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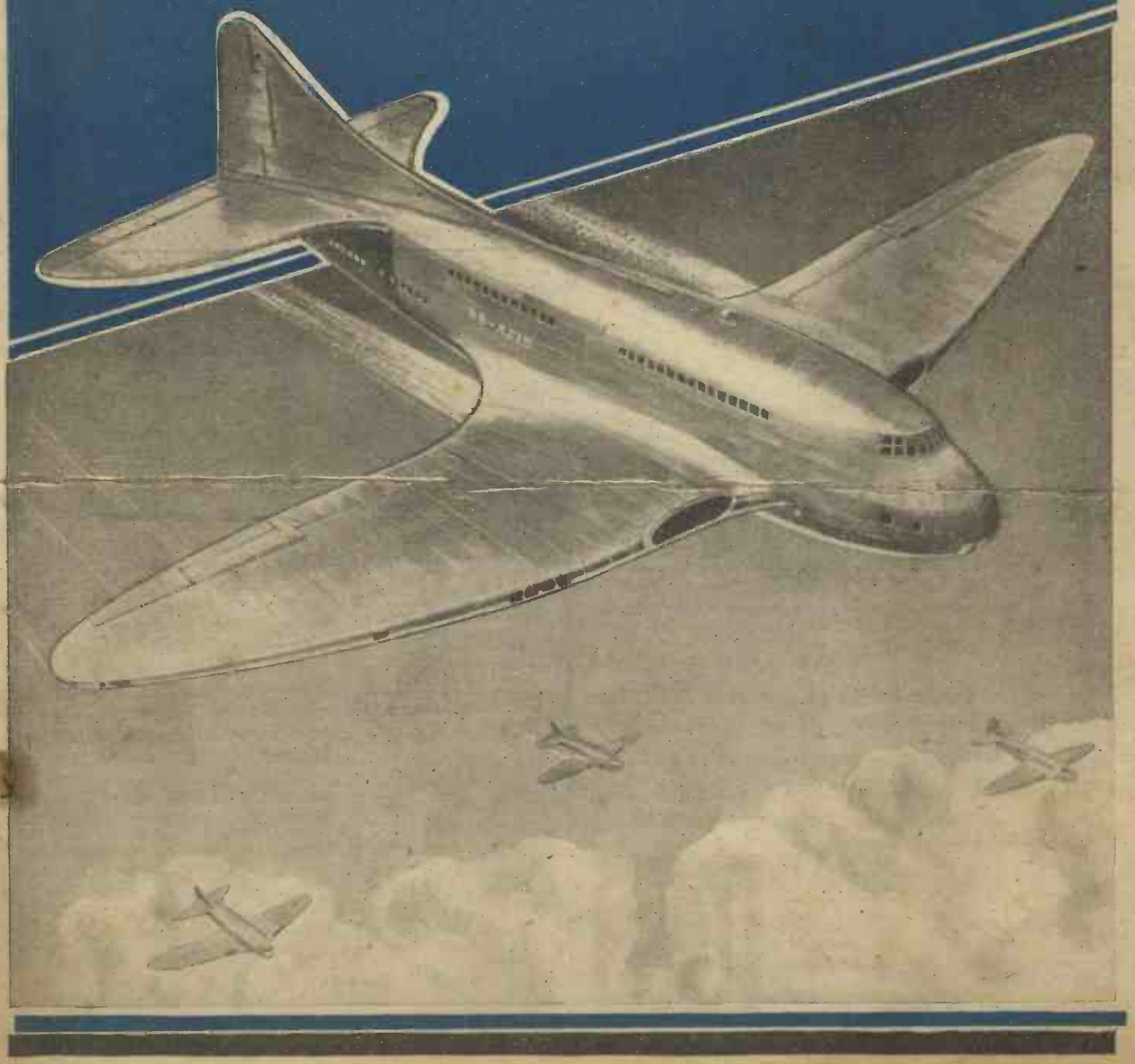
PRACTICAL MECHANICS

MAY 1943



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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. X. MAY, 1943 No. 116

FAIR COMMENT—BY THE EDITOR

Readers' Queries

WE ask for the co-operation of our readers in limiting their queries, in view of staff shortage. We cannot undertake to supply sketches and diagrams, nor to work out special examples which are not of general interest; nor can we undertake to supply electrical wiring diagrams for the rewinding of dynamos and motors. This section of our query service has reached enormous proportions during the last three years, and as most of our electrical staff are now in the Services, we must suspend our electrical query service until after the war.

We do not undertake to answer examination questions. We have received during the past three months from various parts of the country large numbers of similar questions, and investigation has shown that these are part of an examination. Quite apart from the time involved in answering them, it is not fair to other examinees if we do so. An examination is intended to test an examinee's knowledge, not ours. Another point: readers are continuing to submit queries without the necessary coupons, a stamped and addressed envelope, and three penny stamps. These letters cannot be dealt with. Some requests are quite unreasonable. One reader the other day asked for a complete set of working diagrams from which he could build a model of an old-time sailing ship; another asked us to design a special tool for him for pressing out armature stampings; whilst another thought it reasonable to ask for complete instructions on the building of a wireless receiver. In peace-time we cheerfully endeavour to assist even in these cases, but during the war readers must content themselves by asking only urgent and necessary questions. All of which means that we ask for the co-operation of our readers during the very difficult war period when, as we are sure they will agree, our main attention must be given to producing the paper.

There is one style of query which is quite unnecessary—the date of an issue in which we dealt with such and such a matter. Most of the querists state that they have the issues. We suggest also that they should obtain the indexes and save themselves time and ourselves a considerable amount of trouble in searching the items up for them.

Many of the queries we receive have been answered several times in our Queries and Replies section. All of these replies are indexed, and the index also guides the reader to other replies which are cognate, and which it would be quite impossible to collate and present in the form of a postal reply.

One other point, please do not submit letters asking for our opinion "to settle an argument."

Rubber Relief Map

THE usual type of relief map cannot be folded. Consequently, because of its size it is not convenient to carry.

To obviate this disadvantage there has been designed an elastic pliable relief map. This gives all the details of a flat map as to the ground features, and, in addition, is a perfectly scaled relief map. It also combines light weight, compactness, durability and convenience as regards its speedy unfolding.

As already mentioned, its chief characteristic is the fact that it is made of elastic material. This may be ordinary rubber, sponge rubber, or rubber impregnated fabric which will permit folding into a small volume.

Tent for Two

AN interchangeable cloak and tent has made its début. Two of these articles may be connected to form a tent for two persons. In this convertible cape and tent covering, overlapping connection is located in the cape portion at the lower end in such a way that, when two capes are to be joined to form the tent, the overlapping connection will tie to the ridge of the tent, thus providing a weatherproof joint. The neck aperture of the cape is arranged in such a manner that, when the garment is used as a tent, the aperture will be at the bottom of the tent.

The overlapping arrangement is furnished with reinforced eyelets through which ropes are drawn. Outside the tent the ropes are used to secure the tent to suitable adjacent supports, such as trees, rods or ski sticks driven into the soil or snow.

Scotland Yