synoptic chart.*

The type of weather map published in the *Daily Mail* is not a true synoptic chart, but just a simplified weather map which provides the necessary information in simple form to those who are unable or do not care to read synoptic charts. Figs. 42, 43, and 44 are typical synoptic charts showing an anticyclone, depression and secondary depression.

Forecasting

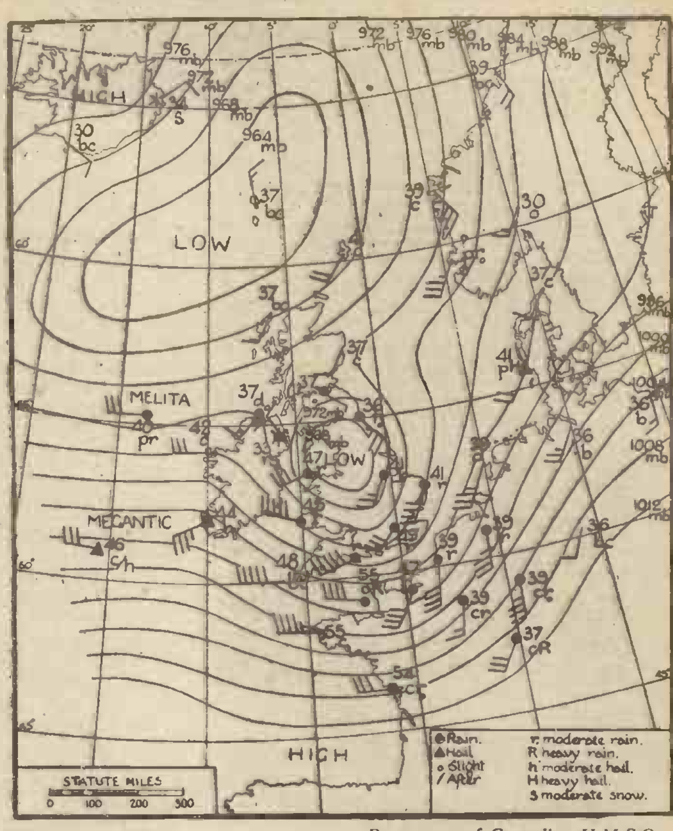
A forecast covers a period of not more than 36 hours and is published in a definite form—a statement of anticipated direction and force of the surface wind and any likely changes, probable state of sky, type of cloud and amount. Type of precipitation, if any, and the likelihood of this. Temperature, particularly where rapid changes or unseasonal temperatures are expected. Occurrence of thunderstorms, fog or night frosts, if any, also further outlook for the following 24 hours.

Practice of Forecasting

The forecaster depends practically entirely upon the synoptic charts before him, together with additional data received from stations. He examines the current chart in conjunction with one or two previous ones. Sometimes he examines charts of similar features taken from the same season over previous years. He then tries to visualise what charts 6, 12, 18 and 24 hours ahead will be like. When he has decided what will happen regarding the general pressure distribution and the movement of air streams he then has to make up his mind how they will in particular affect the weather and wind changes over the area for which he is forecasting. Now the task of the forecaster, although interesting, is not enviable and is best summed up from the following extract from H.M.S.O. Publication MO 247, Section 104.

"It will be recognised then that the making of a sound weather forecast is by no means an easy matter, but connotes that the forecaster shall have at his disposal a well-organised stock of meteorological and physical knowledge which knowledge can only be obtained by diligent study and the ability to use which can only be gained as a result of much practice. The forecaster is in much the position of a physician: to be successful he must be able to diagnose rapidly, but soundly, must be able to determine quickly which factors are essential and which non-essential and then, having judged the factors by his diagnosis, he must be able to predict the future action of these factors, and to interpret that action in the light of his particular needs. Forecasting is, in short, a scientific process based upon physics, precedent and soundly sifted experience; and the ability to forecast well is an ability that has to be diligently wooed and is even then only hardly won."

* Newspapers have not yet resumed the practice of printing synoptic charts.



By courtesy of Controller, H.M.S.O.

Fig. 44.—Secondary depression moving over the British Isles on January 12th, 1930, at 6 p.m. Note how close are the isobars to the south, where the wind is strongest, indicated also by the feathers on the Beaufort wind arrows. Observations were taken on liners "Melita" and "Megantic."

Information Entered on a Weather Chart

The following information is entered on a weather chart:

(1) Atmospheric pressure in millibars reduced to mean sea level, which is different from the pressure at the observing station when the height is above sea level.

(2) Pressure change during the last 36 hours plus or minus millibars.

(3) Temperature. Dry bulb.

(4) Dew point. Temperature where air is saturated.

(5) Cloud type and amount, height of base of low cloud.

(6) Visibility.

(7) Wind force and direction at surface.

(8) Weather.

Beaufort Weather Notations

Since it is neither possible nor desirable to enter in full, information from each station or weather map, abbreviations are therefore used. These observations are entered in a log. The scale of abbreviations were devised by Admiral Beaufort who also devised the Beaufort wind scales, see earlier issue. A few of these abbreviations are given below, where it will be seen that in general the initial letters of the words have been used in the notation.

b —blue sky
c —cloudy
bc —partly cloudy
z —haze
o —overcast
f —fog
m —mist
rs —sleet
p r —rain shower
r —rain
d —drizzle
s —snow
h —hail

General Characters

j means in sight, but not at observing station, viz., jr means rain in sight.

p means shower, viz., p r means rain showers.

Capitals, viz., R means heavy rain, etc.

Small letters, viz., r means ordinary rain, etc.

Suffix o means slight, viz., ro, slight rain, etc.

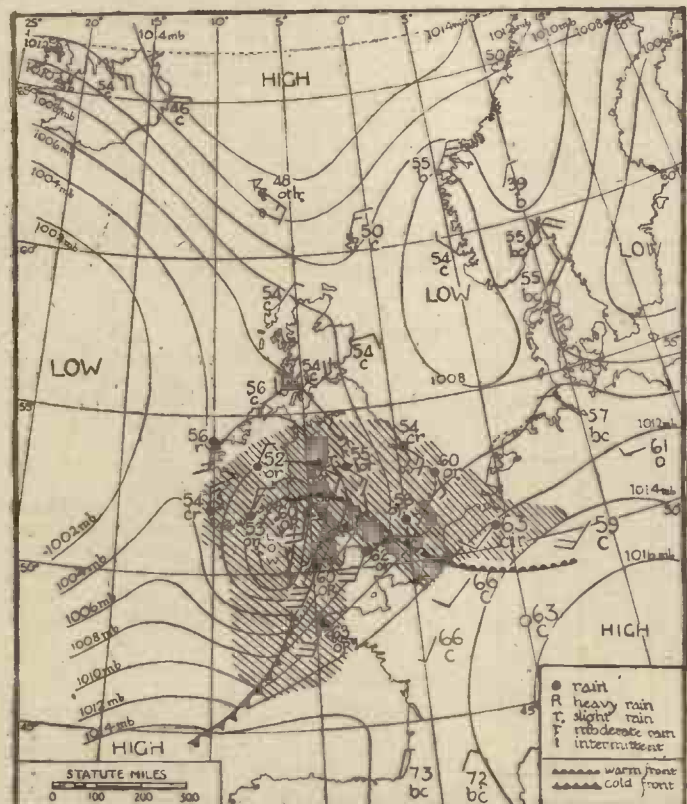
i, intermittent, viz., ido, intermittent slight drizzle.

Letters repeated, continuous. RR, continuous heavy rain.

Charts for the Public

Since the public requires only a general view of the conditions as a whole of the weather, details are not entered on charts published by newspapers, etc. A number of stations only are given the particulars of wind, weather and temperature at each station. The pressure in millibars is not entered for each station, but is shown by isobars usually drawn at 4 mb intervals, Figs. 42 and 44, or 2 mb, Fig. 43.

(*To be concluded.*)



By courtesy of Controller, H.M.S.O.

Fig. 43.—Depression over England, September 17th, 1930, 6 p.m. Warm and cold fronts clearly marked—not yet occluded.

Garden Woodwork

A Lych-gate and a Light Seat for the Lawn

By "HANDYMAN"

Fig. 1.—The finished lych-gate in a garden setting.

A SMALL lych-gate, as illustrated in Fig. 1, would form a novel attraction in a garden in place of the more common rose-arch.

For the uprights two 9ft. lengths of 4in. square timber will be required, sawn at the top to an angle of 45 degrees on each side, with a central slot cut to a depth of 4½in. to receive the ridge-board, A (Fig. 2), which is 1in. thick. The uprights are also recessed, as at B, to take the cross-members C, which are also recessed to make halved joints with the uprights. The cross-members, which can be cut from 4in. by 3in. wood, are 3ft. long, and are slightly tapered towards their outer ends, as shown in Figs. 2 and 3. The joints should be secured with galvanised screws.

Ridge-board and Framework

The distance between the two uprights will depend on the width of the garden path, and assuming that this is 3ft. wide, the ridge-board will be 4ft. 2in. long, allowing a 3in. overhang for the roof.

Dig the holes for the uprights 1ft. 6in. deep, and after placing the posts in position nail across temporarily one or two bracing strips of thin wood, so that the uprights remain parallel while the ridge-board is screwed in place. The posts can then be bedded in the ground with concrete.

Two 3in. triangular members, D, the same length as the ridge-board, are screwed to the cross-pieces, C, for supporting the roof rafters, E, for which 3in. by 1in. batten can be used. There are three rafters on each side—one across the middle of the framework, and one at each end. The barge-boards, F, which cover the end rafters, can be cut from wood ⅞in. thick and 4in. wide, the top ends being sawn at an angle of 45 degrees, and the lower ends shaped as shown in Fig. 2.

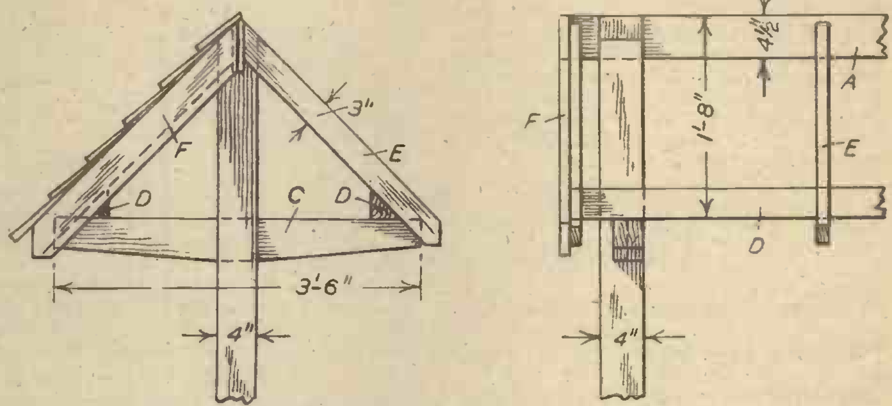


Fig. 2.—End view and part side view of the roof portion.

Weatherboard Roof

As shown in Figs. 1 and 2, the roof is intended to be made up of weatherboards, and these are cut to a length of 4ft. 6in., which will provide for an overhang of about 1in. at each end of the roof.

Gate Construction

Planed battens 3in. by 1½in. can be used for the main framework of the gate, and for the short uprights 2in. by 1½in. wood will be suitable. It will be noticed, with reference to Fig. 1, that only four short uprights are shown in the gate, and five uprights are indicated in Fig. 4. The actual number can be left to the maker's discretion. Whatever number is used it is important to space them at equal distances apart.

After cutting the wood to the required lengths the ends of the three horizontal members can be sawn, as in Fig. 5, and the uprights recessed to form halved joints. The centre and bottom horizontal members are also recessed to take the halved ends of the uprights.

Screw the parts together after giving a coat of paint to all the joints, and well countersink all screw holes, which should be plugged with plastic wood after the screws are driven in.

Hinges and Painting

Two hinges of the cross-garnet type can be used, screwed to the back of the gate, one level with the top horizontal rail, the other level with the lower rail. To avoid rusting, galvanised screws should be used. A simple form of gate latch can be fitted according to the builder's fancy.

With regard to painting, one method is to treat the whole structure with a good wood preservative. An alternative method is to coat all the woodwork, with the exception of the roof, with a good outdoor varnish. The roof can be painted a terra-cotta or tile colour.

A Lawn Seat

The little seat shown in Fig. 6 would, if finished in white paint, look well on a lawn. Only four pieces of deal board and a few battens are required for its construction.

For the two long sides, Fig. 7, planed wood ⅞in. thick will be required, and these can be marked out to the dimensions given. After sawing to the shape required, plane the edges and round off the top front corner.

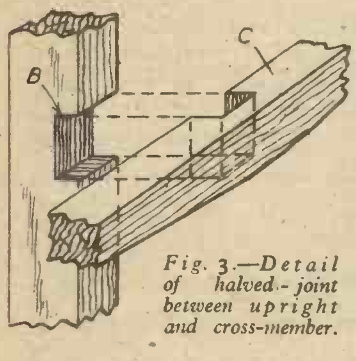


Fig. 3.—Detail of halved-joint between upright and cross-member.

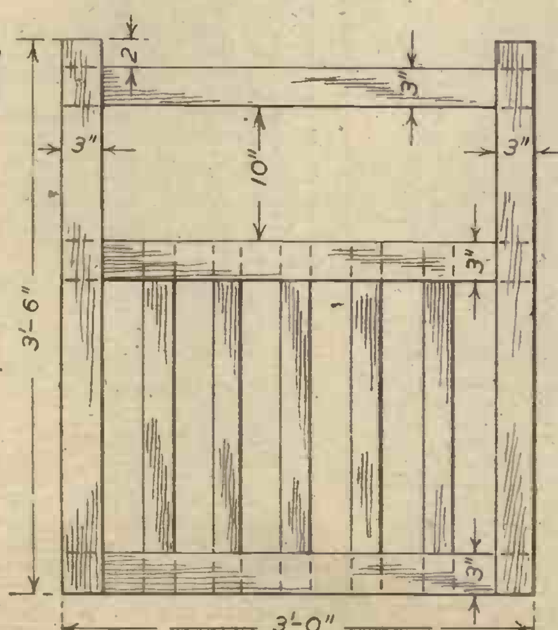


Fig. 4.—Front view of gate, giving chief dimensions.

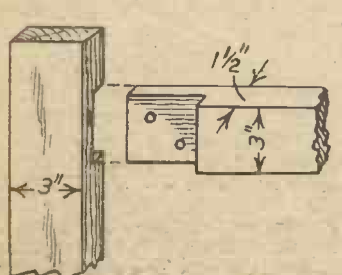


Fig. 5.—Showing halving at end of horizontal member.

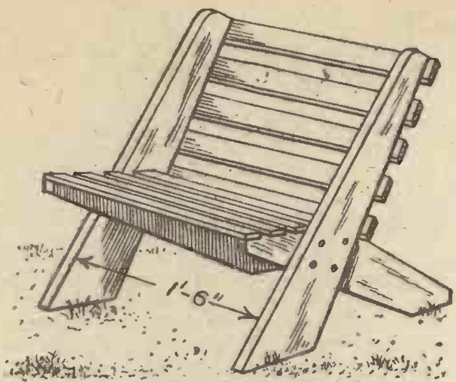


Fig. 6.—A three-quarter front view of the finished seat.

Two more pieces, each 2ft. 9in. long, can be cut for the short sides, which can be sawn and finished to the dimensions given in Fig. 7.

Assembling the Parts

Each pair of side pieces are fixed together with four 1¾in. screws so that the top edge of the short side, which forms the seat support, is 14in. from the bottom edge of the long side. Reference to Fig. 8 will make this clear.

The slats for the seat, and those forming the back, can be cut from 2in. by ⅝in. batten. Those for the seat are 18in. long, the back slats being 21in. long.

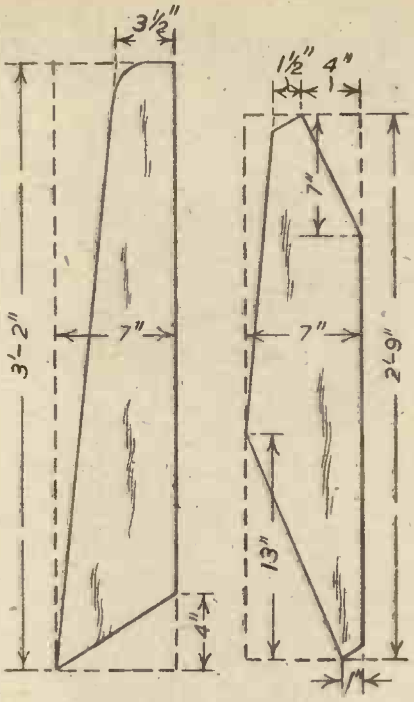


Fig. 7.—Dimensions of the side pieces.

Fix the slats in place by a single screw at each end. Fix the seat slats first and then screw on the back slats so that they overlap the side pieces an equal amount on each side.

Instead of fixing the side members of the seat together with screws, ¼in. diameter bolts and nuts can be used, the holes to take them being bored through two side pieces in one operation to ensure the holes registering properly.

When pressing the bolts in position insert them from the outside of the side members so that the nuts will be hidden from view.

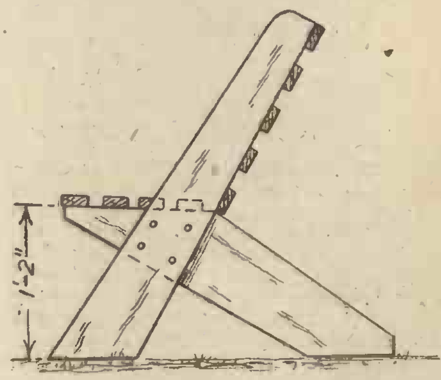


Fig. 8.—Side view of the lawn seat.

Firing Gear for Aircraft

The Development of the Dunlop Pneumatic and Electrical Systems

DUNLOP firing gear, as used throughout the war on British fighter aircraft equipped with fixed guns, was evolved in 1935 and was originally entirely pneumatic.

The first aircraft equipped with the system were the Gloster Gauntlet and Gloster Gladiator, which were at that time fitted with Mk. V Vickers guns.

The gun firing button fitted to the control column.

Advent of the Browning Gun

With the advent of the Browning gun the Dunlop system was soon adapted as the standard firing system for this improved armament. The simplicity and reliability of this mechanism was amply proved in the Battle of Britain when so much depended on that part of the aircraft which actually transmitted the skill of the pilot in the destruction of the enemy. It will be remembered that every enemy aircraft destroyed in this battle by fixed-gun fighters was destroyed with the aid of this gear, which was the standard equipment with Hurricane, Spitfire and other later fighter aircraft right from their inception.

Development of the Firing Button

Efforts for improvement were unceasing, leading from the twin pneumatic gun button for firing guns and cannons individually to electro-pneumatic operation. The advantage gained was to reduce to a minimum the time-lag from pressing the gun-firing button to the bullets leaving the gun. The times are measured in milliseconds and the vital importance is obvious. The present trend of development has brought about the all-electric system, fully developed by Dunlop, and this still remains the standard for British fixed-gun fighter aircraft.

In this system the button is fitted with a safety flap, permitting the selection of three groups of armament—guns, cannons or a combination of both; also the operation of the cine camera with and without guns.

Of special interest among other items of ancillary equipment, necessary for the functioning of the gun gear, is the control box as fitted to the Beaufighter and Mosquito which centralises the control of the various armament groups, neatly housed in a compact box, for the convenience of the gunner.

A rig for testing aircraft armaments.

Rocket Propulsion

Ground-to-air Rockets : American Guided Missiles

By K. W. GATLAND

(*Continued from page 278, May issue*)

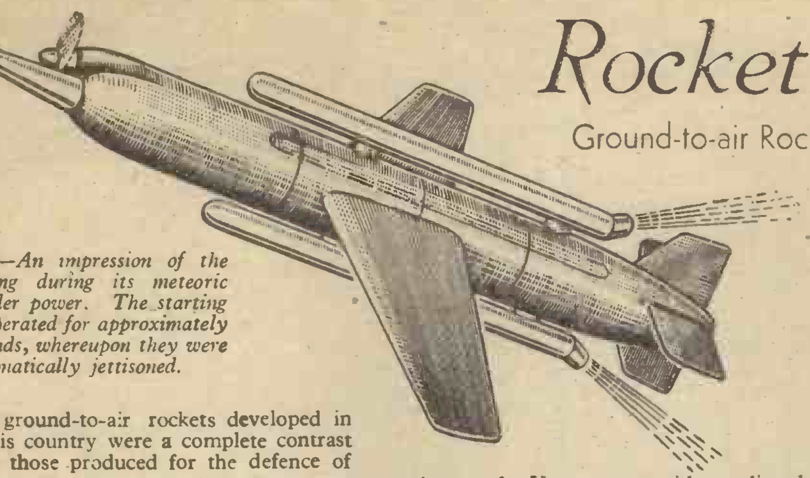


Fig. 68.—An impression of the Smetterling during its meteoric climb under power. The starting rockets operated for approximately four seconds, whereupon they were automatically jettisoned.

THE ground-to-air rockets developed in this country were a complete contrast to those produced for the defence of the Reich.

The British Z-batteries, which had their first large-scale demonstration in 1943 and were key weapons in the defence system evolved to combat the "flying-bomb," were the essence of simplicity. They comprised simply a rotational base platform on which were supported two adjustable launching rails, and each projector was operated by a crew of two, loader and firer.

The Z-rockets, which were approximately 6ft. long and 4in. in diameter, burned stick-formed cordite, and were fired electrically. A 20lb. warhead comprised the nose section, and four small guide fins were fitted at the tail (Fig. 67).

Operation

The projectiles having been loaded, the crew took up their positions, one on each side of the platform. The direction and elevation set, the firer then depressed the firing lever, and the missiles would streak away, perhaps climbing as high as 20,000ft. to reach their objective. The operators were protected against flame and blast by steel side screens, which were adequate cover from the rockets as they sped away from the rails above their heads. Reloading was generally a matter of a minute, or slightly less.

Although intended primarily as a barrage weapon, the Z-projector had provision for direct sighting against ground-straffing aircraft.

The Home Guard was largely responsible for manning the Z-batteries of the London area during the flying-bomb attacks, when numbers of V1s were either directly exploded in flight or sufficiently deflected by blast to crash harmlessly in open ground. In a multiple arrangement, with 48 projectors to a site, they encompassed the target with a veritable "minefield" of blast and shrapnel, from which few aircraft, piloted or otherwise, emerged unscathed.

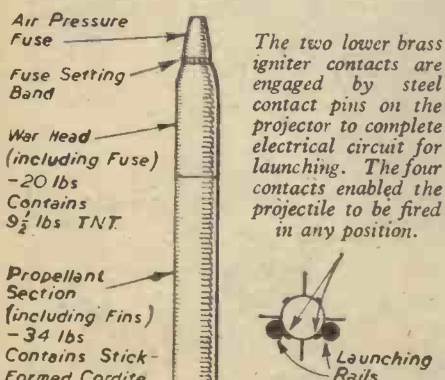


Fig. 67.—The "Z-battery" rocket. Produced by the Projectile Development Department of the Ministry of Supply.

The Germans, however, found no such simple solution. Actually, theirs was a more difficult problem owing to the high-flying "Fortress," among other high performance bombers, which were pressed into service at an early stage of the Allied bombing plan. Germany's defence clearly demanded something more than cordite rockets.

It was obvious that explosive missiles able to range to 40,000ft., perhaps more, would be needed, and needed quickly, if the devastating assaults on the crucial Rhineland areas were to be checked before German industry became an irreparable ruin.

To this end the production of three distinct classes of defensive weapons was set in hand, as follows: (a) high performance jet and rocket-propelled fighters, (b) air-to-air rocket firing aircraft, and (c) ground-to-air rocket missiles. All had an important place in an elaborate defence system to protect the Rhineland, and there appears little doubt that had it been possible for the Germans to bring this plan to early fruition the pages of history would have told a very different story. As it was, the scheme was still very incomplete at the time of the collapse.

The threat to industry and transport had become so acute as the result of the first few months' air battering that even aircraft firms and their design staffs were brought into the scheme to provide explosive missiles ; not only this, but factories that for years had been producing equipment for the army were switched to the manufacture of component parts.

Examples of the weapons produced by aircraft builders were the air-to-air missile Henschel 298 (described in the previous article), the Messerschmitt designed Eizian (Gentian), and the Schmetterling, which was made the responsibility of Junkers. All three embodied wings, and the Eizian, of which little information is available, appeared as a small version of the Me.163, with four motor units.

The three other principal ground-to-air weapons, however, would be more correctly termed "projectiles." The Rheintochter R1 (and later the R3, an improved version) was a massive rocket shell designed on the "step" principle, and the Wasserfall resembled a scaled-down version of the A4 long-range projectile. Finally, there was the manned projectile Bachem BP-20 Natter (Viper), which, like most of the other projects, was still undergoing experiment at the war's ending.

The Schmetterling

Designed by Professor Wagner, of Junkers, the Schmetterling (Fig. 68) was to have been homed to its target by radio. The Germans considered the accuracy of the missile to be such that one Allied bomber would have been destroyed by every one they released. It was obviously the key weapon of the scheme, and, as such, bore the ominous designation "V3." Its development was A1 priority, and at the time of the defeat the weapon was ready for quantitive production.

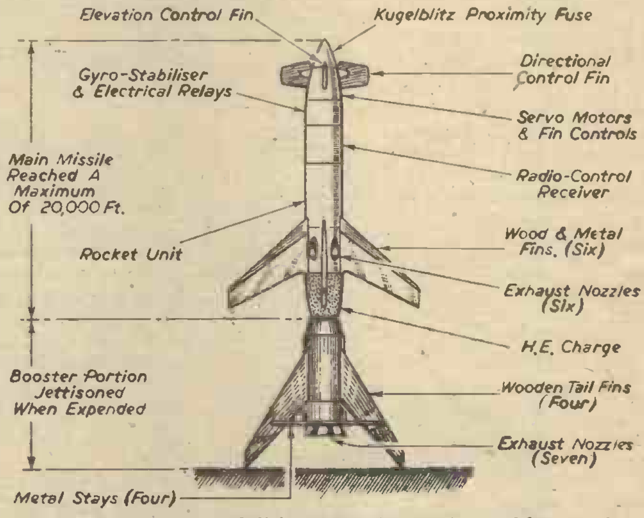


Fig. 69.—Part-sectional diagram showing the internal layout of the Rheintochter R.I.

The Schmetterling appeared as a small mid-wing aeroplane. It embodied a long cylindrical fuselage and a short-span wing attached approximately half-way along its length. A cruciform stabiliser unit was fitted at the tail-end.

The fuselage was assembled in sections, each section housing one of the main components, and, with a 55lb. warhead, which extended from the port side of the nosing, its overall length was 13ft. 1¼in. A small air-stream propeller was fitted at starboard as power for the electrical services.

In the section directly behind the warhead were a compressed air tank and radio. The second and third compartments contained propellant tanks, and the after-most section housed the control gear and main rocket motors. The latter could be either two 109-558 or two 109-729 bi-fuel units, employing 98 per cent. nitric acid with 57 per cent. m-xylidine plus 43 per cent. triethylamine, which gave a duration at full thrust of 33 seconds. This, incidentally, was also the propellant of the X-4 described in the previous article.

The method of wing construction was unique in that the structure was *cast* as a complete unit, including the main spar, trailing edge and six main ribs. There were also diagonal webs interlacing the ribs and a tubular member extended from the fuselage through the two innermost ribs as the main wing fixing. The structure was covered with a thin light-alloy skin, and spoilers were attached at the trailing edge near the tips for lateral control.

The tail unit was also cast and covered in the same manner as the wing.

The missile was launched by two dry-fuel rocket units, one attached above the fuselage and the other below. These rendered a high initial acceleration, and when their propellants became exhausted, within about four seconds, they automatically disengaged and dropped away.

The production model had a wing span of 6ft. 2in. and a tail span of 3ft. 3in. The all-up weight was 970lb., which was reduced to 55lb. after the A.T.O. rocket had been jettisoned.

The performance figures speak for themselves: ceiling, 50,000ft.; range, 20 miles with a maximum speed of 620 miles per hour.

The Rheintochter R1

Another interesting ground-to-air development was the Rheintochter R1 (Fig. 69), designed by Rheinmetall Borsig. A massive two-step rocket, weighing almost 1½ tons, it was intended to be directed to its target by two radar plots, one on the target bomber and the other on the projectile, correlated by a ground operator.

The R1 had a total length of 18ft. 10½in., of which approximately one-third comprised the second stage "booster" portion. The main missile measured 11ft. 10½in. and was 1ft. 8in. in diameter. It embodied six large fins having a total span of 8ft. 8in., which swept back 40in. from the leading edge. They had a root chord of 2ft. 8¾in. and a tip chord of 10in. Four controlling fins, linked to operate in opposed pairs, were fitted at the nosing, the top and bottom fins for directional flight and the lateral fins for elevation.

From nose to tail, the first stage comprised the following main components: proximity fuse, control fin motors, gyroscopes, radio directive gear, rocket unit (with six outward inclined exhaust venturis), and, finally, aft of the tail fins, a 50lb. charge of high explosive.

The "booster" unit was 4ft. 10½in. long and 22in. in diameter. Inside was a powerful dry-fuel rocket unit which exhausted from the rear through seven nozzles. Four fins were also fitted, having a total span of 7ft. 3in., a 2ft. 8½in. root chord and a tip chord of 12in.

The control fins and fixed stabilisers were of thin section and constructed largely of wood. A heavy gauge metal covering was embodied in the after surfaces of the six fins on the main missile.

It is of interest to note that the trailing edges of the two sets of stabilisers were not finished off sharply as is the case in normal aerofoil practice and on other missiles, but were cut square to thicknesses narrowing from 1½in. at the root to ⅜in at the tip. The controlling fins were similarly tapered from a root thickness of ½in. to ¼in. at the tip. This construction follows closely the theory of the Sänger super-sonic aerofoil (PRACTICAL MECHANICS, January, 1946, p. 134), in which, it will be recalled, the section is thin with a knife-like leading edge and the maximum thickness well aft. It is this type of section that has the greatest penetration at speeds in the region of sound, the reason being that the compressibility flow will always break away from the surface shortly behind the mid-section of the aerofoil, involving the trailing edge in pronounced rarefaction.

The Rheintochter R1 was launched from an inclined ramp, the second stage "booster" being used for initial propulsion. This became expended of fuel at an approximate height of two kilometres, whereupon it was automatically jettisoned. At this juncture, the main portion of the missile would further accelerate under its independent power to reach a maximum speed of approximately 1,000 miles per hour.

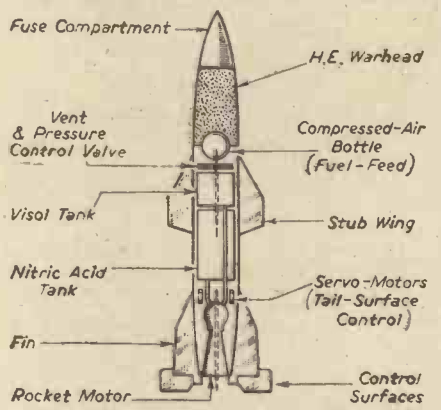


Fig. 70.—The Wasserfall. This part-sectional diagram gives some idea of the layout of the main components.

Despite its majestic appearance, the projectile had an effective ceiling of only 20,000ft. It employed dry-fuel in both stages—diglycoldinitrate—but in an effort to improve the range the R3 version had a liquid bi-fuel unit in the main missile.

The Wasserfall

An offshoot of the A-1/A-10 projectile development programme at Peenemunde, the Wasserfall (Fig. 70) clearly resembled the V2. It was, of course, smaller, having a length of 24ft. and a maximum diameter of 3ft., but nevertheless appeared enormous as an A.A. rocket. Its fully loaded weight was in the region of 3½ tons. There were also four short-span wings attached about half-way between the nose and tail, and, as with the V-rocket, four air-stream fins with controllable tail surfaces were fitted at the rear as well as movable graphite vanes in the jet. In first experimental models, these control aerofoils were operated by a Siemens K.12 automatic gyro-pilot.

Propulsion of the Wasserfall was by the reaction of visol and nitric acid, which fed into a single combustion chamber mounted in the tail.

Less than 50 of these missiles were fired in free-flight, and of these only 12 were successful. Needless to say, they were not used in action.

A scale model of the missile was on view at the British Museum, South Kensington, during the "Exhibition of German Aeronautical Developments" held there earlier this year.

The model in question, which was stated to be a quarter the size of the actual weapon, had apparently been hurriedly disposed of in the local pond at Nordhausen at the time of the surrender. It was found when the area was later investigated by the Allies, and still bore traces of dried mud on its green painted surface.

U.S. Guided Missiles

It is perhaps not widely known in this country that several types of guided missiles were produced in America. The majority of these were to original designs, and at least one was proved to be superior in general performance to its best German counterpart.

The design of these ground-to-air, air-to-air, air-to-ship weapons was put into the hands of a Government establishment known as the Naval Aircraft Modification Unit's Pilotless a/c Division.

The entire development was carried out by this Division, including the research and testing of rocket propulsors, intermittent and turbo-jet power plants, radio-control, target-seeking and telemetering devices. A number of the missiles incorporated television "eyes" which enabled the controller on the ground or in the parent aircraft to view the progress of his charge on a television screen and to guide it into the target by radio-control. The Germans were definitely far behind the Americans in matters of radio-control and target-seeking, though they were obviously more advanced in rocket technique.

A particularly interesting rocket missile was "Little Joe" (Fig. 71), a radio-guided anti-aircraft weapon which could be launched

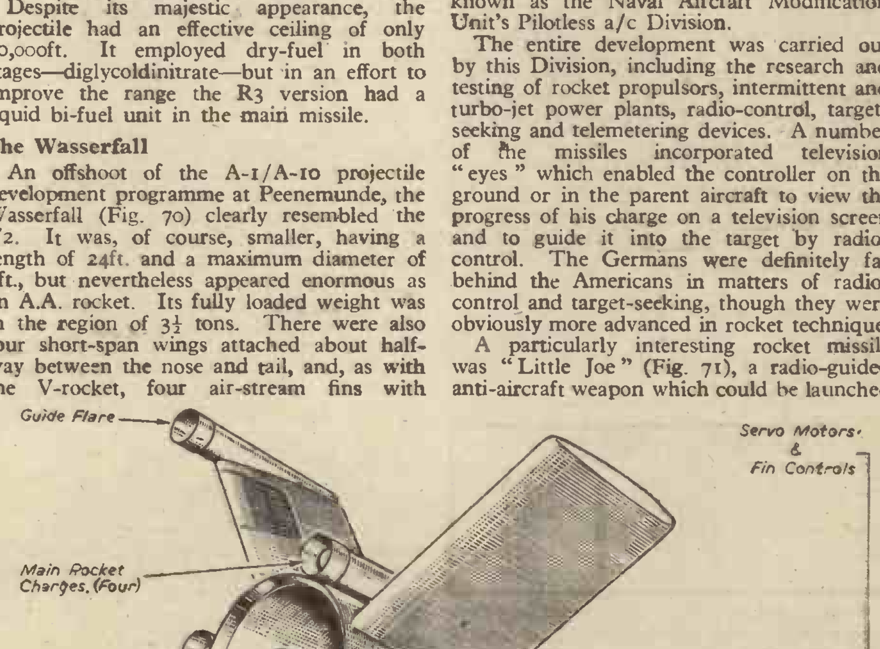


Fig. 71.—"Little Joe." Not the prettiest of aerial weapons, but one that did much to counter the Japanese "Baka" suicide 'plane.

either from the surface or the air. It was originally designed to combat the Japanese "Baka" suicide 'plane, and was powered by four main rocket charges and one 1,000lb. thrust Jato starting unit.

"Little Joe" was an ungainly weapon, and one of the first guided missiles that America produced. Four square-cut stabilisers were attached at the rear, two of which had controllable aerofoils, and four smaller fins were fitted around the nosing in a similar fashion to the arrangement on the Rheintochter R1. The main rocket units were equally spaced around the tail-fins, and the one Jato rocket was housed within the after section of the projectile body, the nozzle emerging from the rear. The missile incorporated a 100lb. war-head, which was detonated by a proximity fuse.

Radio-guided Winged Missiles

Equipped with television and radio-controlled, the rocket powered "Gorgon" KAZN-1 (Fig. 72) was fired from the surface against flying targets, from the air to surface targets, and from air-to-air.

In terms of aeronautical practice, its design was unorthodox in that the horizontal stabiliser was situated at the nose, the main plane at the rear. The vertical stabiliser extended equally above and below the rear fuselage.

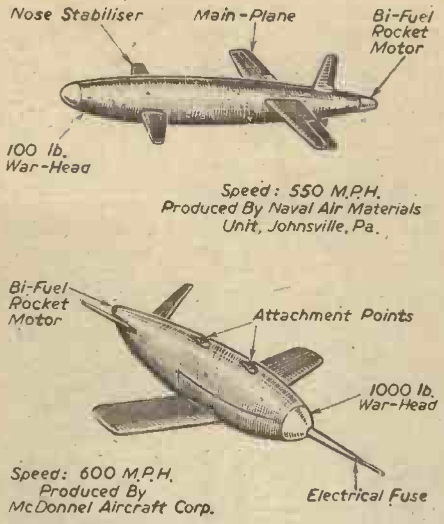


Fig. 72.—The Gorgon (above) and the Gargoyle below); two examples of American winged missile development.

The fuselage was 16ft. in length and nicely streamlined, the wings tapered and 11ft. in span. Wood was used throughout in its construction, including the laminar flow wings, which were to standard design and interchangeable with other missiles.

The power unit was patterned on the German bi-fuel acid-aniline rocket engines, which propelled the "Gorgon" at a maximum speed approaching 700 miles per hour.

Another missile in this class was the "Gargoyle" (Fig. 72), a miniature low-wing monoplane with a heavily dihedraled tail plane which served the dual purpose of vertical and horizontal stabilisers. It sped towards its target at approximately 650 miles per hour under power from a single bi-fuel rocket unit, a flare in the tail assisting in its sighting. Like the majority of other missiles, it was guided remotely by a radio control unit, either from the ground or from the air. *(To be continued)*

The Design of Induction Motors

Brief Notes Forming a Useful Guide

By H. SPARKE

When designing an induction motor to satisfy the requirements of any given set of conditions, it is generally very useful to obtain an approximate idea of its probable principal dimensions.

Particulars of the supply, such as voltage, frequency and number of phases must be known, and also the B.H.P. and speed of the motor, to suit the individual case.

Number of Poles

The relationship between the number of poles, synchronous speed and the frequency is given by the formula:

$$p=\frac{120\sim}{n}$$

where

$\sim$ is the frequency.
n is the r.p.m.
p is the number of poles.

No. of Poles	Synchr. Speed	Actual Speed
2	3,000	2,900
4	1,500	1,440
6	1,000	970
8	750	725
10	600	580

The actual speed is always slightly less than synchronous speed, between 2 and 5 per cent.

Size of Rotor

Assuming that 2 per cent. of the gross power will be wasted in heat in the rotor, for every kilowatt of power there will be 20 watts wasted in the rotor, so that there will have to be 20 sq. in. of rotor surface per kilowatt of power, or 15 sq. in. per horse-power. This condition is slightly better in large motors, and slightly worse in smaller machines.

The working surface of the rotor is π DL, where D is the diameter and L is the gross length of the core.

Therefore, $\frac{\pi DL}{H.P.}=15$ and $DL=4.77$ H.P., or, in other words, the product of length and diameter of core must be approximately five times the horse-power.

The relative values of L and D are determined after next considering the speed. Where the r.p.m. required from the motor is not known the following formula may be used:

$$D=220\sqrt{\frac{H.P.}{V}}$$

This gives a good value for D in inches where V is the permissible peripheral velocity in ft./min. In deciding the value of V, 4,000 ft./min. is a safe value for motors up to 50 h.p. and as the diameter increases the peripheral speed can be increased to double this value for large diameter rotors.

If, however, the r.p.m. is known, by virtue of the number of poles and frequency of supply, the diameter is therefore dependent upon the surface speed. Dividing this surface speed by the r.p.m., we arrive at the length round the periphery, after which dividing by π the resulting diameter is arrived at in inches.

When arriving at the bore of the stator core it is vital to keep the air gap as small as possible, .04in. is sufficient and 1/16in. in a machine of 50 h.p.

Windings

Before an appropriate winding is finally arrived at, the voltage must be considered. The simplest method is to apply dynamo principles, and to fix the number of conductors in series in terms of their lengths and speed and strength of the field they cut.

When a three-phase winding is connected in delta, the voltage across the windings of one phase will be line voltage, but if star connected will be .58 of the line voltage. There is a positive advantage in star connection, as in the case of the stator, by so doing it is possible to use a thicker wire with fewer turns than would be possible with delta connection.

Consequently, not only is the room taken up by insulation less, but the winding labour is reduced.

Current

The voltage of supply being fixed, the method of grouping fixes the voltage on each of the phases separately. Knowing this and also the total watts supplied, and assuming a probable power factor cos ϕ, a value for c, the current in each branch can be approximated

$$w=\sqrt{3}\ v\ c\cos\phi$$

$$c=\frac{w}{\sqrt{3}\ v\cos\phi}$$

Efficiency

For a 5 h.p. machine w will be equal to $5\times746=3{,}730$, but assuming a full load efficiency of 88 per cent. the watts to be supplied will have to be 4,238 in order to yield 5 h.p. The duties of the stator are to carry the current to provide in each of the three phases a B.E.M.F. equal to the supply voltage.

Stator Conductors

The calculation of stator conductors is carried out by use of the formula:

$$(V_1-V_2)\times10^8=q\ B\ \lambda v_1$$

where

V_1 = voltage across each phase.
V_2 = volts lost in resistance of stator conductors.
q = breadth coefficient.
B = flux density.
λ = total length of conductor in cms.
v_1 = linear periphery speed (synchronous) in cms./sec.

Lost volts may be taken as 5 per cent. for small machines.

Rotor Conductors

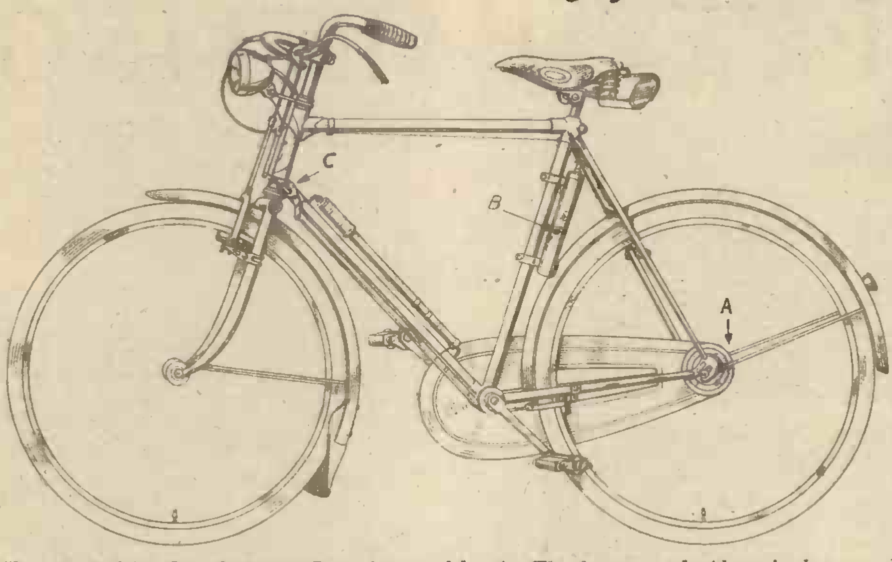
Considering the ironwork of the rotor, the total length of laminated iron parallel to the shaft is the same as the stator, and the clearance between the two having been settled as small as possible, where the number of poles are numerous the centre portion of the laminated discs are inoperative. This allows for the laminated portion of the rotor to be constructed as a ring mounted upon a spider. The number of rotor conductors should be different to the number of slots on the stator, so that there is no tendency at starting or at any speed below synchronous for the motor to cog magnetically.

The greater the cross section of the rotor conductors the greater will be the efficiency of the rotor, provided sufficient iron space is also allowed. There is nothing to be gained by making the total cross section greater than the total cross section of the stator, and in practice is a little less.

These conductors are of solid copper, and only lightly insulated, and can be put into much less space than the stator conductors, and for this reason the rotor slots are generally smaller than one half of those in the stator

Motor-car Type Lighting for Cyclists

Dynohub and Variable Gear in One Unit



The new Raleigh Superbe patent Dyno-luxe model. A—The dynamo and wide ratio three-speed gear. B—The dry accumulator with rectifier. C—The patent safety lock.

PRIOR to the war the Raleigh Company made a big advancement in cycle lighting by producing the revolutionary hub-dynamo. It was of the 12-pole pattern, and, fitted to a cycle, gave the appearance of an ordinary hub brake. The slow speed, multi-polar design and absence of rubbing surfaces made the friction drag practically nil, so that light was obtained with the minimum of effort.

During the war years the cycle industry was at a standstill, but the Raleigh Company now announce that they have perfected a device which gives car lighting on a bicycle. It is due to the inventive skill of the British cycle designers that a dynamo and accumulator has now been designed of such negligible size and weight that a cyclist can use it. In this almost frictionless dynamo which is built into the three-speed gear, the cycle industry are ahead of the lighting practice in all other road vehicles, both at home and abroad.

The Dynamo Unit

In this new hub, shown in Fig. 1, the six-volt dynamo unit as fitted to the "Dynohub" is combined with a wide ratio three-speed gear giving an increase of 33⅓ per cent. direct drive. and a reduction of 25 per cent. Although both units are in the same shell, they are entirely separate from each other, all the features of the Dynohub being retained, plus the advantages of a hub gear. The combination gives a saving of approximately 10 oz. over a separate gear hub and Dynohub.

The Accumulator Unit

This takes the form of a neat cylindrical case attached to the rear of the seat tube and contains a rectifier and three special dry accumulator cells (see Fig. 2). The rectifier converts the A.C. current from the Dynohub to D.C., suitable for charging the accumulators and at the same time obviates the need for a complicated "cut-out" mechanism. The light is steady when at a standstill or while riding at any speed. The three accumulator cells are of a special "dry" form and have no free acid which can spill, even if the bicycle be inverted. The only attention they require is the addition periodically of distilled water which is immediately absorbed by the cells. Should the cells run down through excessive standing, they can be recharged from an external supply. Alternatively, they will recover in use, provided the riding time exceeds the standing time. Even though the cells are run down too far to give a standing light, the headlamp will still operate while the cycle is being ridden.

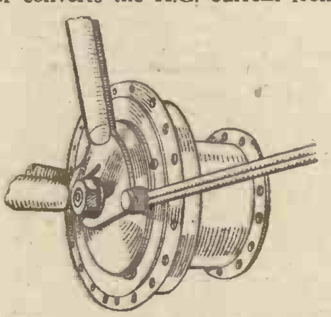


Fig. 1.—The dynamo and three-speed gear combined in the rear hub, the two units being so constructed that independent operation is assured.

The Lamps

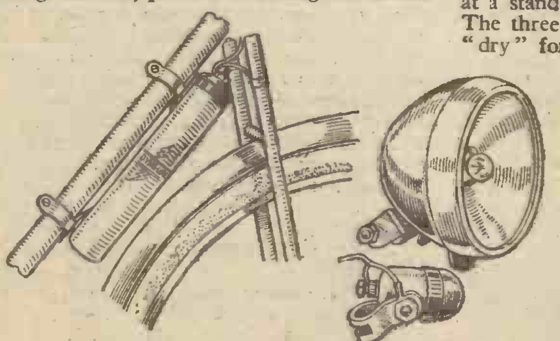
The headlamp has now been redesigned to give a cleaner appearance, as shown in Fig. 3. The switch mechanism is below the lamp and gives positive off and on positions. The terminals are housed within the lamp to give better weather protection, and the wires enter the lamp through a hole in the mounting bracket. This type of wire attachment also prevents short circuits, and is less liable to fracture the wires through tugging. The focusing screw is sunk into the back of the lamp, so giving the lamp a clean, smooth exterior.

The rear lamp (see Fig. 3) has not been modified and is a neat fitment, entirely weatherproof, an essential feature, considering its exposed position. The light shows over the complete 180 deg. to the rear, and is visible from all angles to the rear.

The Dynohub

The Dynohub mentioned at the beginning of this article has also been modified, and the electrical output has been increased from 1¼ to 2 watts. The weight has also been reduced by 4½oz. Better protection against the ingress of road dirt has been provided, and the outer cover plate has been redesigned so as to resist damage from accidental blows. The terminals are spaced to give better accessibility and also to avoid the possibility of being short-circuited. This new terminal arrangement also gives greater clearance for the fork blades. By

(*Continued on page 325*).



Figs. 2 and 3.—(Above) The dry accumulator with rectifier attached to the rear of the seat tube. The three cells of the accumulator are charged automatically when the cycle is in motion. (Right) The front and rear lamps, the front lamp being of improved design.

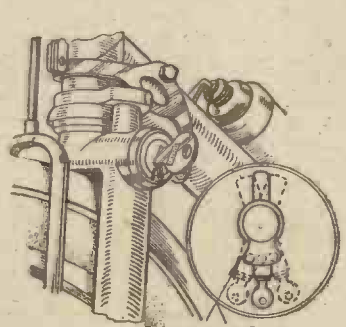


Fig. 4.—The patent safety lock built into the fork crown.

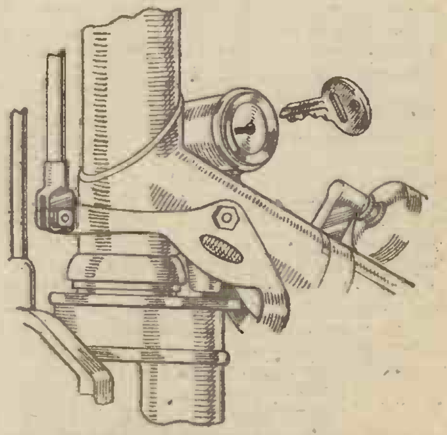
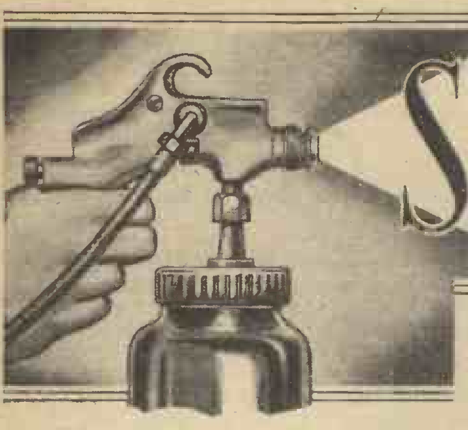


Fig. 5.—The patent safety lock fitted to the Humber Royal Dyno-luxe model. It is located on the bottom head lug and operated from the near side of the cycle.



SPRAY PAINTING

The First of a Short Series of Articles on the Technique of Using a Spray Gun, Constructing Your Own Guns, and a Double-acting Air-compressor

Fig. 2.—A spray gun arranged for suction feed.

MANY different arrangements are used in spray painting, and finishing becomes the easiest part of the job when done with a spray gun. Not only is spraying many times faster than hand brushing, but it also gives superior work and permits the use of fast-drying lacquers and synthetic enamels.

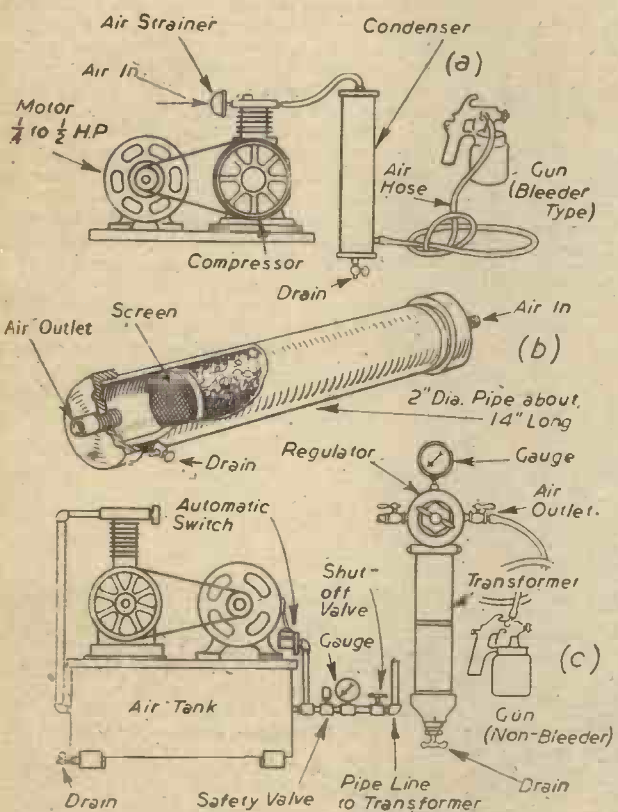


Fig. 1.—Details of a spray-gun installation.

The simplest practical set-up is the portable unit shown in Fig. 1 (a). The condenser, Fig. 1 (b), can be made from 2in. pipe, and can be arranged to drain from either the bottom or end. The condenser smooths out pulsations in the air supply, and also extracts the water and oil which form when the air is compressed. A more elaborate set-up, where the unit is to be stationary, is shown in Fig. 1 (c). In this arrangement, air is first pumped into a storage tank. An automatic switch on the tank turns off the motor when the pressure reaches 100lb., and turns it on again when the pressure drops to 80lb. Since the full 80lb. pressure is seldom needed, the main air line must be piped to a transformer. The transformer consists of two parts. The upper part is a regulator, which can be adjusted to deliver any required air pressure; the bottom part is a condenser, as already described.

Portable Installation

The spray gun for the portable installation shown in Fig. 1 (a) must be of the bleeder type. The unit shown in Fig. 1 (c) takes a non-bleeder gun. A bleeder gun is constructed to pass air at all times, and must be used when air is taken direct from the compressor or where the compressing unit does not have some form of pressure control. A non-bleeder gun can be made a bleeder type by tying back the trigger to pass air, but not pulled so far as to pass fluid. Two or three other features of gun construction must be considered. Most important of these is whether the gun shall be suction or pressure feed. In the suction feed, the fluid is pulled to the nozzle of the gun by the vacuum created by the air; in the pressure feed, air is introduced into the paint cup to force the fluid to the nozzle. Pressure feed is useful and necessary for heavy fluids; suction feed is practical for average fluids and is simpler and less expensive.

Pressure or Suction Feed

Most guns can be used with either pressure or suction feed. Fig. 2 shows a gun arranged for suction feed. By fitting a pressure feed cup and a different cap, the gun can be used with pressure feed. Many workers neglect the second feature—changing the cap—but it is of considerable importance. If you sight across the nozzle of a suction-feed gun you will notice that the fluid tip projects about $\frac{1}{32}$in. beyond the air cap. This arrangement, as shown in Fig. 3, creates the vacuum necessary to draw the fluid to the nozzle. The pressure cap is shown at (b), which extends beyond the fluid tip. This cap will not work with suction feed. The cap shown at (a) (suction feed) will work with pressure feed but gives poorer atomisation of the fluid. The cap shown at (c) is a universal design used for either suction or pressure feed, but less effective with either than a true suction or pressure cap.

The air cap of an external-mix gun has three holes in it. The central hole passes the air, which breaks up or atomises the fluid into a definite pattern. When air passes through the centre hole only the pattern is round, as shown in Fig. 4; when air passes through all three holes the pattern is the familiar fan spray. The longer dimension of the fan spray, Fig. 4, is called, somewhat incorrectly, its width. This pattern can be moved to any angle by turning the air cap, the pattern being always opposite to the position of the horn holes. Thus, if the horn holes are horizontal, the long dimension of the fan pattern will be vertical. This is the adjustment usually used. Most guns make a

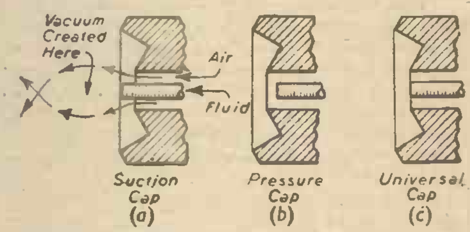


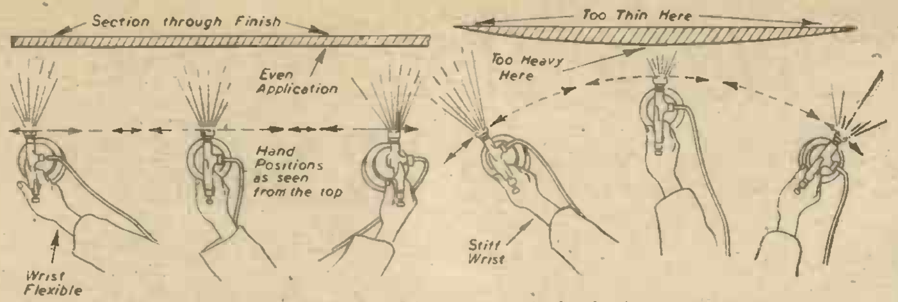
Fig. 3.—Suction, pressure and universal caps.

fan pattern only, but better quality guns make both fan and round patterns. When the gun is of the internal-mix type, that is, the air and paint are mixed inside the cap, the air cap is slotted to give the same fan spray. Between external- and internal-mix guns, external-mix is the most prevalent and practical.

Adjusting the Spray

The first operation in spray finishing calls for the making of a pattern. Hold the nozzle of the gun about 6in. away from a sheet of cardboard or paper and pull the trigger. The resulting pattern shows whether the gun is properly adjusted to go ahead with the work. Fig. 5 shows the perfect pattern—a long oval, with the paint evenly distributed and finely atomised at the edges. The heavy-centre pattern, Fig. 6, is poorly atomised, caused by insufficient pressure. The peanut pattern shown in Fig. 7 gives good distribution, but is poorly shaped. It is caused by

Figs. 4 to 9.—Indicating the various patterns formed by a spray gun.



Figs. 10 and 11.—Correct and incorrect methods of using a spray gun.

Right—Gun moves parallel to the surface of work.

Wrong—Arcing causes poor distribution of finish.

the clogging of one of the horn holes. The pattern shown in Fig. 8 is usually caused by a dirty gun, resulting in a partial clogging of the fluid tip. The split pattern, Fig. 9, results when too much air pressure is used, and is corrected by reducing pressure or increasing the flow of material. Of the various patterns, the one shown in Fig. 6 will give most trouble to the home-shop owner. This fault is one of equipment—there is not enough pressure to break up the paint which is being sprayed. To some extent this can be corrected by cutting down the amount of fluid delivered to the nozzle (your gun should have an adjustment for this), but the only true remedy is to install a larger compressor or use a smaller gun.

Method of Spraying

After obtaining a good pattern, you are all set to spray. The very first rule to remember is always to keep your gun at right-angles to the surface being finished, Fig. 10. This requires a flexible wrist, and demands a little attention until the right movement becomes automatic. Fig. 11 shows the common fault of the beginner. Arcing in this manner causes poor distribution of the finishing material. Learn how to "trigger" your gun. The start and finish of a stroke on a flat wall surface must be feathered off. If you are working on a flat surface which can be covered with one stroke, start the fluid before you hit the work and stop it immediately after running beyond the work. Overlap your strokes about one-half, that is, the edge of the second stroke should come to about the centre of the first stroke. Keep the gun in motion.

A second point to be considered is the distance from the gun to the work. This varies with different materials and guns, but 8in. is a good general average. Spraying distances for certain materials can be checked readily by spanning the fingers from the gun nozzle to the work.

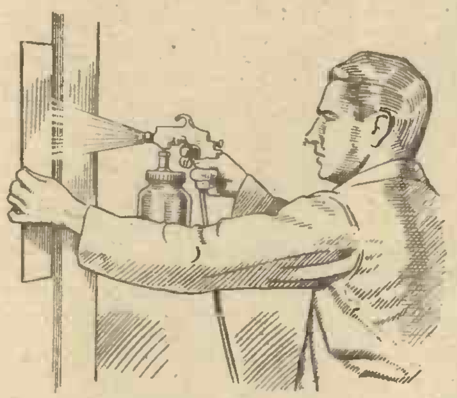


Fig. 12.—Cardboard strips can be used for a large number of spraying jobs where masking is necessary.

Cleaning the Gun

Cleanliness is of prime importance in spray finishing. Strain any doubtful material through a tea-strainer or cloth. Always clean the gun after using it. This operation is very simple and is done by simply placing the fluid tube in a jar of thinner and pulling the trigger. Some workers also alternate this by holding two fingers lightly over the nozzle. When the trigger is pulled, the thinner surges violently in the cup and exerts a powerful cleaning action.

While spray finishing can be done anywhere in the shop, it is best to reserve and equip a certain space for the work. A turntable on which work can be placed and rotated is a worthwhile item, and is quite simple to make. An exhaust fan is advantageous but not strictly necessary in the home shop where only one piece at a time is finished. Most workers get along nicely by opening two windows of the basement, thus creating a cross current which quickly carries away fumes caused by the spraying of the finishing material. On the portable outfit the motor, compressor and condenser are combined in one unit.

Stencilling

Portable equipment has a useful feature in that it can be moved to any location. Thus, if you want to stencil a border on the bedroom wall it is a simple matter to pick up the equipment and carry it upstairs. The stencilling operation is done with the usual paper or metal stencils, holding a strip of cardboard against the wall to catch any overspray. Stencils should be worked with a round spray. If your gun does not have this adjustment, a round spray can be made by blocking off the horn holes with friction tape. Fig. 12 shows how a strip of cardboard is used to catch overspray. Similar methods can be used to protect windows and other surfaces. Where clean separation is required, as in two-tone colour work, masking tape should be used to cover areas which are not to be painted.

By courtesy of Popular Mechanics Press—Chicago.

(To be continued.)

A Giant Calculating Machine

WHAT is stated to be the world's greatest calculating machine is the invention of Commander Howard H. Aiken, U.S.N.R. It was presented to Harvard University to be used by the U.S. Navy. The machine is a revolutionary new electrical device, and will explore vast fields in pure mathematics and in all sciences previously barred by excessively intricate and time-consuming calculations. It will do its work rapidly and accurately, producing answers to innumerable problems which have hitherto defied solution. Completely new in principle, the machine employs a unique automatic sequence control. Anyone can operate it, but problems must be prepared by a mathematician, who will use a code book to prepare the coded tape form in which the problem must be submitted to the machine. Two years of research were required to develop the basic theory behind the giant calculator, and six years of design, construction and testing were necessary to transform Commander Aiken's original conception into the completed machine at the engineering laboratory of I.B.M. at Endicott, N.Y. The machine is 51ft. long and 8ft. high. It has some 500 miles of wire, 3,000,000 wire connections, 3,500 multipole relays with 35,000 contacts, 2,225 counters, 1,464 ten-pole switches and tiers of 72 adding machines each with 23 significant numbers. The illustration shows the machine from the operating end.

Bridge Building in Burma

The part played by 51 (E.A.) Engineer Battalion, E.A.E., in assisting in the reconstruction of the Burma Railways

The final work being done on Pyinmana Bridge, where the new span rests on the bomb-scarred pier used for the old bridge.

In July of 1945 the 51 (E.A.) Engineer Battalion, E.A.E., was detailed to assist in the reconstruction of the bridges on the railway line from Rangoon to Mandalay. These bridges had been continually bombed by the R.A.F. during the Burma campaign in order to prevent the use of the railway by the Japanese.

The Engineer Battalion was allotted the northern section of the line between Paleik, 15 miles south of Mandalay, and Pyinmana, 245 miles north of Rangoon. The length of this section is 200 miles and contained nine railway bridges to be repaired or reconstructed. The line had to be reopened in the shortest time in order that Pyinmana might be used as railhead for projected operations to the South. Fortunately, the end of the war came before these operations were launched.

The work done by the Battalion was not wasted as shortly afterwards reconstruction started at the Rangoon end of the line with a view to linking up with the Mandalay end, thus enabling personnel, food, and other stores for military and civil purposes to be transported throughout Central Burma by rail. This is particularly valuable from a civilian point of view as the amount of civilian transport available is extremely small and great difficulty was experienced in moving surplus food from one area to other areas when there was a shortage.

Technical Problems

The work carried out by the Battalion was the biggest undertaking and of a much more technical nature than any tackled before. Railway bridging is a new departure in the work carried out by the East African Engineers.

It was in fact the Battalion's first worthwhile job since entering Burma, and one really felt that something constructive was at last being done. At this time the Battalion was short of British ranks and so a number of technicians from R.E. and I.E. units were attached to assist in the work.

The two main tasks carried out were the reconstruction of the bridges at Sinthe and Pyinmana. These were among the three most difficult tasks carried out on the Rangoon - Mandalay line to date.

Sinthe Chaung is 30 miles north of Pyinmana and was crossed by a railway bridge consisting of four 100ft. spans of the standard type of railway girders used in Burma before the war, supported on brick piers. The R.A.F. had destroyed this bridge very successfully, and when two companies of the Battalion arrived to rebuild the bridge they were confronted by a tangle of broken steel and rubble.

Clearing the Site

The first task was to clear the site. Explosives were used to cut up the girders into smaller pieces so that they could be placed on skids and towed out of the way with a bulldozer. Then the piers had to be cut down until a firm base was found on which to rebuild. One pier had to be cut down to a depth of five feet below the level of the river. This was made possible by the construction of a timber coffer dam surrounding the place to be excavated. Continual pumping was required to remove the water which kept seeping in under the dam.

The two steel girder spans near the banks were found to be repairable and so they were jacked up from the river bed and supported on temporary timber cribs.

The officer-in-charge of this job spent many anxious moments, the jacks giving trouble, and often failing to lift their weight. Repair consisted of cutting out damaged parts of the usable spans with oxy-acetylene cutting apparatus and replacing them with parts cut out of those spans which were unfit for use. The new parts were either bolted or welded into position. One of the difficulties encountered in this repair work was the removal of the rivets holding the various parts together.

Several methods were tried, including shooting at the rivet heads with a Boyes anti-tank rifle. This was done by the B/C.S.M. at point blank range behind cover. This was successful, but extremely difficult. The majority of bullets fired made a neat hole in the rivet dislodging it at the same time. The best method was by using a heavy pneumatic concrete breaker with its steel forged to a chisel point and tempered.

The quantity of nuts and bolts used may be imagined by the fact that over 200 nuts and bolts were used to fasten up one junction point only. The work was of a very heavy nature, very few of the new parts being capable of man handling. The complete spans weighed over 70 tons each, and moving them horizontally and vertically was no easy matter.

One pier was rebuilt in brickwork, and the other two by light steel trestles supported on reinforced concrete slabs.

Bridging the Gaps

The two gaps where the irrepairable spans had been were bridged with Callender-Hamilton spans, which are items of military

Sinthe Bridge ready for use. The two new centre spans, each weighing 70 tons, can be seen. They are supported by light steel trestles on reinforced concrete slabs.

bridging equipment made up of standard steel parts bolted together. These girders were built on the bed of the river, then jacked up on timber cribs until they reached their correct position, after which they were lowered on to the piers. These are the girders forming the centre half of the bridge shown in the illustration.

Risk of Floods

Under normal conditions no one would dream of reconstructing bridges of this nature during the monsoon season, but as the railway was required as a line of communication, the risk of floods had to be accepted. In order to allow stores to be dispatched to Pyinmana bridge by rail, a temporary timber bridge and sand embankment were built upstream of the main bridge. Fortunately, during the floods, which occurred about once a week, this diversion acted as a breakwater. When the river flooded, the water rose four or five feet and at the same time scoured out the bed of the river so that its depth reached eight to 10 feet. The whole construction area was inundated and the temporary timber cribs were threatened. On the occasion of the worst flood one crib was washed away, but fortunately the concrete for one pier had been laid that morning, and three steel columns hurriedly erected one hour before the flood reached the bridge, with the result that the weight of the span which had been on the timber crib was taken on the pier. On this occasion also the Africans and Europeans rose from their beds to go out to the bridge to salvage stores—the atmosphere was wet but also pretty blue—however, after wading around waist deep for an hour or so much material was saved.

At Pyinmana bridge only one large span was fit for use. This was precariously balanced on two piers across the main channel of the river, one end being supported more by faith than strength. About 25 feet of the bridge at this end had to be practically entirely replaced.

Brickwork Pier

After cleaning the site one pier was rebuilt in brickwork and another with a light steel trestle on a reinforced concrete slab in the same way as at Sinthe. The other two piers were repaired and strengthened.

Two Callender-Hamilton spans were again used to replace the irrepairable spans which had been removed, but the method of getting them into position was different. The two spans were each built complete on the railway embankment a little way from the bridge. They were joined together with a special arrangement of steel angles and plates. The piers were by this time already in position so that the spans should not tip over into the river during launching. The spans were then skidded forward on railway lines by means of an arrangement of steel wire rope and pulley blocks, the motive power being a bulldozer. When the spans were across the gap they were separated and traversed into their correct positions and jacked down on to the piers.

The scale of the work carried out may be gauged from the quantities of material used in these two bridges. The main items used were: 200 tons new steel work, 600,000 bricks, 150 tons of concrete, 20,000 nuts and bolts, 400 tons of timber, 800 feet of electric welding, 1,200 feet run of oxy-acetylene cutting, 2,000 rivets removed and 1½ miles of new railway track laid. The total amount of stores used was approximately 1,500 tons.

It is hoped that as a result of this and other work carried out by the East Africa Engineers, the peoples of East Africa will realise that the sappers recruited from their territories are capable of the most technical types of engineering tasks, as well as the normal forms of military engineering required in the field of battle, and on the lines of communication thereto.

Repairing one of the spans on Pyinmana Bridge, much of the work being done at a considerable height.

Two sappers from East Africa concreting the base of one of the large piers.

Motor-car Type Lighting for Cyclists

(*Continued from page* 321)

the removal of one nut and four screws the entire dynamo unit can be removed from the hub to give access to the wheel bearings when they require attention. All the original features of the Dynohub have been retained, such as absence of drag, silent running, no wearing parts and no brushes.

Steering Lock

Another ingenious feature in Raleigh, Rudge and Humber machines, all of which incorporate the new form of lighting, is a steering lock.

In the Raleigh model the lock is housed in the left hand or near side of the tubular fork crown, as shown in Fig. 4, and comprises a barrel unit with five wards located in a sleeve in the fork crown. The barrel unit, when released and rotated by the car-type "Union" key, operates a locking bolt vertically upward through the boss on the crown. This engages in one of three holes in an extension of the frame bottom head lug, thereby rigidly fixing the steering of the cycle and preventing it being ridden away.

With the Rudge and Humber models the lock is housed in an extrusion of the frame bottom head lug on the left hand or near side of the bicycle, as shown in Fig. 5, and comprises a barrel unit with five wards located in a sleeve in the extrusion. The barrel unit, when released and rotated by the car-type "Union" key, operates a locking bolt vertically downward through the frame. This bolt engages in one of three holes in an extended plate attached to the fork crown, thereby rigidly fixing the steering as before.

In each case, when the key is withdrawn from the barrel the lock is positively secured and prevented from rotating in either the locked or the unlocked position, therefore it is impossible for the lock to operate except when the key is inserted and turned.

This type of lock is proof against the petty thief, but it is recommended that the owner locks the cycle with the handlebars turned to the right or the left whenever possible.

The Foundations of Thermodynamics—7

Thermometers : Thomson's Temperature Scale : Seebeck and Peltier Effects

By R. L. MAUGHAN, M.Sc., F.Inst.P.

(Concluded from page 241, April issue.)

THE invention of a temperature measuring instrument in which a gas is used as the thermometric substance instead of a liquid brought with it many advantages over the earlier liquid-in-glass type of thermometer, as, indeed, had been the aim of its inventors. Chief of these merits, perhaps, were the increased ranges of temperature which it became possible to explore, and the definition of a reliable and natural absolute zero of temperature. But as an offset to these advantages, the gas thermometer was handicapped by its necessarily large and complicated design, which made it a cumbersome and unwieldy instrument to operate in comparison with the compact and portable single-tube structure of the liquid-in-glass thermometer. Thermometer designers therefore sought for a new type of instrument in which the combined advantages of the liquid-in-glass and gas-in-glass thermometers could be preserved and extended, and yet which would be free from the defects of both these instruments. It was concluded that the possibilities of the thermal expansion property of substances as a means of assessing temperature had been exhausted with the introduction and development of the gas thermometer, and that a radical change in the approach to the problem was necessary if further progress was to be made in the science of thermometry. The search for a new type led to the introduction of the electrical resistance thermometer, by means of which a temperature number is calculated from the measured values of the resistance of a metal wire heated to various temperatures.

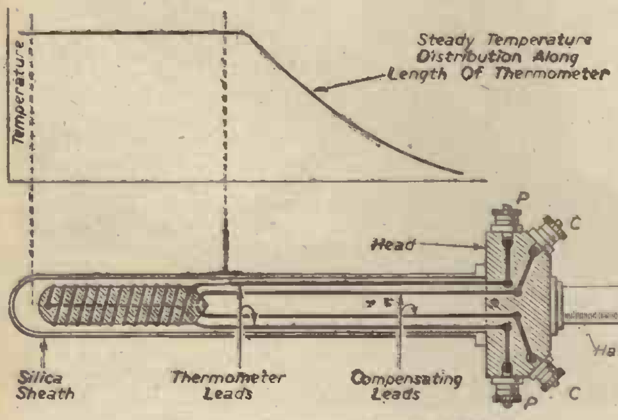


Fig. 30.—Platinum resistance thermometer.

The Platinum Resistance Thermometer

The choice of platinum as the metal for use in this thermometer provided a substance whose high melting point (1774 deg. C.) makes it capable of dealing with temperatures over a greatly extended range, and whose comparative chemical inactivity protects it from excessive contamination from hot vapours with which it might make contact. Furthermore, its ductility enables it to be drawn into the form of a fine wire suitable for making resistance measurements, whose coils can be housed in a small space, which gives the finished thermometer the slender tube-like appearance, lightness and portability comparable to that of the liquid-in-glass thermometer. It is illustrated in Fig. 30, and the standard circuit used to measure its electrical resistance is sketched in Fig. 31. The thermometer consists essentially of two lengths of finely drawn platinum wire, each with its ends connected to a pair of terminals set in the head of the instrument. The wires are arranged in four parallel lines in pipe-clay guide-tubes, with an extra length of one of the wires coiled about a mica frame in the foot of the instrument, at the end of the pipe-clay tubes. The wires, tubes and frame are screened from direct contact with the hot body by means of a porcelain sheath, which is fitted to the wooden head of the instrument. The wires and their guide tubes are held in position inside the sheath by a number of mica discs arranged at intervals along the length of the tube. The shorter of the wires has its terminals labelled C, and the longer one, with its extra length coiled in the end of the sheath, is connected to the pair of terminals marked P.

Measuring Thermometer's Resistance

When the thermometer is inserted in the furnace, or the crucible of molten metal, or whatever the object is whose temperature is being assessed, the wholly immersed end

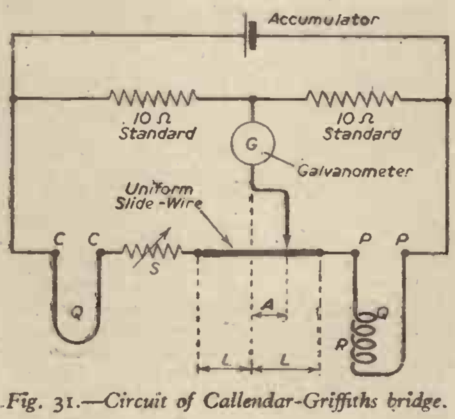


Fig. 31.—Circuit of Callendar-Griffiths bridge.

is heated to the steady temperature of the object itself, while the remaining parts of the sheath and its contents reach temperatures at some degrees below this. The falling gradient of temperature from tube-end to handle is present to the same extent in each of the four parallel leads, so that any increase in electrical resistance due to a heating of the P leads is reproduced exactly in the C leads. The electrical circuit usually employed to measure the thermometer's resistance, the Callendar and Griffiths bridge, is shown in Fig. 31. Its structure is a modified form of the network of conductors introduced for the purpose of measuring resistance by Christie, and later developed by Sir Charles Wheatstone, whose name is usually associated with this type of resistance bridge. The arrangement of the circuit is such that the ohmic resistances (represented by Q in each case) of the equally heated wires in the C and P leads compensate for each other by being present in each of the balance arms of the bridge, and leave a condition of balance in the circuit expressed by

$$Q+S+(L+A).w=(L-A).w+Q+R$$

where S is a known variable resistance, w is the resistance of unit length of the uniform bridge wire whose total length is 2L, and A is the distance from the mid-point of the slide wire to the point where the jockey of the galvanometer finds a balance, and therefore the resistance R of the thermometer coil, which is wholly at the temperature of the space under investigation, may be calculated from the equation $R=S+2.A.w$. The temperature number t in centigrade degrees on the platinum resistance scale associated with such a temperature can then be found from the standard formula

$$t=\frac{(R_t-R_o)\times 100}{R_{100}-R_o}$$

where R_t, R_{100}, and R_o represent the measured resistances of the thermometer coil at the unknown temperature, at the steam-point and at the ice-point respectively.

It was mentioned in part 6 of this article that a general defect inherent in all temperature scales which are based upon the thermal behaviour of material substances is that no two of these scales can ever agree completely, since the rates of temperature variation of various properties of matter are not the same. A pointed example of this is to be seen in the case of the platinum resistance scale, for whereas the relation between the resistance of the thermometer coil and temperature expressed in degrees centigrade on the platinum resistance scale is a linear one, as represented by the equation

$$t=\frac{(R_t-R_o)\times 100}{R_{100}-R_o},$$

the variation of the resistance of the same coil with temperature T as registered in degrees centigrade on the gas scale is parabolic, and is expressed by the equation $R_T=R_o.(1+A.T+B.T^2)$, where R_t refers to the same physical resistance as R_T (though T and t are not the same numbers), and A and B are constants specific to the metal platinum. The discovery of a scale of temperature which was absolute in the sense that its definition and characteristics were free from the particular thermal properties of real material substances was made in 1848 by William Thomson, after a study of the Carnot heat theorem, which had received a few years previously the publicity and

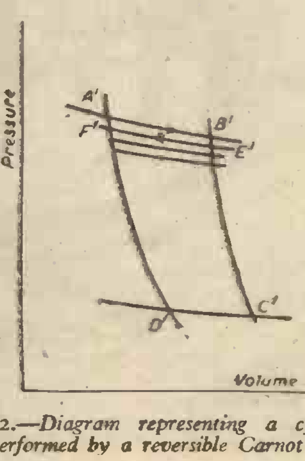


Fig. 32.—Diagram representing a cycle of work performed by a reversible Carnot engine.

recognition it deserved in a new edition of the Carnot manuscripts prepared by Clapeyron.

Thomson's Temperature Scale

Thomson based the conception of his scale upon the properties of a reversible Carnot heat engine using ideal gas in its cylinder as working substance. He selected the ice and

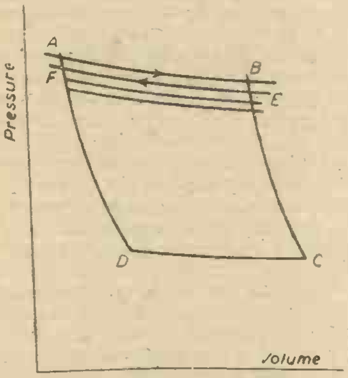


Fig. 33.—Diagram of work cycle of Carnot's engine.

steam points as its fixed points, and placed it in the centigrade category of temperature scales by dividing its fundamental interval into 100 degrees. The size of a degree on the Thomson scale is defined as follows. In Fig. 32 the area ABCD represents a cycle of work performed by a reversible Carnot engine operating between the steam-point and the ice-point as its temperature levels. The line AB represents the steam-point isothermal, and CD the ice-point isothermal, while BC and DA are any pair of adiabatic lines drawn across the isothermals to complete the figure. If 99 additional isothermals are then constructed between the two fixed-point isothermals so as to divide the area ABCD into 100 equal parts, then each of these isothermal lines represents a degree on the thermodynamic scale, and the temperature difference between any two adjacent isothermals has the magnitude of one degree. This definition of a degree is independent of the particular pair of adiabatics chosen to complete the cycle, for if in Fig. 32 the area of the component cycle ABEF is W/100 (where W is the area of the cycle ABCD and is numerically equal to the work delivered by the engine per cycle after drawing Q units of heat from the source), and in Fig. 33 the corresponding area $A^1B^1E^1F^1$ is $W^1/100$, then the efficiency $W/100 \times Q$ of the cycle ABEF must be equal to the efficiency $W^1/100 \times Q^1$ of the cycle $A^1B^1E^1F^1$, since by the corollary to Carnot's theorem, the efficiencies W/Q, W^1/Q^1 are equal, as both cycles are performed by reversible engines working between the same two temperature levels, namely, the steam-point and the ice-point. Hence the component cycles ABEF, $A^1B^1E^1F^1$ are, in virtue of the same corollary, performed between the same two temperature levels, and as the upper levels AB, A^1B^1 represent the same temperature (the steam-point), the isothermals FE, F^1E^1 must also represent equal temperatures. The argument can then be extended to the next component cycles immediately below ABEF, $A^1B^1E^1F^1$, and continued throughout the entire range of the scale.

Thermodynamic Scale

The absolute zero of the thermodynamic scale is defined as the temperature which is reached after the adiabatic expansion of the gas has been prolonged to such an extent that no heat is left in it for rejection into the sink. The relation between the thermodynamic scale of temperature and the ideal gas scale, which has, as it has been seen, an absolute zero imposed upon it by natural law at 273.13 centigrade degrees below the ice-point, can be examined by making use of the definition of the absolute zero of the thermodynamic scale. For if in Fig. 34 the symbol N_1 is taken to represent the steam-point in degrees of temperature registered on the thermodynamic scale, and N_2 the ice-point temperature on the same scale, then the quantity of heat Q_1 absorbed isothermally at the steam-point during the performance of the cycle ABCD may be written as $Q_1 = N_1 \times M$, where M is the area of the unit cycle bounded by isothermals having a one degree difference, since Q_1 is equivalent to the total area under the line AB, down to the absolute zero. Similarly, $Q_2 = N_2 \times M$, where Q_2 is the quantity of heat rejected isothermally at the ice-point during the compression stage of the cycle of work ABCD. Hence $Q_1/Q_2 = N_1/N_2$. But it has already been seen that $Q_1/Q_2 = T_1/T_2$, where T_1 and T_2 denote the steam-point and ice-point temperatures respectively on the ideal gas scale, and thus $N_1/N_2 = T_1/T_2$. The full relation between the two scales is then disclosed by using the facts that the fundamental interval of both scales contains 100 degrees, and that the absolute zero of the ideal gas scale lies at 273.13 deg. below the ice-point. For T_1/T_2 then becomes $(100+273.13)/273.13$, and N_1/N_2 becomes $(100+N_2)/N_2$, and by re-writing the equation as $(100+N_2)/N_2 = (100+273.13)/273.13$ it follows that $N_2 = 273.13$, and thus both scales coincide at every point.

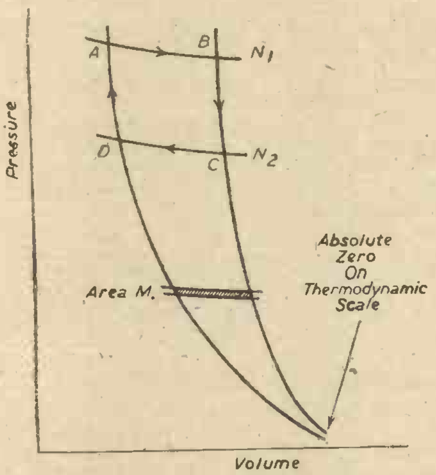


Fig. 34.—Graph representing thermodynamic scale temperature.

In the year 1855, seven years after he had devised the thermodynamic scale of temperature, William Thomson made the discovery of the thermoelectric phenomenon with which his name has since been associated, and which has already been described in some detail earlier in this article. The manner in which this discovery was approached by Thomson aptly demonstrated the use to which thermodynamical principles could be put as a practical instrument of research in physical science, and set a fashion in research technique which was afterwards followed by many scientists of the nineteenth century.

Seebeck and Peltier Effects

It had been generally known since the publication of the work of Seebeck in 1821 and of Peltier in 1834 that an electric current could be generated in a loop composed of two chemically different conductors by maintaining the junctions of the loop at different temperatures (Seebeck effect), and that conversely the flow of electric current from an electric cell contained in such a circuit was accompanied by an absorption of heat at one junction and an evolution of heat at the other one (Peltier effect), but up to the middle of the nineteenth century no theoretical explanation existed to account for these effects. The observation that the heat transactions which occur at the junctions of a thermocircuit are thermodynamically reversible in relation to the direction of the electric current, induced Thomson to apply the reversibility rules deduced from Carnot's principle, which Clausius and Thomson himself had successfully re-investigated in 1850-1, to the problem of the thermocircuit. It was found in a preliminary experimental study of a selection of circuits containing various materials in pairs that the release or intake of heat at a junction depended upon three factors: the strength of the current in the circuit, the duration of its flow, and a constant quantity described as the Peltier coefficient, which was characteristic of the chemistry of the materials joined in the circuit, and of the temperature of their junction. In a formula this can be stated as $Q = P.c.t$, where Q, P, c and t denote heat quantity, Peltier coefficient, current strength and time of flow, in that order. If this equation is applied in turn to each of the junctions of the thermocircuit illustrated in Fig. 35, the balance of heat $Q_1 - Q_2$ consumed by the circuit can be written as $Q_1 - Q_2 = (P_1 - P_2).c.t$. But in accordance with the doctrine that energy is conserved in its amount when it undergoes transformation, the heat which disappears in the circuit must reappear as an equivalent quantity of electrical energy, and hence $Q_1 - Q_2 = E.c.t$, where E is the electromotive force generated in the circuit, and consequently $E = P_1 - P_2$. In virtue of the reversibility of the Seebeck and Peltier effects, the entropy principle can at once be applied to the heat exchanges in the circuit illustrated in Fig. 35, to give the relation $Q_1/T_1 = Q_2/T_2$, from which it follows that $P_1.c.t/T_1 = P_2.c.t/T_2$, and $P_2 = P_1/T_2/T_1$. Substitution for the Peltier coefficient P_2 in the above expression of E gives $E = P_1 - P_1.T_2/T_1$, or $E = \frac{P_1}{T_1}(T_1 - T_2)$

Thermo-E.M.F.

This final equation is capable of a simple graphical interpretation, if it is considered that in the given thermocircuit the hot junction temperature T_1 is kept constant, while the cold junction temperature T_2 is varied. Under these conditions the thermo-E.M.F. E must vary also, but as a linear function of T_2, since the Peltier coefficient P_1 remains constant as long as its junction temperature T_1 is not altered. By this argument Thomson arrived at the unhappy conclusion that the graphical relation between thermo-E.M.F. and junction temperature was, according to thermodynamic theory, to be represented by a straight line, as shown in Fig. 36, line A. This deduction was in complete disagreement with the result obtained in practice from experimental measurements of thermocircuit quantities. Such measurements showed that no substances could be found to give a linear relation between thermo-E.M.F. and junction temperature difference, that all known substances exhibited a pronounced non-linear relation, which for the vast majority of materials was parabolic, as shown by line B, Fig. 36. This discrepancy between theory and practice was

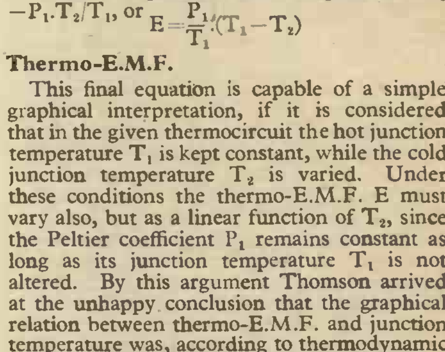


Fig. 35.—General thermo-circuit.

too strongly marked to be explained away in terms of experimental error or faulty calculation, and accordingly Thomson was led to suspect the existence of a new and hitherto unrecorded thermoelectric effect operating in the circuit, which if taken into account in his calculations might adjust the difference between the theoretical and experimental graphs. Since the effects at both junctions of the thermocircuit appeared to have been thoroughly probed and analysed, he decided that the unknown effect, if it existed, could only reside in the lengths of conductor between the two junctions, and from this starting-point began the investigation which ended, in 1855, with the discovery that a small additional stream of heat is released or absorbed along the entire length of a conductor wherever there is a temperature difference from point to point in it, and as long as it carries an electric current.

Thomson or Kelvin Effect

A study of this phenomenon, the Thomson or Kelvin effect, as it is sometimes called after the title which Thomson received in 1892, supplied the missing quantities which were needed in Thomson's earlier calculation to give the correct equation to the curve relating thermo-E.M.F. and junction temperature difference. It was found from experimental measurements of the effect for a series of substances that the release or intake of heat over the surface of a given length of conductor depended upon four factors: the strength of the electric current flowing in the conductor, the time of its flow, the temperature difference established along the length of the specimen, and a constant quantity, since called the Thomson coefficient, whose value was determined by the nature of the material. This fact was stated in a formula as $dQ = S.c.t.dT$, where dQ denotes the small quantity of heat transacted in t seconds over a certain length of conductor carrying a steady current c, and having a correspondingly small temperature difference dT between its ends. S represents the Thomson coefficient which carries a conventional positive sign if the particular substance absorbs heat, and a negative sign if it releases heat. If in Fig. 35 it is supposed that material A possesses a positive Thomson coefficient and material B a negative one, then the extra heat consumed by the circuit in unit time for the conduction of unit current over

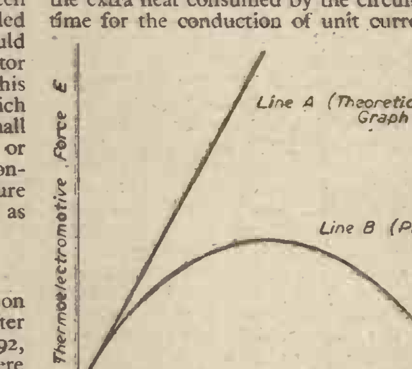


Fig. 36.—Thermoelectromotive curve.

the total length of conductor between the junctions is given by $\int_{T_2}^{T_1} . (S_A - S_B).dT$, so that the amended expression for the thermo-E.M.F. becomes

$$E = P_1 - P_2 + \int_{T_2}^{T_1} . (S_A - S_B).dT.$$

As both coefficients P and S were themselves found to be functions of E and T, this equation reduced to an expression of E in terms of T, which agreed with the experimentally determined curve drawn in Fig. 36, line B.

Value of Thermodynamical Reasoning

The worth of thermodynamical reasoning as a weapon for searching for new facts and as a means of explaining known facts was widely appreciated and thoroughly exploited by scientists during the remaining decades of the nineteenth century. Indeed, it seemed to many that the power of the new weapon was boundless, until at the close of the century its failure to provide an adequate explanation of the measured distribution of energy in the spectrum of full radiation revealed its limitations. Thermodynamics had already scored several major successes in the branch of physics concerned with radiant energy. Kirchhoff, in 1860, had proved by reference to thermodynamical principles that the ability of all substances to emit and to absorb radiant energy are directly proportional; in 1884 Boltzmann adapted the Carnot theorem to establish a theoretical proof of the fourth power radiation law discovered experimentally by Stefan five years earlier, and Wien by 1893 had deduced his two famous laws which give a truthful, if incomplete, description of the manner in which radiant energy is distributed amongst the wavelengths which carry it through space. But further attempts to complete this description by finding an explicit equation for the energy-wavelength curve as found in practice met with failure. Several years of systematic work using thermodynamic principles were pursued, notably by Planck, Rayleigh, Jeans and Michelson, before it was realised that the answer to the radiation problem lay beyond the scope of thermodynamical theory. Its ultimate solution, proposed by Planck in terms of his quantum hypothesis of energy in 1900, helped to usher in along with J. J. Thomson's discovery of the electron a few years earlier, and Einstein's relativity principle a few years later, the present epoch of modern physics.

Notes and News

The Vampire Fighter

THE world's fastest single-engined aeroplane, the de Havilland jet-propelled Vampire fighter, is used by the Naval Air Arm as well as by the R.A.F.

Its speed, although still a closely guarded secret, is known to be considerably more than 500 m.p.h. The Vampire becomes airborne very quickly, and has a comparatively slow landing speed.

Powered by a single Goblin jet-turbine engine, the Vampire, a twin-boom fighter with four 20-millimetre cannon, can fly at an altitude of between 45,000ft. and 50,000ft.

Power Plant for Vestmanna Islands

MODERN electric power plant is being installed in the Vestmanna group of islands, 30 miles south of Iceland. The inhabitants, numbering 6,000, are mainly dependent on the fishing industry and their decision to substitute alternating current for the inadequate direct-current service at present in use is indicative of their modern outlook. The main contractors for the power-station equipment are British Oil Engines (Export), Limited, London, S.W.1. The two engines comprising the power plant were made by Messrs. Mirrlees, Bickerton and Day, Limited, Stockport. The generators, manufactured by The Brush Electrical Engineering Company, Limited, Loughborough, will supply alternating current at 6.6 kV.

Pusher-type Bomber

THE United States Army's latest and biggest super-bomber is the XB-36. It is a six-engined 'plane nearly twice as big as the B-29, and has an operating radius of 5,000 miles.

The "Vampire" taking off for a demonstration flight at Heston aerodrome recently.

THE WORLD OF MODELS

A Cabinet-maker whose Hobby is Making Model Ships

By "MOTILUS"

THIS is not the first time the city of Nottingham and its model-making have featured in these pages, so Mr. Dennis Sears, of London Road, Nottingham, is in good company!

By trade Mr. Sears is a cabinet-maker, but during his leisure time in the past 12 years he has made scale models of over 400 models, and here are pictures of a few of them.

Scale Model "Mauretania"

His first model, made way back in 1936, affords a striking contrast with his latest achievement, an 8ft. scale model of the new *Mauretania* (Fig. 1).

His initial model liner is nearly 3ft. long and was made of plywood. He now considers it a crude effort, though many would be proud to own it as a first effort.

Of the new *Mauretania* model, Mr. Sears says he started to construct this in 1938, the year of the vessel's launching. He went to Liverpool especially for the launching ceremony, and was also there to see the new *Mauretania* sail down the Mersey on her maiden voyage.

Fig. 2.—Three early attempts of Mr. Sears—left to right, motor-liner "Georgic," Liverpool tug s.s. "Wellington," and the first model liner he ever made—the "Queen Mary."

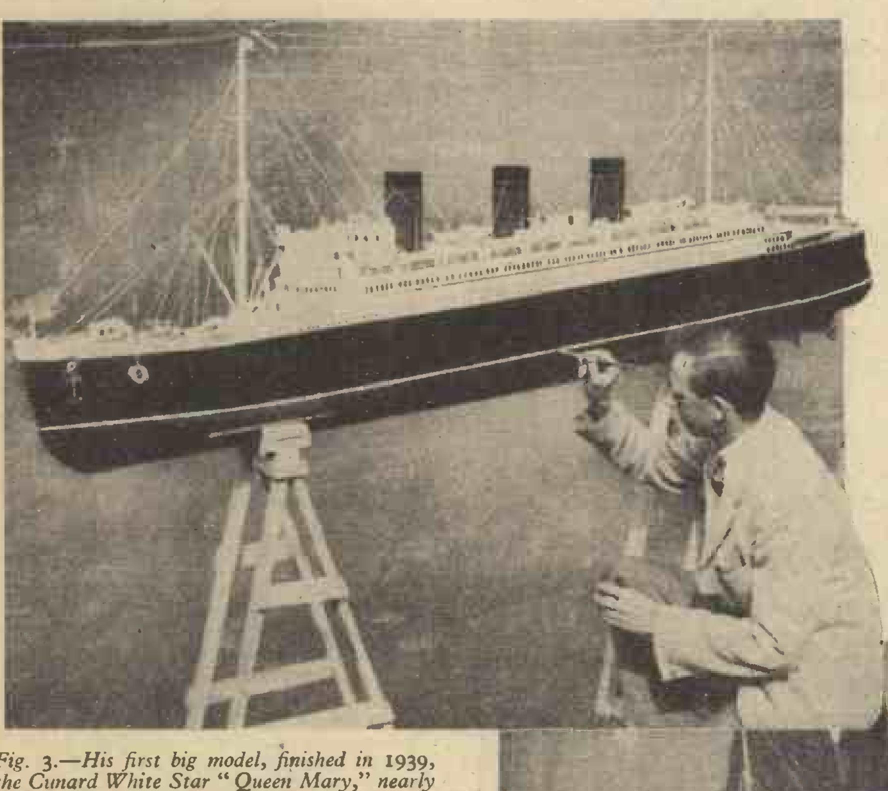


Fig. 3.—His first big model, finished in 1939, the Cunard White Star "Queen Mary," nearly 8ft. in length, which took 22 months to make.

But time went on, he told me, and progress was slow. Then came the war, and as he could not get the timber large enough for a model of the size he had chosen, he was obliged to put the work on one side. Last year, however, the timber became available, and so he was able to finish the model, which is valued at over £200. It is just over 8ft. in length and the hull is planked up in 1in. wood —deal and pine. He made everything by hand, except the anchor and chain, which he bought finished. The plans he worked from were supplied by the Cunard White Star Company, and his new *Mauretania* is the latest and largest of his many models. It is, like most of the others he has constructed, a floating model.

Fig. 2 gives some idea of Mr. Sears's early models. On the left is a model of the 28,000-ton motor liner *Georgic* which he made in 1938. Over 4ft. in length and taking 12 months to complete, this is a floating model and was tried out successfully in the small pond Mr. Sears has constructed in his garden for the testing of models.

The centre model is of a Liverpool tug, s.s. *Wellington*, some 15in. in length, and on the right can be seen the model *Queen Mary*, first model liner he ever made, and it was constructed the same year as the ship sailed on her maiden voyage.

The "Queen Mary"

In 1939 he again tackled the *Queen Mary*, constructing a model nearly 8ft. long and this, seen in Fig. 3, took 22 months to make. The hull was made from thin ply, as a solid piece of wood for such a large model was not obtainable. The keel was constructed throughout of ¾in. wood, and the ribs of the hull were perforated metal strips. The ply

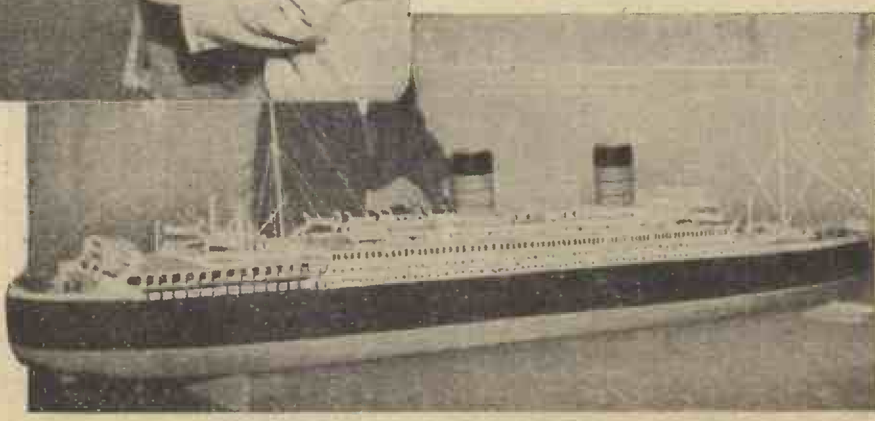
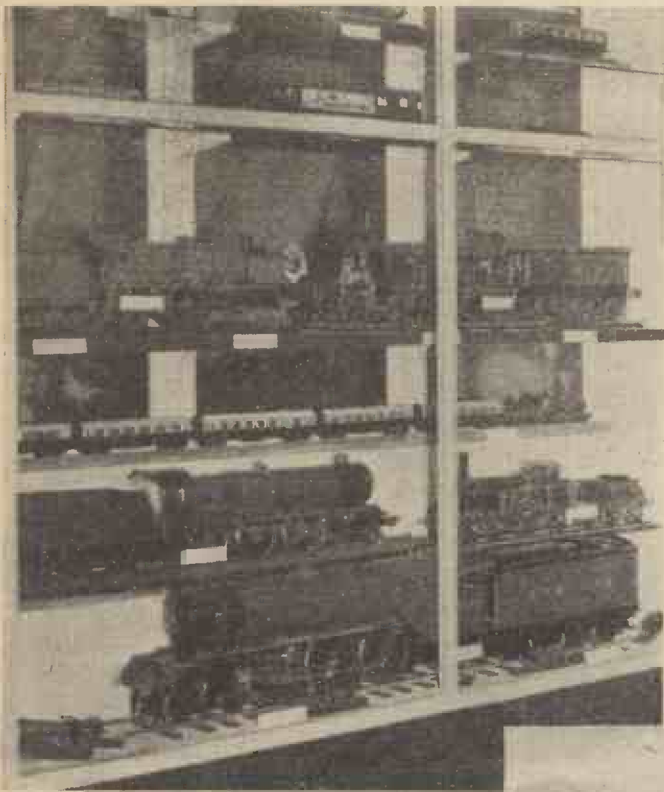


Fig. 1.—The Real Thing! Mr. Sears' latest effort—an 8ft. long floating model of the new "Mauretania."



Some of the scale models of famous British locomotives on view at the Exhibition at Charing Cross Underground Station.

was then bolted on to the strips and made a very successful job when finished.

The plans for the *Queen Mary* were supplied by the Cunard White Star, also many photographs and books, and though starting as a small boy to make models of ships, Mr. Sears considers this model his "crown of success." His *Queen Mary* model has been on view in many parts of Nottinghamshire during the war for the Merchant Navy Comforts service, and went as far as Derby not long ago for a Ministry of Food exhibition.

He has also constructed a second model of the *Georgic* after she had been converted into a troopship. Her outward appearance has changed somewhat since she was bombed and sunk by enemy action at Suez. She has only one funnel and one mast.

His two *Georgic* models make an interesting comparison—before and after—the first being painted in peacetime White Star colours, and the latest model painted all grey, showing her wartime livery.

"Old Timers"

Some of the outstanding models Mr. Sears has built include old-time ship models of the *Royal Prince*, *Revenge*, the *Great Harry*, the famous *Bounty*, and the *Cutty Sark*.

Last year he completed a model of a convoy including m.v. *Georgic* (18in.), *Duchess of Richmond* (20in.), *Queen Mary* (22in.), *Arandora Star* (10in.), *City of Benares*, an oil-tanker, cargo steamer, ocean-going tug, and several other small craft. This exhibit raised considerable sums for charity.

His other war models include His Majesty's ships *Rodney*, *Nelson*, *Prince of Wales*, *Ark Royal*, *Renown*, *Hood*, and *Exeter*. He has also modelled an R.A.F. rescue launch, a naval trawler, and the famous paddle steamer, *Royal Eagle*.

(Below)—Part of the realistic model railway layout at the British Railways Exhibition at Charing Cross.

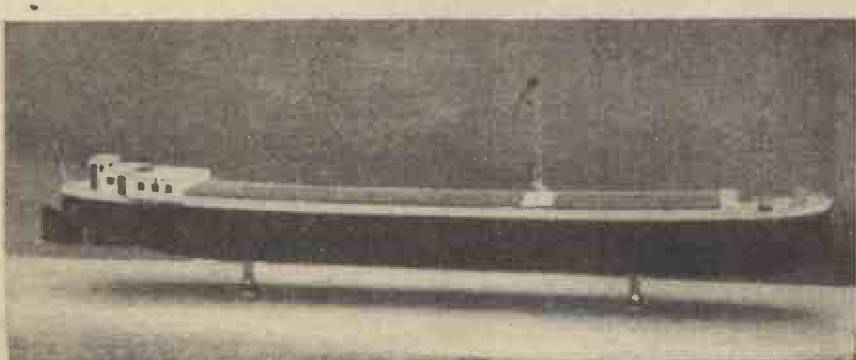
Mulberry Harbour in Miniature

His most unusual model to date was probably the Mulberry harbour in miniature. Measuring about 3yds. by 4yds. it was set out on a base representing the sea, with the French coastline in front. This model was complete with many small ships and landing-craft of different types.

A large detailed model of the spud-head piers and floating roadway, with a landing-craft ship 2ft. 6in. in length, was also made, which stood at the side of the base and was available for minute inspection by those interested at the various exhibitions. Mr. Sears was greatly helped in the construction of this model by "Mulberry Port," a book published by the Shipbuilding and Shipping Record, price 6s., which gave a detailed plan of the port and ships.

Readers will notice that we have made no mention about the means of propulsion of these models, but they are really static or glass-case models, and are just intended to float, but not to be propelled, as Mr. Sears is more interested in the external appearance of the ship model than its function as a working model.

Throughout the war Mr. Sears continued with his modelling in leisure hours, and some of his models have been made almost entirely of scrap. As I write these words I have a letter from him before me saying he is going up to Liverpool again for the week-end. "It will be grand," he writes, "to get by the sea again for a few hours and to see some more ships."



A fine scale model of a modern oil tanker.

British Railways Exhibition

AN exhibition demonstrating the vital work of British railways during the past 100 years was opened at Charing Cross Underground Railway Station, London, recently by Lord Portal, chairman of the Railway Companies Association.

The exhibition showed how British railways have progressed from the Rocket, and earlier days, to the time when a British locomotive has established the world speed record for steam traction of 126 miles an hour.

Part of the exhibition comprised over 1,400ft. of "0"-gauge electrified tracks on which miniature main line trains ran to schedule. The track layout was approximately 50ft. long and 10ft. wide.

In addition to main line trains there were model goods locomotives and rolling stock, bridges, crane gantries, goods sheds, and many other structures common to the modern railway.

Not the least interesting of this very realistic model railway system was a section of the Underground railway, with its miniature train and station. The exhibition remained open till May 18th.

Letters from Readers

Purifying River Water

SIR,—I was interested in your reply to a query in the April issue of PRACTICAL MECHANICS as to the using of river water for drinking purposes.

This is possible, and requires no expensive apparatus. The Metafiltration Co., Ltd., Belgrave Rd., Hounslow, make a small filter which is a small metal cylinder containing a metal candle around which packs a white powder called Kieselguhr. With the aid of a small semi-rotary pump, water can be pumped through the filter, the kieselguhr powder forms around the metal candle and there is perfect clarification of the water. The filter can be used until water cannot be pumped through it, then the small quantity of kieselguhr is renewed.

For sterilisation of the water a stabilised form of bleaching powder should be used. The water is pumped through the filter direct to a storage tank, then add 60 grains of powder for 200 gallons, allow to settle for approx. one hour, and the water is fit for drinking. A handy form of bleaching powder is sold by I.C.I., Ltd., Widnes, in ½lb. tins, known as "Staboclor," and these tins are complete with a 60-grain measure. The salty taste can be removed, if necessary, by adding ammonium chloride tablets (5 gr.), 3 tablets for approx. 200 gallons, or sodium hypochloride, approx. 3 grains for 200 gallons. The whole of the apparatus is cheap, compact, and portable, and unless the water is muddy each charge of the filter will last for a very large number of gallons. A similar filter to the above is known as a "Stellar" filter, and I think it is manufactured by the Patterson Engineering Co., 69, Windsor House, Kingsway, London, W.C.1. I have used this type of filter and can assure you that it gives very good results.—H. S. EMERY (Gunnersbury Park).

Wind-driven Generating Plant

SIR,—The article on the Lucas wind-driven generating plant in the April issue is very interesting.

In 1928 I was at the Morning Sun Hotel, Izotsha, South Coast, Natal, which had a wind-driven generating plant with automatic control against overspeeding, and by means of batteries the whole hotel was lighted.

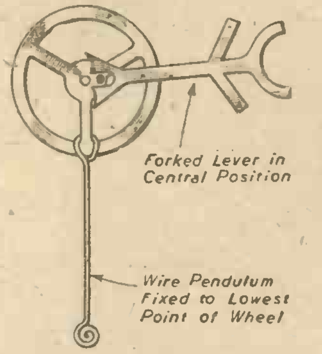
Readers of your "Cycling" section may be interested to know that in Natal cycles are licensed, the same as motor-cycles and cars. A different enamelled number-plate is issued for every year. Old licence tokens come in handy as ornaments among the Zulus.—G. RODELL (Harpenden).

A Novel Clock Repair

SIR,—While "tinkering" with an old clock some months ago, I had the misfortune to break the hair-spring, and as an experiment I fitted a pendulum in its place. Somewhat to my surprise I found that this was quite effective, and after one or two adjustments the clock was again put to use and has given very good service ever since.

It is very simple to make this alteration, especially with the cheaper kind of clocks. First, it should be ascertained whether the "works" can be turned in the case until the balance-wheel is at the bottom, and then whether the dial can be returned to its normal position, if fixed to the "works." All that is then necessary is to snip off the old hair-spring and fit the pendulum, which is made of a piece of soft wire, one end being firmly fixed on the rim of the wheel and the other end coiled up to form a small weight, as shown in the sketch. Before fixing, the lowest point on the rim should be ascertained, with the forked lever directly in line with the axis of the balance-wheel. The wire can be fixed to this point simply by twisting the end firmly on the rim or by lightly soldering.

It should now be possible to set the clock in motion, and should it gain or lose, the pendulum can be lengthened or shortened a little accordingly. In the clock I have mentioned, the pendulum was, in length, roughly 1½ times the diameter of the wheel. —W. ROLFE (Gravesend).



A simple method of fitting a pendulum to the balance wheel of a clock. (W. Rolfe.)

Is Manual Flight Possible ?

SIR,—In your issue for February, 1946, the author of "Is Manual Flight Possible ?" gives us a very plausible theory on man power. He offers a problem and gives the solution. All we have to do is to make a flapping wing machine weighing 30lb. and "up we go."

But it isn't anything like as simple as this. I don't know if he has any knowledge of modern glider practice, but the approximate weight of an average sailplane or high-efficiency glider is 300lb. I can assure him there is not a single pound of surplus weight.

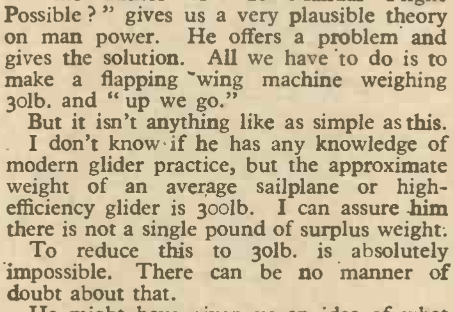
To reduce this to 30lb. is absolutely impossible. There can be no manner of doubt about that.

He might have given us an idea of what the probable cost of such a machine as he describes might be.—J. STEPHENSON (Doncaster).

A 1,000-volt Flash Tester

SIR,—The query submitted by C. W. Laight, Birmingham, and the reply published in the February issue, interested me very much.

Surely it will be appreciated that having a fuse in the secondary circuit as a warning for earths will be very inconvenient. Before putting any appliance to a high voltage test I always short the test prods to ensure everything is in order, and most inspectors ask for assurance in this manner.



Circuit diagram for a flash tester, using lamps as a warning signal.

Here is an inexpensive circuit using lamps as a warning which I have found very satisfactory, the operation of which is as follows :

Should everything be in order, the four lamps in series will be brilliant, and in the case of a short they will be very dim, with the warning lamp showing. If this apparatus is encased and the lamps screened, with a clear glass over the lamps in series and a ruby glass over the warning lamp, it will be very effective.—T. PRIOR (Motherwell).

CLUB NEWS

Bournemouth and District Society of Model Engineers

THIS Society held a most enjoyable dinner at the Tarragona Hotel, Boscombe (the club's headquarters) on Friday, March 22nd.

The occasion was partly of a social nature to mark the reopening of the club's activities on an intensive scale, and partly to raise funds towards the cost of an ambitious multi-gauge outdoor track in Southbourne—this project being possible through the courtesy of Mr. S. G. Morgan, headmaster of Southbourne Preparatory School, who has given permission for the track to be laid in the school grounds.

Mr. V. du Bedat Smythe, president, in his opening address gave some details of the track, which will be initially 160ft. long and mounted on concrete posts.

Mr. A. Sheppard, the chairman, formally welcomed the visitors—Mr. R. H. Fuller, of Messrs. Bassett-Lowke, Ltd., Mr. J. S. Beeson, of Ringwood, a prominent local model maker, and Mr. Morgan.

After the speeches the visitors judged the members' models on exhibition for the Sainsbury Cup, among which were a fine *Princess Margaret Rose* 4-6-2 in gauge "00," an L.N.E.R. tank in gauge "0," and a 2½in. gauge 2-6-2 *Green Arrow*. There was also a particularly well-constructed ship model and a novel 6 c.c. twin internal-combustion aero engine.

Mr. Fuller presented the cup to Mr. Lloyd for his chassis and internal works of a traction engine, a piece of very fine craftsmanship from one of our older members.

Readers interested in the Club and its activities are invited to get in touch with the Hon. Sec., G. E. Frewer, "Arun," Elm Avenue, Christchurch.

The Society of Model Aeronautical Engineers

THE Gamage Cup Competition for any type of rubber-driven model was held on Sunday, April 14th, 1946.

There were approximately 200 entries and, subject to a further scrutiny, the following are the first 12 placings.

Competitors were allowed three flights, and the times given are the aggregate of the flights made in seconds.

1. Warring, R. H., Zombies, 2806.7 ; 2. Millar, J. R., Northern Heights M.F.C., 2008 ; 3. Brockman, D. A., Zombies, 1438.85 ; 4. Pitcher, J. L., Croydon M.F.C., 1314.9 ; 5. Taylor, J. P., Rhyl & Preston M.F.C., 1282.5 ; 6. Kelsey, S., Cheam M.F.C., 1251.1 ; 7. Farthing, M., Croydon M.F.C., 1237 ; 8. Watkins, J., Croydon M.F.C., 1231.2 ; 9. King, M., Walthamstow M.F.C., 1190 ; 10. Armes, A. C., Pharos, 1161 ; 11. Calvert, E. H., Bradford M.F.C., 1148.75 ; 12. Lewis, E. H., Blackheath M.F.C., 1082.6.

Our Cover Subject

THE illustration on the front cover this month shows a tar distillation plant at Beckton Gasworks, near London, where half a dozen basic products are extracted from tar. Crude naphtha, from which moth-balls are made, is one of the products.

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.

Fur-removing Solution

I HAVE a domestic hot water system which I have reason to believe has become furred. I understand there is a preparation on the market in tablet or block form which can be put into the cold water supply tank and, when circulated into the hot water system, acts on the fur and dissolves it.

If you know of any such preparation, I should be glad if you would let me know where to obtain it, and how to use same.—A. E. Jones (Orpington).

ORDINARY common soda, or better still, a 50 : 50 mixture of soda and trisodium phosphate (obtainable from Messrs. B. Laporte, Ltd., Luton, Beds), when placed in the water system, will slowly dissolve fur, and many of the tablets used for this purpose consist of these materials.

We understand that effective water-softening and fur-removing materials are now obtainable from Sofnol, Ltd., Greenwich, which firm also issues booklets on this subject. We would advise you to write to this address, stating your aim and requesting the appropriate preparation for the purpose.

Making Water-colour Paint Tablets; Distemper

WILL you please supply me with a formula for making small paint tablets (of the type used in children's paint-boxes), and the pressure required to press the materials into a solid tablet.

Could you also give me a formula for making a liquid paint (water soluble) that is air solidifying ?—T. Rainsford (Barking).

ESSENTIALLY, the water-colour tablets to which you refer comprise ordinary white dextrine which has been ground up with a mineral colour, moistened with water and allowed to solidify in a tray or mould. The process of making them is quite simple.

Grind up six parts of white dextrine with two parts of whiting or china clay. When intimately mixed, take three parts of this mixture and (approximately) three parts of a mineral colour, such as ultramarine, ochre, burnt sienna, red oxide, etc. Again, make an intimate mixture of the two ingredients, and then slake the mixture with water, making a stiff paste. This is now packed into trays, or other suitable containers, and allowed to dry out. The water-colour paint is then ready for use. If the paint tends to "rub" off the paper, increase the proportion of dextrine in the mixture.

China clay, mineral colours and whiting can all be obtained from any good paint shop. White dextrine is still rather scarce, but you will probably have luck in obtaining it, price about 1s. 6d. lb., from one or other of the big London chemical supply houses, such as Messrs. Griffin & Tatlock, Ltd., Kemble Street, Kingsway, W.C.2, or Messrs. A. Gallenkamp & Co., Ltd., 17-29, Sun Street, Finsbury Square, E.C.2.

By "water soluble liquid paint" we presume that you mean a distemper. This is based on whiting and size. A good formula is :—

Whiting, 5lb.	Paint drier, 1oz.
Glue size, 1lb.	Water, ½ gallon.
Raw linseed oil, 1 gill.	

Dissolve the size in the water. Add the whiting and finally the linseed oil and the drier. This gives a white paint. It can be coloured by the addition of any mineral colour.

Parchmentising Paper

I BELIEVE parchment paper can be made by the process of dipping ordinary paper in a strong solution of sulphuric acid for a second or two, and then repeating with a solution of ammonia, afterwards rinsing with ordinary water and drying.

Would you please inform me what is the best type of paper to use ? Also, what should be the specific gravity of the two solutions, and how can I colour the paper or obtain a mottled effect ?—V. Siggery (Leicester).

THE sulphuric acid-ammonia process for parchmentising paper which you mention is only suitable for very small-scale working. It is dangerous, owing to the liability of acid spurting.

However, by diluting strong sulphuric acid (add the acid to the water, *not* vice-versa) to a specific gravity of 1.7, you can obtain a gentler-acting solution which will completely parchmentise paper after about 10 seconds' immersion, and, moreover, no subsequent ammonia treatment is required.

A still better parchmentising effect is to be had by making up a 50 : 50 solution of calcium thiocyanate and calcium chloride in water. Dissolve equal amounts of these salts in water (any quantity) and evaporate the resulting solution until its boiling-point attains 155-157 deg. C. This is the parchmentising solution. It should be used hot, and the action will be complete in 30 seconds, after which the paper is washed and dried.

Calcium chloride and thiocyanate are obtainable from most laboratory supply firms in the London area.

The Manchester Oxide Co., Ltd., Miles Platting, Manchester, 10, which originally developed the thiocyanate parchmentising process, used to supply the ready-made solution, but we are under the impression that this product was discontinued during the war.

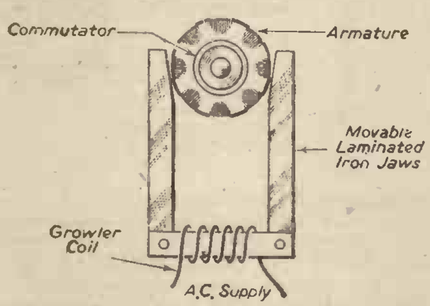
Any type of paper can be parchmentised to some degree, but the best results are obtained with the various rag papers and high grade drawing and cartridge papers.

Mottled effects are brought about by sprinkling the paper with the parchmentising solution. You cannot actually colour the paper by means of the parchmentising process. You must use coloured paper to start with.

Testing Direct Current Armatures

WILL you please oblige me by answering the following query :—

When using a "Growler" for testing direct current armatures for short-circuits, the slot containing the faulty coil is indicated by the rapid vibrations of a piece of steel strip when the latter is held over the slot. Why is it that the slots of an armature which is sound do not give this indication ? After all, the armature winding in itself when connected completely to the commutator is a closed circuit. The armatures referred to are the present day lap and wave windings.—W. Taylor (Ripley).



General arrangement of a "Growler" unit for testing direct current armatures (W. Taylor).

WHILST the armature winding forms a closed circuit the windings are, or should be, connected so that when revolving in the field magnets the voltage induced in the conductors under the influence of one pole is in the opposite direction to that induced under a pole of opposite magnetic polarity. The same principle applies when the stationary armature is acted upon by a 2-pole alternating magnetic field as supplied by the growler. The voltage induced in one half of the windings should oppose that in the other half, so the resultant voltage and current in the armature windings is zero. Under these circumstances the armature merely forms a magnetic path between the poles of the growler.

If one armature coil is short-circuited, the windings will then be electrically unbalanced with a fairly high value of current in the short-circuited coil. This short-circuit current will be limited only by the resistance and inductance of the coil, and a pulsating magnetic field will be created round the faulty conductors, which will cause vibration of a strip of magnetic material in the vicinity.

Colouring Celluloid Solution

I HAVE a solution of equal parts acetone and acetate in which I have dissolved some celluloid. I need to colour this in various shades, both clear and opaque.

Would you please inform me of the names of such pigments, and where obtainable ?—W. L. Bishop (Kenton).

IN order to colour your celluloid solution, obtain a small quantity of methylated or preferably surgical spirit and dissolve in it some spirit-soluble dye until a strong dye solution is obtained. Then add a little of this dye solution to the celluloid solution with frequent shaking, until the celluloid solution is sufficiently coloured. Up to about 10 per cent. of dye solution can be added to the celluloid solution in this manner. It is, however, best to make the dye solution as strong as possible, and to add only a minimum quantity of it to the celluloid solution.

You will probably be able to get small quantities of spirit-soluble dyes from your local druggist or paint store. If otherwise, apply to a good firm of laboratory furnishers, as, for example, Messrs. Griffin & Tatlock, Ltd., Kemble Street, Kingsway, London, W.C.2 or Messrs. W. & J. George and Becker, Ltd., 17-29, Hatton Wall, London, E.C.1.

Small Induction Coil

I WISH to construct a small induction coil, but I am at a loss to know how to set about the calculations. The coil is to work off a No. 8 battery, and is required to produce a small spark, or alternatively to make a wire glow. I should be obliged if you could help me on the following points :—

How to calculate the diameter and the length of the primary and secondary coils.

Does the size and shape of the soft iron core make much difference to the efficiency of the coil ?

What is the best material for the coil ?— N. Barnfather (Birmingham).

THE calculations involved in the design of an induction coil are much too complex to be adequately dealt with in the space available. The book "Automobile Electrical Equipment," by Young and Griffiths (Iliffe & Sons, Ltd.) gives some useful notes on this subject.

A spark which would be sufficient for ignition purposes could be obtained from a coil constructed on the following lines. The core could be made of soft iron wires 2in. long to a diameter of 3/16in., this being wrapped with one layer of empire tape. On this could be wound the primary, having four layers about 1⅜in. long of 23 s.w.g. enamelled wire. The secondary could be wound on a former or tube about 1⅞in. long made of adhesive paper tape, this coil having 8,000 turns of 46 s.w.g. enamelled wire with a layer of paper 0.001in. thick between each of the layers of wire. This coil could be 1⅞in. long. The completed coil should be immersed in hot paraffin wax, remain there for a few minutes until all the air has been expelled, then removed and drained.

If the coil is required for ignition purposes you will, no doubt, arrange for a suitable contact-breaker, driven by the engine, to be connected in the primary circuit. For other purposes a small contact-breaker could be made from a flat spring mounted at one end, with a soft iron button about 3/16in. diameter by 3/32in. thick fitted at the other end and a short distance from the end of the coil core. The strip should carry a small contact which engages with a corresponding contact in the end of a screw. A fixed condenser of about 0.005 mfd. capacity could be connected across the contacts.

Plaster of Paris Casting Material

I HAVE been casting wall plaques with a mixture of plaster of paris, but find them easily breakable.

Could you inform me of a stronger casting material such as used for plaster statues, etc.—H. Homer (Hall Green).

YOU can make plaster of paris casting material much less brittle by incorporating with it some fibrous material such as asbestos powder. This can be added up to about 25 per cent. in amount.

Alternatively, you can use a magnesium oxychloride mix.

Dissolve 40 parts of magnesium chloride in 60 parts of water, and with this solution slake to the consistency of mortar either pure calcined magnesite or calcined magnesite mixed with asbestos powder, china clay or some other suitable filler, keeping the magnesite to the proportion of about 50 per cent. of the total solid material.

Compositions made up on this basis will set hard in about 30 hours, and because they expand very slightly on setting they give very sharp castings.

Unfortunately, magnesite is difficult to obtain at the present time, but you could make inquiries at large chemical wholesalers in your district, such as, for instance, Messrs. W. & J. George & Becker, Ltd., 157, Great Charles Street, Birmingham, 3.

Electric Water-heater

I WISH to construct a water-heater, and would be pleased if you could supply me with the following information :—

The time required to raise 8 gallons of water to boiling-point, using a 1,000-watt element operating from a 230 volt supply (ignoring efficiency).

What is the value of the resistance element necessary to maintain the temperature of the water at approximately 95 deg. C. after it has been raised to boiling-point ? Also, the most convenient method of doing this ?—D. Gilbert (Charlton).

NEGLECTING the heat required to raise the temperature of the tank, and the losses by radiation and convection, the time required for the 1,000-watt element to raise the temperature of the water from 60 deg. F. to boiling-point (but not to boil the water) would be approximately 3½ hours.

The size of element necessary to maintain the temperature at 95 deg. C. after heating will depend entirely on the rate at which heat is dissipated from the container by radiation and convection air currents. With a well-lagged container the losses may be in the region of 120 watts per hour. We suggest your best method would be to use a 1,000 watt heater, assuming you can allow upwards of 3½ hours for the initial heating, in conjunction with a thermostat set to maintain the temperature between about 92 and 98 deg. C.

"Acid" Plating Bath

I WISH to copper-plate some small articles made of aluminium bronze, and propose to use a copper plate for the anode and the aluminium bronze for the cathode, both in an acidified solution of copper-sulphate.

Could you tell me of any catalyst I could use ? Also, what is the best sort of material for a container for the $CuSO_4$? Would an old car battery container, cleaned out, do ?

What sort of battery would I require to supply the current for the process ?—H. Brierley (Sale).

A GOOD "acid" plating bath for copper deposition is the following :—

Copper sulphate, pure crystal	1lb.
Conc. sulphuric acid, pure	2½oz.
Water	½ gallon

The anode should be of the purest sheet copper obtainable.

Strictly speaking, no "catalyst" is used with any plating bath, but sometimes "addition agents" are recommended for certain baths. In the case of acid copper-plating, a suitable addition agent is made by heating in a test-tube at 100 deg. C. for one hour ½ gram pure phenol (carbolic acid) with 1 cc. conc. sulphuric acid. The resulting product is phenol-sulphonic acid, and this quantity is suitable for ½ gallon of the "acid" copper solution.

The copper solution is best contained in a glass or a porcelain vessel, but an old hard-rubber battery case would also be suitable. An E.M.F. of about 4 volts D.C. is ample, but the current density (i.e., the amperage) must be about 15 amperes per square foot of surface undergoing plating. If this amperage is not used, the deposited copper will tend to be rather soft and easily scratched. If the amperage is exceeded, the deposited copper will be harder.

As a current generator for the above, 4-volt accumulators connected in parallel so as to give the required amperage are what you require. If the article to be plated is only small, a single accumulator will be ample. There is no need to exceed a voltage of 4. It is the amperage or quantity of the current passing through the bath which is the all-important matter. This, as we have previously mentioned, must be 15 amps. per square foot of cathode surface. Hence, if you were plating an article having an approximately ¼ square foot surface, you would require an amperage of just a little under 4 (i.e., 3.7 amps.).

Leather Dressing : Preserving Gut Belting

WOULD you please give me formulae for the following ?

(1) A preparation for preventing leather driving belts from cracking ; the preparation should be non-greasy as the belt is used for driving a lathe.

(2) A preparation for preserving gut driving belting.—J. Ormond (Bournemouth).

(1) You cannot have a non-greasy leather preservative, since the aim of all such leather dressings is to replace and to fortify the natural oil inherent in the leather, the loss of which results in a drying up and a cracking of the leather.

An excellent leather dressing comprises a mixture of equal volumes of castor oil and neatsfoot oil, with or without the addition of up to about 15 per cent. of paraffin or beeswax, the wax being dissolved in the warm oil. Used sparingly, this dressing (either with or without the wax) will not render a belt unduly greasy, and it will prolong its life for a very great period. A little resin may also be dissolved in the mixed oils, this being said to give the belt an enhanced "grip," but, of course, the resin is by no means an essential ingredient of the composition.

(2) Gut drives can be preserved by any means which will keep them soft and supple as, for example, by wiping an oily rag over them from time to time. The following emulsified oil preparation, however, is said to be most efficient for the preservative treatment of gut lines of all kinds :—

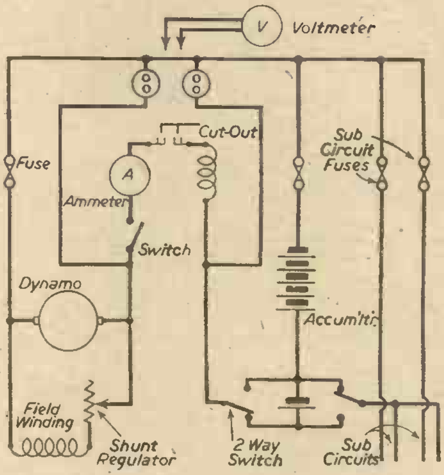
Gelatine, 1½ lbs.
Glycerine, 2½ ozs.
Turkey red oil, ½ oz.
Water, 1 gallon.

Dissolve the above ingredients in the water just below boiling-point (say, 95 degs. C.), and then add ½oz. of neatsfoot oil slowly and with rapid stirring, which stirring should be continued until the liquid is cold. The gut lines may be immersed in this liquid overnight or, alternatively, a cloth saturated with the liquid may be wiped over the gut lines from time to time.

Electric Lighting Plant for a Pleasure Boat

MY friend and I have bought an old lifeboat which we have converted for our own use. The boat is 35ft. 6in. long, and we are now waiting to get hold of a suitable engine, and I intend to wire the boat for electric light. There will be 10 lighting points and three plug points in different parts of the boat.

I shall be glad if you will give me some information concerning the dynamo, batteries, switchboard, fuseboard and load per fuse, etc., and would greatly appreciate a circuit diagram giving the rough layout.—T. Brown (Newcastle).



Circuit diagram of an electric lighting plant for a pleasure boat (T. Brown).

ASSUMING the plug points are to be used only for lighting, it would appear that a 12-volt 100 ampere-hour accumulator would be ample for your purpose. The best position for the dynamo and switchboard would appear to be the engine-room, and it would be an advantage if you could have the accumulator under cover on deck so that fumes can escape to the open air.

A shunt-wound dynamo giving about 10 amps. at 20 volts could be used for charging the accumulator mentioned above. This could be connected as indicated in the accompanying diagram, a single voltmeter provided with a plug being used.

Choke for Fluorescent Lamp

COULD you give me any information on the non-adjustable chokes now being used with 80-watt fluorescent tubes ? I believe these are different from the chokes originally used.

Also, can you tell me where bi-metal strip or sheet suitable for small time-lag switches can be obtained ?—W. J. Shillabeer (Gosport).

THE choke coil used with the 80-watt fluorescent lamp usually comprises a coil on the centre limb of a three-limbed core, a small air gap being left in the magnetic circuit. The coil is tapped for use on supply voltages differing by about 10 volts within its range.

Bi-metals suitable for time-lag elements are manufactured by W. Wilkinson, of Shustoke, Warwickshire.

Vacuum Cleaner Motor

I HAVE a vacuum cleaner motor (260v. A.C. or D.C) complete except for armature, which has been stripped, and I wish to rewind it as the rest of the motor seems to be in good condition. The armature has 11 slots and 33 commutation sections. Can you give me the size of wire required, number of turns, and method of winding ?—D. Stark (Glasgow).

WE suggest you try the following armature winding. Each of the 11 coils to have 168 turns of 38 s.w.g. s.s.c. enamelled wire with loops brought out from the 56th and 112th turns for connecting to the commutator. A coil span from slots 1 to 6, etc., would be suitable. With the armature placed so that slots 1 and 6 are equi-distant from the centre of one pole face, number the commutator segments which then lie under the nearest brush, numbers 2 and 3. All numbering is considered clockwise at the commutator end.

For clockwise rotation at the commutator end connect the start of the coil in slots 1 and 6 to segment 3, first loop to 4, second loop to 5, and finish of the coil to segment 6. Connect the start of the coil in slots 2 and 7 to segment 6, first loop to 7, second loop to 8, finish of the coil to segment 9 and so on. For counter-clockwise rotation subtract 4 from the numbers of segments quoted above for the coil connections.

The two field coils should, of course, be connected in series with the armature in such a way as to give poles of opposite magnetic polarity.

Quillaia Powder : Emulsifying an Oil

WILL you please answer the following queries :— Where can I obtain Quillaia powder, and what are suitable proportions of same and borax which, when added to 10oz. of soft soap solution, would increase its foaming capacity ? Also, could the soft soap solution be limited to a certain extent and replaced by a synthetic detergent ?

How could I emulsify a small quantity of an essential oil in order to make the oil soluble in water ?

I am using a step white which contains white lead and turpentine, but find I cannot obtain a smooth and polished surface with same. Can you give me a formula which would answer this purpose ?—J. W. Rowland (Sheffield).

QUILLAIA or "soap bark" powder has a powerful effect in increasing the foaming powers of solutions. This is on account of a glucoside named "saponin" which it contains. If you add quillaia bark powder (or an aqueous extract of the same) to a soap solution, the foaming effect will be obtained without any addition of borax. Use about a saltspoonful of the quillaia bark to about 4oz. of the soap solution. This will give an average "normal" result, the foam produced being fairly long lasting.

Quillaia can be obtained (in normal times) from any firm of chemical wholesalers. It is scarce at present, but you might try W. J. Bush & Co., Ltd., Ash Grove, Hackney, London, or, alternatively, Messrs. A. Gallenkamp & Co., Ltd., 17-29, Sun Street, Finsbury Square, London, E.C.2.

The quillaia bark (with or without borax) will confer foaming properties on any solution. Hence, in place of soap you may use a synthetic detergent, such as "Teepol," supplied (in gallon lots) by Messrs. R. W. Grieff & Co., Ltd., Royal Exchange, Manchester.

It is as well to bear in mind that quillaia has irritant and poisonous properties. It causes violent sneezing when inhaled and when absorbed into the system it can act as a heart poison.

The precise method of emulsifying an essential oil depends somewhat upon the nature of the oil, but the following process may be reckoned to constitute a general and satisfactory method :—

Essential oil	56 c.cs.
Oleic acid	6.5 c.cs.
Triethanolamine	1.3 c.cs.
Water	80 c.cs.

Method : Mix the triethanolamine, oleic acid and approximately one-third of the essential oil. Stir rapidly (preferably with a mechanical stirrer) until a homogeneous cream is obtained. Then add slowly, with constant and rapid stirring, one-third of the water. Finally, add the remaining oil and then the remaining water. A stable emulsion will then usually result.

We are not clear as to the exact purpose for which you use your "step white." If, however, you are employing it as a sort of enamel or paint, all you need do is to add a proportion of varnish (say, 1 in 4). This will give you a much smoother surface and one in which the smoothness will increase in proportion to the varnish content of the mixture.

Removing Varnish from Oil-paintings

I SHALL be very pleased if you will give me some information as to how to clean old varnish from oil-paintings without damage to the original paint.—F. L. Stabback (Liverpool).

THE removal of varnish from an oil-painting is always a job which is attended with some risk. The exact mode of procedure depends to some extent upon the age of the varnish. If the varnish is very old and cracked, it will often be found that the flat tip of the finger rubbed gently and patiently over the varnish will bring it all away. At other times, the finger-tip may be given a "bite" by rubbing it on to a little powdered resin before applying it to the old varnish.

This "finger-tip method" is the safest of all, but it requires time and patience, and more than a week will be occupied by thus treating a single canvas of any considerable size.

Alternatively, the old varnish may be wiped over with a cloth saturated with genuine turpentine or with methylated spirits to which has been added a little ammonia, or, again, with an organic chlor-derivative such as trichlorethylene. All these soften the varnish and enable it to be scraped or rubbed away. But when applying any such methods, the greatest care must be taken to see that the actual painting itself is not rubbed away.

Another method, in the case of old paintings, is to rub the brittle varnish away with the edge of a copper coin such as a halfpenny. Provided that care is used, this method can be surprisingly efficient, the brittle varnish being reduced to dust without any injury being done to the underlying painting.

In any case, however, the "de-varnishing" of paintings is a very slow process, needing considerable judgment and discretion. But given due care, it can nearly always be accomplished safely.

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Comments of the Month By F. J. C.

The Rift Widens

IN spite of the "heal the split" efforts of well-meaning but misguided partisans, there is not the slightest possibility of any *rapprochement* between the N.C.U. and the B.L.R.C. Nor is there any reason for it. The B.L.R.C. is on perfectly safe ground, massed start or no, in deciding to paddle its own canoe and to embark upon a programme of sporting events on its own lines for riders who are sufficiently bold not to bother about the N.C.U. We think that the R.T.T.C. has been gravely misled in supporting N.C.U. policy on this matter, bearing in mind that the R.T.T.C. is in itself a body formed as a result of a dispute with the N.C.U. It cannot sincerely object to another body adopting the methods which it found so successful itself.

On the other hand the B.L.R.C. seems to be even more firmly establishing itself. It has a live programme of events for this year, and the presence of the Irish team in this country over Easter is an indication that at least one national body is not backing the N.C.U.

Various meetings of the N.C.U., where delegates have proposed that the N.C.U. should approach the B.L.R.C., have voted against such a move—no doubt on the advice of legislators and others who seem anxious that Yorkshire and the North should control cycling sport. The N.C.U. finds itself in a most unenviable and unhappy position, and its die-hards, having nailed their flag to the mast, find that they have burnt their boats and that there cannot be peace, retrenchment or reform over this matter. Once again the N.C.U. has made a mess of it. If the N.C.U. has a future at all, it will need a lot of new blood in the form of younger men free from inhibitions, hatreds and spites. Even its supporters severely criticised its much publicised Easter programme at Herne Hill, which was a most boring affair and unlikely to attract the spectators to attend a second meeting. But, of course, one sees in the N.C.U. Herne Hill venture one of its reasons for opposing massed start racing, and the danger bogy is merely an N.C.U. red herring.

Macmillan's Bicycle

IT was in 1839 that Kirkpatrick Macmillan applied pedals and a rear drive to the earlier velocipede, and there has recently been a pilgrimage to his birthplace and the old smithy at Courthill where he built his first machine, to unveil a memorial tablet to his memory. We have always felt that cyclists interested in the history of the bicycle would like to have a memento of his famous machine and we have therefore made arrangements to publish in this journal drawings of a scale model of it, and this will appear shortly. The model will, of course, be a working model, not just an outline model. We propose to provide blueprints of the machine complete with working diagrams.

Northern Ireland Transport Mess

THE Northern Ireland Road Transport Board is an outstanding example of complete failure on the part of the State to substitute its own monopoly for independently operated transport services. In 1934 there existed in Northern Ireland 721 owners of 1,456 commercial vehicles, engaged exclusively in the carriage of goods for hire. In addition there were 800 vehicles operated by 519 owners for purposes equivalent to those of "B" licence holders in Great Britain. No licence was required for what would, in this country, approximate to a "C" licensed vehicle, of which there were some 5,200 in 1934.

The number of operators and vehicles was out of all proportion to the size of the country and the density of the population. There also existed four railway systems which carried a considerable amount of traffic.

As a result competition was extremely keen and to reduce costs most drivers were grossly underpaid and the majority of vehicles were in a deplorable state of maintenance.

This competition between hauliers resulted in prices for haulage being so low that few goods were carried by the railways, the charges of which were much higher. The L.M.S. railway was so concerned with the position that it informed the Government of Northern Ireland that it would be forced to close its Northern Ireland Branch. Thereupon the Government of Northern Ireland invited Sir Felix Pole to submit a plan for dealing with the situation. This plan was embodied in the Road and Rail Transport (N.I.) Act, 1935.

The New Road Policy

THE Minister of Transport recently made a statement in the House of Commons on highway policies. He said that in considering the many competing claims during the next few years upon the supply of labour likely to be available, the need for the greatest possible flexibility in any programme of road works had to be kept in mind. In view of the appalling accident statistics we should have thought that no national problem is more urgent than that of making the roads safe. Accidents are, as a fact, rapidly reducing the labour supply!

The Minister proposes to direct such resources as may be at his disposal to the promotion of safety on the highways, improvements to assist development areas and industrial development including better access to ports and markets, improved through communications, rehabilitation and improvements of towns and countryside, the redevelopment of devastated areas, the improvement of access between the home and the workshop or office and reduction of traffic congestion. Major road works are necessarily fairly long-term projects and it is thought advisable to spread the programme over the next 10 years, split into three stages of two, three and five.

Road Maintenance

IN the first stage attention must be given to the overtaking of the large arrears of road maintenance accumulated during the war, and to the repair of the serious damage sustained in certain areas from tank training and similar military activities. Provision will be made for the improvement of particularly dangerous points on roads as revealed by accident records; for the resumption of certain schemes which at the outbreak of war were either postponed or closed down—such as the Crofter Counties Scheme and the Dartford-Purfleet Tunnel; and for works of first priority in and in connection with the development areas, including the Severn Bridge and the Jarrow Tunnel with their associated roads. The road works forming part of the reconstruction of our devastated cities will also be put in hand as soon as the responsible authorities have settled their plans.

The second stage should see the completion of arrears of maintenance and continued activity in the elimination of accident "black spots"; increased activity on major road works of new construction, among which high priority will continue to be given to road improvements (including a limited number of motor roads) for the development areas and other works begun before the war, many of which should be finished during this stage. The reconstruction of weak bridges on important routes as well as road work required to relieve congestion of traffic in London and other cities is to be speeded up.

In the last five years the programme envisages a comprehensive reconstruction of the principal national routes. Some of these pass through many towns and villages and are so restricted by frontage development or by physical features that, in the interests of safety, efficiency and economy, it will be best to construct new roads reserved for motor traffic.

If Parliament sees fit to grant the necessary powers, it would be the intention to start on a further number of motor roads where that course is found to be preferable to the widening or by-passing of the existing roads. The latter, freed from fast-moving through traffic, would then remain available for pedestrian, cyclist, and local motor traffic, which would use them in greater comfort and security.

The rate at which it would be possible to initiate and proceed with work will depend on the priority which it is found possible to give the different schemes as part of the total investment activity of the country and in particular on a number of factors, including the availability of qualified technical staff and of suitable labour (which will vary in different areas) and the amount of financial provision which can be made.

Apart from the trunk roads, the initiative in highway improvements rests primarily with the local highway authorities and, in order to assist them in carrying out a progressive policy, it is intended to simplify the system of grants from the Road Fund.

Coal for Road-making

A COUNCILLOR, speaking at a meeting of Doncaster Rural District Council, said that the coal distributed in the Bawtry district recently was such poor quality that one farmer used most of his supply to mend his cart roads.

Defective Cycles

"MOST children's cycles are faulty," said the Chief Constable of Huntingdonshire, in his report on road traffic accidents. He said it was the business of parents to see that their children did not go to school on bicycles with defective brakes or lights, and they should realise that the children's lives were at stake. He also made the comment: "If a motorist has his lights properly adjusted, his brakes in good order and he pays attention to the road, he should never run anyone down at night."

Slaughter on the Road

"IT is a terrible thing to contemplate that a man going about his business in a quiet and orderly fashion can be run down and slaughtered like this," said the coroner at the inquest at Bedford on a cyclist who was run down and killed by a motorist. It was raining at the time, but it was stated that the accident occurred near a street lamp and the road was well lit. A police witness said the cyclist's rear light was in working order but he could find no evidence that the motorist's windscreen wiper had been operating at the time of the impact.

Maker of Early Cycles

MR. WILLIAM SHADBOLT, of Thrapston, Northants, who recently died at the age of 78, started business in Thrapston in 1888 as a cycle maker and repairer. He was the maker of the Victor cycle.

Leicester's Cycle Park

THE cost of the fittings for the first public cycle park in Leicester is estimated at £330, and the financial details have been approved by the Finance Committee. There will be a charge of twopence per cycle. Weekly tickets will cost 1s. 6d. The park will be in Charles Street, and attendants will be employed to look after the machines and see that there is no tampering with them.

Dots for Safety

USING record cards punched with a series of dots by using a hand punch, Sergeant Alfred Hinkson, of the Rugby Police, has evolved a system for keeping complete records of every type of road accident in Warwickshire. If an accident happens, a complete record is kept and steps are taken to see that a similar accident does not happen again. Sergeant Hinkson is now official Traffic Statistician for Warwickshire.

Too True

"CYCLING is an extraordinarily pleasant way of getting about," said Sir Alker Tripp, Assistant Metropolitan Police Commissioner, who has been a cyclist himself for 50 years. He also suggests that the way to stop accidents to cyclists is to have motorways, not cycle tracks.

Cycle Trade by the Sea

THE London Branch of the National Association of Cycle Traders have arranged an outing to Ramsgate, Kent, for Thursday, July 4th, so if London cyclists find their local shop closed they'll know the reason why. Traders wishing to attend this big rally are advised to make early application for tickets.

No Tube Without Cover

FOR imposing on the sale of a cycle inner tube a condition requiring the purchase also of an outer cover, William Horace Vernon, trading as the Vernon Tyre Co., Broadgate, Lincoln, was at Lincoln Police Court fined £7 10s. and ordered to pay £5 5s. costs. Vernon pleaded "Not Guilty" and said in his defence that at the time of the alleged offence there were no inner tubes of the required size in his shop.

A New One

FOR his novel plea, a man who was before Leicester City magistrates on a charge of stealing a bicycle should have received a little more consideration than he did. He told the magistrates: "I must have had a black-out. I had been to a dance and decided to walk home, and when I was charged I had no recollection of having seen the bike." The disbelieving magistrates fined him £5.

Another One-way Street

A PETERBOROUGH policewoman who caught a cyclist riding in the wrong direction in a one-way street in the city and reported him, started something she did not expect. The official encounter led to some unofficial meetings and now the policewoman and the cyclist have set off together down the one-way street of matrimony.

So He Says

A CYCLIST who was charged at Newport Pagnell, Bucks, with riding without a light, told the constable who stopped him that he did not intend to buy batteries as "it is cheaper to get pinched." He was fined 10s., which would have bought him quite a few batteries.

Pioneer of "Safeties"

MR. A. E. MORRISON, of Glen Parva, Leicester, who has died at the age of 69, started his business career in 1890 by making "safety" bicycles in a small workshop. Later he turned his attention to the manufacture of cars.

Seventy-nine—Still Cycling

MR. WILLIAM PINNOCK, of Rothwell, Northants, who has just celebrated his golden wedding anniversary, is still as keen a cyclist now that he is 79 years old as he was when he first rode a bicycle more years ago than he cares to remember.

Provincial Courtesy Cops

LEICESTER is one of the first provincial towns to have "Courtesy Cops," and they started their patrols during the Easter holidays. All road offenders were reprimanded by loudspeaker, but there was one solitary youthful motorist who showed real road courtesy while driving and received from the patrol a public pat on the back instead of a scolding.

Lok-a-Bike

MR. HERBERT A. G. BUTT, of Butt Products, Ltd., Kenilworth, states that he has equal manufacturing rights in the LOK-A-BIKE which was reviewed on page 50 of our issue dated April, 1946. This device can also be obtained from him.

Exhibition of Old-fashioned Cycles

AT the Bazaar de l'Hotel de Ville, a department stores in the heart of Paris, there was recently held the "Exposition Retrospective du Cycle" where queer machines of bygone days were on show. Some very strange vehicles were lent by their owners, and it was the first time that the public had an opportunity of viewing them.

Seen at the Exhibition of old-time cycles recently held in Paris. Both machines belong to Mr. Robert Grandseigne, who was the first aviator to fly over Paris in 1911. The machine shown on the left is apparently petrol-driven, the tricycle on the right being driven by a steam engine and coal-fired boiler.

Around the Wheelworld

By ICARUS

R.R.A. Records

ONE of the difficulties of assessing the relative merits of the records of the past in relation to the records of the present, as homologated by the R.R.A., is the fact that the Road Records Association is chiefly concerned with the times taken by a particular rider on a particular day riding unassisted and unpaced between one point and another. The R.R.A. takes little cognisance of the shorter routes provided since the original records were made, nor of the improvements in the bicycle itself, nor of the improvements in road surfaces. Consider some of Harry Green's records. Is it not perfectly feasible to assume that had he been equipped at the time he made his records with modern machines fitted with modern tyres and been able to adopt the shorter courses on the better road surfaces of to-day that he would have lopped several hours off his place to place records? In other words, a rider who beats one of the R.R.A. records of the past should not presume that he is necessarily a better rider than the man who previously created or held the record. For a record to be of any value at all, it should be created or broken under standard conditions. In other words, it ceases to be a record at all if the conditions under which it is broken are not constant for each rider. Of what value, therefore, are the R.R.A. records? The distance from Land's End to John O' Groats, for example, is considerably shorter under modern routes than it was when the record was first made, and the watch is not a fair arbiter of the relative performances. Even though the distances are the same to-day as they were at the time of the original record, road surfaces, tyres, and other factors affecting the speed of the rider may alter the case. An R.R.A. record, therefore, is merely a certification of a time between two points at a particular time, and is not a measure of the prowess of one rider against the performance of a previous rider riding between those two same points. I acknowledge that it would be difficult to devise a system of rules which would take the varying factors into account, but at the same time it must be admitted that time alone is not an indication of relative performance. I commend this matter to the so-called R.R.A. committee. Perhaps there is wisdom in a multitude of counsellors—usually I have found within a multitude of counsellors, and particularly in the cycling movement, there is nothing but confusion, bickering and intrigue and I do not hold the R.R.A. blameless in this respect.

In fact, I think the time has come when we want an entirely new national body embracing time trials, road records, track racing and touring—a body which will really represent all shades of cycling opinion and one which divorces cycling from politics. I see no particular reason why the National Clarion Cycling Club should claim to be a national body, with its tiny membership which was formerly allied to a political body. In fact, it was founded by a political body.

Audrey Allis as Hostess

OVER 400 Service and ex-Service cyclists gathered at the Porchester Hall, Bayswater, W., on an April Saturday as the guests of Audrey Allis, their "pen pal" during the war years. Prior to arriving at the party Miss Allis broadcast in the radio programme, "In Town To-night," and was accorded a tumultuous reception when she took her place at the brightly decorated top table in Porchester Hall.

In his toast, "Our Ladies and Civilian Guests," Audrey's uncle, "Ragged Staff," referred to the presence of Major H. R. Watling, O.B.E., Secretary of the Manufacturers' Union, A. H. Ward (*The Trader*), and F. J. Camm, Editor of *The Cyclist*, who had shown sympathetic interest in Miss Allis's writing efforts from the commencement. Marguerite Wilson, the famous lady professional record holder, was welcomed, together with many club girls who had all done "their bit" during the war years by letter-writing to "Absent Friends" and organising various Comforts Funds.

Dick Swann, founder of the Technical C.C., the noted M.E.F. cycling club, and John Gunning, a Palestine policeman and member of the Norwood Paragon C.C., shared the toast of "Our Hostess," to which Miss Allis modestly replied.

"Our Sponsors" were sincerely toasted by "Ragged Staff," who spoke of the manner in which Sir Edmund Crane, chairman of the Hercules Cycle and Motor Co., Ltd., had undertaken the financial responsibility of the party. Sir Edmund responded in a telling speech in which he urged all cyclists to play their part in good road behaviour and to enjoy in the fullest sense the happiness that cycling brings to its devotees.

A memorable evening concluded with entertainment by a first-class orchestra, singers and comedians, including Anona Winn and Stainless Stephen, the radio stars.

Anglo-Irish Reunion

THE Anglo-Irish Reunion was held recently under the auspices of the London Gaelic Athletic Association and the B.L.R.C.

The meeting at Paddington track in which the two sides were fairly evenly matched was followed by a dinner at Young's Chinese Restaurant.

The chair was taken by Jimmy Kain in the absence of E. W. Tugwill.

Bill Mills, in a witty speech, proposed the toast of The National Cycling Association of Ireland.

Mr. Durman, in the absence of Mr. F. J. Camm, responded to the toast of "The Visitors" proposed by D. Carey.

The Danger Bogy Debunked

THE current issue of the B.L.R.C. Handbook for 1946 contains an interesting article by Mr. F. J. Camm (Editor of *The Cyclist*) under the above title, with a subheading "Dangerous N.C.U. Nonsense." I cannot quote the article in full, but I give a few paragraphs from it.

"Adversity, it is said, makes strange bedfellows, and there could be no stranger occupants of that hard-sprung couch—cycling politics—than the N.C.U. and the R.T.T.C., with their dutiful and uneasy chambermaid, the C.T.C. Over fifty years ago, when the Hooleys and the Hooligans, the Penningtons and the Pedallers between them constituted the industry and the pastime, there was born a curious body known as the National Cyclists' Union. It is a most ambiguous title in that, in effect, it has never represented *national* cycling opinions, and as a union has never been *united*. In those early days, however, its articles of association were all embracing. It was formed to govern not only massed start racing on the roads, but also track racing, attempts at records, and nearly all other cycling events. . . . The National Cyclists' Union, with that trembling aspen-like fear of authority which it seems to have evinced through five decades, threw up its hands in an air of supplication and banned cycle racing (pardon, time trials) on the roads as well as attempts on records and prohibited its officials from partaking in any capacity whatsoever in road events. It was in future to confine its attention entirely to racing on closed surfaces. It issued licences to riders, and no track event could be run except under N.C.U. rules. We all know how loose those rules have been, if we recall Harry Hill's attempt at the hour record on the Paddington track, which was found not to have been measured by the N.C.U.! (It was, as a fact, measured by Mr. Camm's independent surveyor as a result of which the record was re-established and handed to its rightful owner). . . . But for the wisdom of men like Bidlake, etc., road sport would have been killed stone dead by the weak-kneed attitude of the N.C.U. But these men continued with time trials, although they adopted an attitude of fear and planned the sport on the hole-and-corner sneak-thief methods which have persisted ever since. . . . What was the reason for this N.C.U. attitude? They thought that road sport was "dangerous," but fifty years of it have shown the police and the N.C.U. to be wrong. Road records have continued ever since, and the N.C.U. and the police were wrong about those, too. The N.C.U. has a thoroughly bad record, for its judgment has been unsound on every issue which it has raised to the level of *cause célèbre*. It has rightly earned the reputation of being the apostle of lost causes. . . . Massed start racing has provided more powerful publicity for cycling than anything which either the trade or the N.C.U. has done during the past fifty years. . . . The N.C.U. is now vitally concerned with developing Herne Hill. . . . Its present attitude seems to indicate a fear that massed start racing will kill track racing. . . . The astonishing thing is that the N.C.U., which tried to throttle time trials and road records, now has a working agreement with the R.T.T.C. . . . As the N.C.U. was wrong over time trials and road records, it is logical to conclude that its judgment is equally unsound about massed start racing. . . . If massed start racing is dangerous, such danger is not a matter of locality, yet the N.C.U. grants licences to its own members to race in such events abroad. . . . The N.C.U. is not representative of anything more than a few hundred track riders. . . . There is no individual or body more anti-social than those who try to stab others in the back. . . . Ignore those old men in the cycling game who seem like mere reference books which have never been revised or brought up to date. No wonder the late John Urry advised clubs to teach their members to spurn and detest the N.C.U."

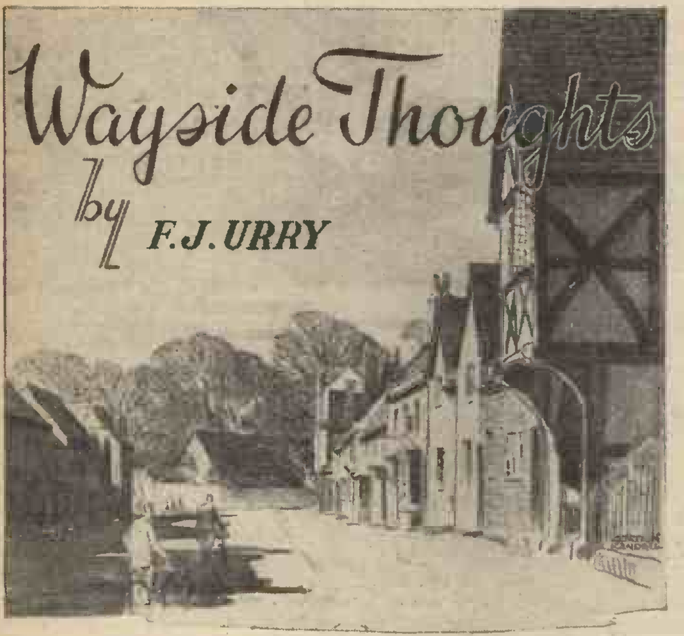
Headmaster's "Safety First" Rule

PUPILS of Whitby Mount (Yorkshire) Junior Boys' County School must not in future cycle to and from school unless they hold a cycling certificate awarded by Mr. W. A. Burton, the headmaster.

The ever-growing number of boys who cycle to school decided Mr. Burton to introduce a test, and he has told the pupils that unless they can pass this test they must leave their cycles at home.

He considers that the test will tend to minimise the risk of danger, and improve the standard of cycling among his pupils.

The headmaster has no power to ban his pupils from cycling to school, and on my authority they can safely ignore his ban.



Not Yet

I CALLED to see if one of my trade friends could build me a new bicycle to charm my love for this type of travel. He is a small maker from whom I have purchased many mounts, and never a poor one. But he held out no immediate hope of satisfying my desires, or indeed of satisfying himself that the goods he was making were worthy of a life's reputation for the best. Tyres, rustless rims, and the very best of equipment were just impossible to obtain, and even the war-grade rims were a difficulty, for his stock of makers' tyres and rims were so unbalanced that otherwise finished machines were awaiting supplies of the latter. The agent is passing through a worrying time saying No! to so many of his customers, but the little maker catering for the specialist buyer is infinitely worse off, since he cannot even satisfy himself. We home riders are suffering from the urgent effects of the present export drive, and even though we may know quite well that the national policy is the right one, individually it does not give us a happy feeling, rather a sense of frustration that we are being treated cavalierly by the trade, stamped to a pattern with too great a feeling of permanency behind it. Well, we shall have to wait, make do and repair, for truth to tell I'd rather be riding a good brand of old bicycle than some of the modern ones I see on offer. If the next few months proves to be a sticky time, and the possession of a first-class machine is difficult to come by, I think by the back end of the season we shall see a change, and the Show—if it is held, which I sincerely hope will be the case—will restart the competition among makers to improve the design and finish of their products.

Good Protection

DURING the cold spells last winter I found my Grenfell cloth reefer a real comfort. I think I told you about it last spring, but did not have much chance to try it out until the pinch of the recent March weather. To all intents and purposes it is a light overcoat without tails, and being made from wind-proof material resists the chilly blasts and keeps my body delightfully warm. I hate riding in tails, and the average lumber jacket does not protect that part of me the exposure of which seems to make the remainder of me chilly. The coat is light, fits easily over the ordinary coat of a cycling suit, and if I do not need its warmth can be rolled up and tucked into the bag. I believe that for the regular daily rider a garment of this nature is valuable, fulfilling the purpose far more comfortably than the overcoat or raincoat you see so frequently in use. It ought not to be expensive to make and market once the P.T. is removed from clothing and coupons are at rest. I suppose it is due to the passage of time that I feel the cold penetrate my bones more deeply than was once the case—not surprising, if a trifle annoying. Cold feet have always been a trouble, and immediately such things are made again I am going to try a pair of shoes lined with lamb's wool *à la* Glastonburys. Indeed, that item of winter equipment is on the list of my "reserve" presents, things wanted but which cannot be purchased now, even though coupons may be available. So, you see, I have gone beyond the stage of being a "tough guy," and have arrived at that period of life when I will do my best to be a comfortable cyclist, for in that adjective is expressed the intention of satisfying my love of wandering in almost any type of weather. How the younger tribe keep warm and comfy in shorts and light-weight jackets when there is ten degrees of frost puzzles me. Perhaps they don't, but like the part. Well, I like comfort first, and hang the looks.

It Costs More

SOME of my cycling friends have spoken to me on the subject of the 27s. 6d. rise on the basic price of bicycles as if the addition came as a shock to them. Personally I think it is a very modest increase when one remembers the wage conditions to-day compared with those pertaining in 1939. Then juvenile labour played a considerable part in the making of the bicycle, and the price of it was based on a figure in the region of £1 per week plus some addition due to the dexterity of the piece-worker. The bad thing about such jobs was that too often they led to blind-alley occupations. That method, I think, has gone for ever, and just as the buyer of a bicycle desires fair wages, he would, I imagine, not have the maker of the vehicle dissatisfied with earnings. We shall never go back to the old days, and a good job, too, and that is the reason for the increase in cost. But it does not mean that the price of bicycles will not ultimately fall, for there is P.T. to consider, which roughly represents a quarter of the retail price; and P.T. must be considerably reduced or cancelled in the not-too-distant future. But the moment isn't yet, nor will it happen until the export hunger has been satisfied and manufacturers are selling bicycles as distinct from merely turning them out. Do not blame the Chancellor of the Exchequer; he wants our money, and so long as demand is more than supply can cope with, do you expect him to drop the means of easy revenue? It is just as simple as that in my view, and I imagine the trade thinks likewise. When makers consider the proper moment has arrived, they will not be slow to voice their protests for the cancellation of the tax, bringing to bear on the powers-that-be the backing of every cyclist. I think they are wise to save their breath for the propitious moment: there are many articles carrying P.T. which have prior claims to cancellation, but the bicycle is fairly high on the list. In a way the increased cost of cycling may easily make the pastime more popular among ordinary citizens who had previously rather scorned it on the score of cheapness; and possibly it will make all of us a little more keen to care for our property, which would be a very good thing both for the bicycle and its rider.

The Season

ALL these details are interesting because they affect our pockets, our aspirations and our patience. They are part of cycling, but not a very active one. The great activity will have started by now, the speed lads and lassies will be ready, the helpers keen again to make their own generous contributions of self-sacrifice, and the officials will be busy. Another season is "on the go," and it will be a big one. Yet possibly not so big as some folk think, for while many folk will be returning to civil life and the good old game, many others, with whose names we have become familiar, will be in the Forces, and sent overseas quickly to finish their military training. Clubs are not going to find the business of the sport as easy as it may look to anyone taking a quick glance. The wars are over, but their aftermath will have its inevitable repercussions on all the younger men for a period which has still to be decided by the Government. All the more reason why those of us who are still free to worship our old love of cycling should do our best to help the game along. Such is the sporting side of cycling as I see it; while the game as a pastime will be more popular than ever, with the lack of touring accommodation the only snag. What I would like to say to the sporting folk is this: Don't forego your interest in cycling as such; racing is good, it encourages the self-sacrifice of training and puts grit into the determination of people who practise it; but cycling for cycling's sake, for the love of country, for the freedom of movement and the delight of the golden days is something every active individual can practise and remain active, fit and happy, and reasonably young. I know, having been through it, and to-day, after 57 years of the game, I'm certain that life without cycling would lose much of its savour for me. Remember, that when your competitive days are over the younger generation need your help and advice, and, just as important, remember, too, that you owe to yourself that ease of travel and great joy which automatically is in the ownership of the man who has been an expert rider in his youth. There are far more things in cycling than the hope of how many minutes you can lop off "even time," and they are well worth cultivation.

Claims Your Activity

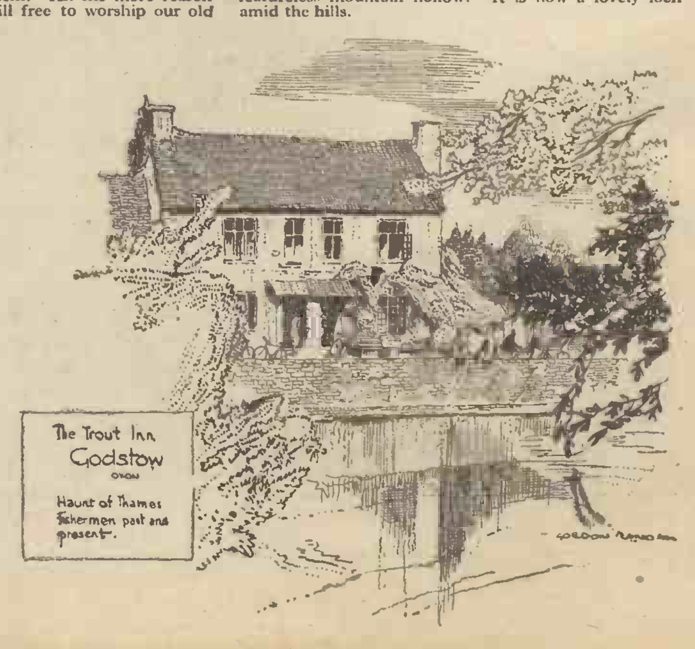
"THE joy of the year" creeps nearer every hour, and the signs of spring are not wanting as I write. They mean much to all lovers of the country, and particularly to those who, like myself, have fewer springs to welcome, and regret the fact. Looking back, fifty springs have been all too few to watch the land grow to loveliness and witness the romance of the great changes from a bitter day of February to the mild beauty and bird melody of a mid-May morning. Isn't it Housman who wrote of the cherry tree:

Stands about the woodland ride
Wearing white for Eastertide

—and that moment of cherry blossom is now with us, for during a trip to the Teme Valley at Stanford Bridge, where the dappled cherry tree trunks show in the sunshine, I thought how I must come again and see "the snow along the bough." The months past have given me several good journeys amid a variety of elements which only the passage from winter to spring can present, or at any event with the knowledge that the bad will soon give way to the good, and the good is but the harbinger of golden days ahead. My daily riding keeps me fit, and those sixty mile journeys are joy-trips, sending me to places banished from vision during the long nights; and how beautiful they are! It is all very well to be whisked there and home again in a motor-car, but such journeys lack any sense of satisfaction because they possess no personal ego. Many people do not agree with me on that point; but then many of them have no experience of the joy implicit in personal activity, and if they were ever cyclists have forgotten the thrill of the motive power in the individual who has remained one. It never dies if you want to keep it alive; you are the deserter, never the pastime.

Those Amenities

WE have heard and read a lot about amenities of the countryside during the last month or so, mainly in reference to the Manifold Valley and Ennerdale. Now, I'm not competent to discuss these questions in a technical manner, and I should feel aggrieved if the schemes under project destroyed the beauty of the countryside; but will they? I knew the Elan Valley before Birmingham started to make their reservoirs, and my recollection is that the place was definitely beautified, and stands to-day as one of the "sights" of mid-Wales. Vyrnwy, too, is very lovely; so is Thirlmere; and that lake above Trawswynedd, built and flooded for power purposes—which so many of us can remember under construction—has created loveliness from out of an otherwise rather arid stretch of road. As far as the Manifold Valley scheme is concerned, I should not like to see its construction alter the flow of the Dove, through its delightful gorge from Beresford Dale to Thorpe Cloud, and if that point can be settled to the satisfaction of people better able to judge than I am, and give the city of Leicester the water it needs, then I think Leicester is entitled to the benefit. Of the Loch Tummel scheme, all I know is that the scene is very beautiful now, also the rivers Tummel and Garry. But I am told by people on the spot or close to it that when the work is completed the loveliness will not have departed, and the amenities to the folk living in the area affected will remain for ever. Loch Katrine is the water for Glasgow citizens, but who shall say its area has been spoiled? And then I remember Clatteringshaws—near New Galloway—when it was a featureless mountain hollow. It is now a lovely loch amid the hills.




BAILEY'S
SUPER PUMP
MADE IN ENGLAND

CYCLORAMA

By H. W. ELEY

The famous
STAR INN
Alfriston, Sussex.
One of our finest specimens of the timber inn of the 15 cent

Homely Hertfordshire

IT was in Charles Lamb's favourite county where I spent my Easter, or most of it, and good it was to cycle around Hatfield, and Essendon, and the environs of Hertford itself. Of course, the weather was perfect—I do not think I can recall a more wonderful day than Easter Monday—and cyclists in their thousands made the most of it. I mixed my cycling with my love for horses, for I attended the gymkhana held in Bedwell Park, near to Essendon, and a happy, English-like function it was. That's the best of a cycle; one can combine cycling with all kinds of other pastimes and pleasures! And what a boon it was to be independent of crowded buses and trains!

They Publicise Cycles and Cycling

RECENTLY, in a Birmingham hotel, I met two advertising men who both do a great deal to keep the bicycle popular and extol the joys of riding. They were D. D. McLachlan, of the Hercules company, and J. F. Brealey, of the B.S.A. organisation, two stalwarts I have known for many years, and for whose cheerful vigour I have a great admiration. Both are good at their jobs because they believe in cycling—and that is the great secret! Fancy being asked to advertise bicycles if you did not love them and use them! Brealey told me that he will be going to Scotland for the Kirkpatrick Macmillan celebrations towards the end of May, and I have no doubt that he will be one of the most active and cheery members of the party organised by the Centenary Club, which numbers amongst its members some of the magnates of the cycle-manufacturing industry.

Leaning Over a Gate

DO you, when out in the country, ever lean over a gate and gaze across a field? It is a practice I commend. Put the old bike against the hedge, light up that old briar, and then, leaning over a gate, give yourself up to a little quiet contemplation. It is surprising how quickly the frets and troubles of the day will melt away! Those worries which seemed so huge and terrible when you were at the office desk will soon shrink into nothingness. The grass is very green, and those red-and-white cows so calmly chewing the cud provide a lesson in contentment. And if it be early evening, that sweet hour before dusk, you will hear the last chirpings of many small birds, saying good night before retiring into the fastness of some hedgerow or bush. And the sky is streaked with pink and gold, and the bluish smoke rising like incense from the chimneys of Old Ash Farm is a pleasing sight. Your tobacco tastes good . . . and there is the fine ride home, through Little Grassford, where there is that comfortable inn "The Fox and Magpie." You will call there for a tankard of ale, and ride home at peace with the world. All because you leaned over a gate! Try it and see.

Big Plans for Alexandra Palace

I HEAR of all kinds of big and ambitious plans for the improvement of Alexandra Palace, and the other day someone told me that a grand cycle track was contemplated, and that an effort would be made to make "Ally Pally" the mecca of cycle racing in the London area. Now, I do not know whether my informant was merely passing on a rumour, but I have often thought that North London could do with an Alexandra Palace run on better and brighter lines. It is a place of enormous possibilities, and we may yet see it turned into the wonderful "haunt" it could be.

Brighter Cycle Shops

HOW good it is to see some colourful window display material in some of the cycle shops again! Far too long have we been denied show-cards, and cut-outs, and all the ingenious aids to window display. I was delighted the other day to see a shop displaying some of the old-time "insets" in cycle tyres, and on the window was a bright and colourful "streamer." Things are looking up, and maybe the days of dismal drabness are going at last.

The
OLD MAGPIES
Sipson Green
Middlesex.
In 1798 a traveller returning by carriage from Windsor was shot dead by highwaymen by this little inn.

Oil in the Wrong Place

YES, very much in the wrong place when it is on the floor of a garage, and a perfectly good bicycle is standing in the pool! That was what I saw the other day when I visited a friend to borrow a spanner. I pointed out with care and emphasis that oil was deleterious to rubber, and that his tyres would be damaged if he stood the bike on dirty oil patches. He took the hint . . . but I wonder how many folk are careless in this respect? Remember, oil is a real enemy of tyres, and should be kept away from them.

"We are Seven"

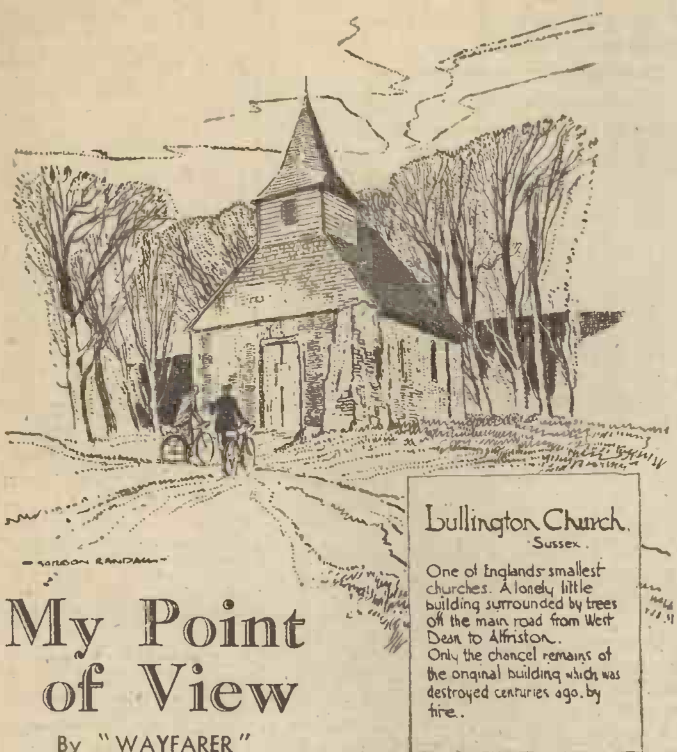
I KNOW a family composed of father, mother and five children. All possess bikes, and all are keen riders. To see those seven bikes, all in well-made racks in a garage, is a fine and encouraging sight! And I like to see the family start off for a run on a Saturday afternoon. They are excellent advertisements for cycling, and, incidentally, all are fit! I pass this story on as a tip to families.

The Lure of Lichfield

ALWAYS a place of beauty, calling one to stroll in its narrow old streets and enjoy the matchless grace of its cathedral, Lichfield will be more than ever in the news this year, for it celebrates the 750th anniversary of the founding of the cathedral, and great preparations are in hand for marking the occasion. Royalty will be there in June, and many a touring cyclist, with good memories of the little Staffordshire city, will make a point of riding there this summer. That famous West Front of the cathedral is glorious; and, of course, the city has many historical associations. Was not the great Doctor Johnson born there? And did not Elias Ashmole hail from that quiet little city by the wide Trent? Not at all a bad place to tour around this summer of 1946.

The House-martins Come Back

THEY always do, those dainty little birds which so many mistake for swifts. And the amazing thing is that they come back to the same little corner of the same old barn or shed, taking up residence as easily and as unconcernedly as if they had never left these shores and wintered in some sunny clime over the seas. Soon we shall have the swallows; and how I love to see them wheeling gracefully over my garden and settling on the clothes-line for one of those "conferences" which, to the swallows, I doubt not are as important as UNO to us! Good it is to see our summer birds returning.



Bullington Church. Sussex.
One of England's smallest churches. A lonely little building surrounded by trees off the main road from West Dean to Alfriston.
Only the chancel remains of the original building which was destroyed centuries ago by fire.

My Point of View

By "WAYFARER"

Without Comment

ADVERTISEMENT in a Manx newspaper :—

Isle of Man Fat Stock
Marketing Association.
Weekly Live Stock Sales.
Special for Ballasalla :—
Gent's Cycle.

Experiences

DURING the four-day holiday with which Easter provided me I travelled a total of 296 miles, without at any time being more than 30 miles from home. I simply sat on my bicycle and let it "go places," although, of course, I had to do a little pedalling now and again—all the roads in my district not going downhill all the time! Despite this average of 74 m.p.d., with late starts and early returns (I was home nightly just in time *not* to listen to the nine o'clock news!), my meals were all leisured ones, and the journeys were far from being "one demnition grind."

No difficulty over meals was experienced except on the Tuesday, when the fourth attempt (in a busy riverside town) was successful. "Three-course-lunch-two-and-six," ejaculated the young woman behind the counter at a restaurant. The price did not stagger me—and I hoped that my appearance did not suggest that it would! That was quite a good lunch, so far as it went—but it didn't go very far! The meat, bully-beef over which hot gravy had been poured, was nearly sufficient to fill a teaspoon (that is literally true), and prompted my inquiry of the waitress as to whether this was a vegetarian restaurant. But, bless ye, that bit of sarcasm was completely wasted!

The point I really desire to bring out, however, relates to my actual experiences on the road during those four days—days, of course, when lots of people were about, and the "basic" was stretched to do more and more miles to the gallon. I gladly testify to the fact that, in the course of those 296 miles, partly on busy main roads and partly on secluded secondary roads, only three objectionable traffic incidents came to my notice. The first occurred on the Saturday, just after I had started out. Two youngish cycle-tourists, properly dressed for the part, and looking very business-like, were holding on to a lorry which was batting along at 25's or so. I happen to view this practice as a highly dangerous one, which is almost 100 per cent. illegal. A tragedy was nearly enacted before my eyes, for one of the boys got into a sort of wobble, and I thought he would have crashed, probably with fatal results. Mercifully, he was able to right himself, and his flight continued. (Just at present, in connection with the anti-nationalisation campaign, one sees plenty of notices about bearing the injunction: "Hands Off Road Transport." May I commend that good advice to all cyclists? Don't take power that does not belong to you: "paddle your own canoe.")

On the second day, a motor-car elected to stop on the inner curve of a roundabout, apparently to enable a change of drivers to take place. Keeping well to my left, I went quietly ahead, and was astonished when another car, loudly honking, bored its way through—a piece of bad manners against which I was helpless. On the third day, the driver of a motor-coach, forgetting the length of his vehicle and not realising that my speed at the moment was not much less than his, gently squeezed me into the kerb. Guessing what might happen—that sixth sense is most useful!—I was ready for this emergency and took evasive action to avoid a toss. These three incidents—of which, to my mind, the first was the worst, because cyclists were at fault—lead me to hope that road conduct is on the mend. There is room for improvement.

Last Item

ONE final incident—very trivial—may be worthy of mention. On the last evening of those four days, near home, a woman blithely stepped off the side-walk as though she were living on an uninhabited island. Then she looked round and saw me bearing down on her. She heard me, too, for I ejaculated "Oy!" or words to that effect. Do you know what she said to me as she hurriedly stepped back on to the side-walk? Of course you don't, and you'd never guess. She said: "*Look where you're going!*" She was surely talking to herself!

Friday's Alluring Thought

THE monks of old went a-fishing on Thursdays, because, in the words of the song, "To-morrow will be Friday"—when meat was not eaten. The cyclist of to-day (many of him) finds on Fridays the focus of his mind narrowing because "To-morrow will be Saturday"—a day which involves a number of hours of liberty and visualises the possibility of much travel. So Friday's alluring thought, in the case of cyclists, relates to Saturday—and also to Sunday. Happy days: Friday for anticipation, and Saturday and Sunday for realisation—not to mention Monday, Tuesday, Wednesday and Thursday for retrospection!

Top o' the Bill

IT may be only a beautiful memory by the time this note appears, but, at the moment of writing, the weather is superb—the top o' the bill type. To-day is Monday, and I was wondering this morning how many people in all made the most of their opportunities yesterday by getting out into the country. There were hordes of cyclists abroad, and, on the main roads, crowds of motorists, but how many non-cyclists, and how many halfhearted cyclists, wasted a golden opportunity by stewing in towns and cities when, so near at hand, in most cases, the delectable countryside, arrayed in gorgeously beautiful spring garments, awaited them? I am better at asking such a question than at answering it! I only know that those who did get away from the populous places shared a rich reward, for "the living out-of-doors" was looking at its best, and the atmosphere was strangely translucent.

On that Sunday I did a journey of 75 miles (I rarely exceed that distance nowadays), but a trip of, say, five miles out and five miles home would have been just as good in its way so long as there was a nice vantage point at which to linger; and that shorter distance is surely within the compass of millions of people who nominally come in the cycling category. The April Sunday of which I write was a truly sublime day, which is never likely to be bettered in high summer, for the very simple reason that you cannot better the best.

Generally Speaking

I THINK that it was in respect of this particular week-end that a friend called my attention to a newspaper paragraph wherein it was stated that the Automobile Association calculated that on the London - Brighton road motor-cars were travelling to the coast at the rate of 1,000 an hour, at noon on the Sunday. My friend inquired how this fitted in with my "heretic views" on traffic congestion. I replied that the facts, as revealed, relating to one particular road at one particular time on one particular day, proved nothing—though, to be sure, they did demonstrate the follow - my - leader sheep-like ideas held by many motorists! I added that this country contained about 178,000 miles of classified roads, and that the distance from London to Brighton was 53 miles. I did not insist on the circumstance that the so-called "calculation" was made at only one point, nor that it applied to the peak-hour (or, perhaps, peak-moment).

The excessive use of one road, I said, did not supply a true picture of general traffic conditions, and it was the general aspect that really mattered. I added that, for my part, I enjoyed complete seclusion in the course of my own journey, except for one mile of main road after lunch and two miles of main road in the evening. Surely we must take the general, rather than the particular, experience of road travel in order to obtain something like an accurate picture of present-day conditions.

Those Dreams

I HAVE just replied to a soldier-correspondent who, on the point of being demobilised, sought some information with regard to the Isle of Skye. This is how he ends his letter: "I have planned this tour for many years and used to lie in bed at night, in a P.o.W. camp in Germany, thinking about it." What a joy it is to help such a reader! I had those dreams in the other Great War, when, thanks to getting in the way of something (as we used to put it), I spent exactly six months in bed. My dreams were of a long, long holiday at the Pen-y-gwryd Hotel, in the shadow of Snowdon. It never came off, but the thought helped to relieve the tedium of a brand-new experience, which the lying-in-bed act certainly was to me. And now this soldier-boy, who has dreamt, during his incarceration, of the Coolins and Loch Coruisk and Uig and Flodigarry, is about to enjoy the realisation. Lucky Jim!

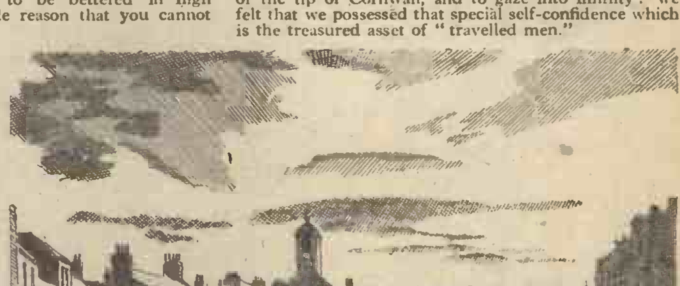
Old Pals

A FRIEND to whom I lent a couple of maps the other day looked at me in an old-fashioned way on noticing the rather ragged condition of one of them. In reply to his unspoken criticism, I said: "See the date? Bought 30 years ago!" And I went on to explain that many of my maps were old pals, not to be lightly set aside in favour of new ones, though from time to time this action became necessary—when maps fell to pieces! Were they able to speak, these ancient sheets could tell an interesting story of adventure "by flood and field." I cannot bear to scrap them. They are cherished companions which have shared my joys and sorrows along the road for many a moon.

In Debt

OUT of the blackness of the night came these words, apropos of nothing in particular: "Yes! I suppose few of us really appreciate the extent of our indebtedness to the bicycle, and to the pastime of cycling." My companion, an old friend recently released from the R.A.F., and now spinning his wheels with renewed joy, had evidently been ruminating on these things as we rode homewards on a 25-mile course, and his thoughts were probably spoken without intent. We had been travelling in silence for a while—that silence which is always better than idle speech—but here was a fitting topic for two ardent cyclists to discuss.

There was no difference of opinion. We were both vividly aware of the extent of our indebtedness to the bicycle: we both felt that the debt was irredeemable: we both saw the relative emptiness of the world without the bicycle: we both knew that cycling had helped us physically as well as mentally and spiritually—that the health we possessed and the knowledge which was ours was due, very largely, to our cycling activities. We knew that we could listen interestedly and talk intelligently and answer questions rightly as regards Devon and Cornwall, the Lake District and East Anglia, Wales and Scotland, and Ireland: we knew that we could recommend a certain hotel at Killarney and a certain boarding-house at Aviemore: we could always see in our mind's eye Ben Nevis and Slieve League and the Black Mountains and Penyghent: we knew what it felt like to stand at the land's extremity, whether at Cape Wrath or the Bloody Foreland or the Braich-y-pwll or the tip of Cornwall, and to gaze into infinity: we felt that we possessed that special self-confidence which is the treasured asset of "travelled men."



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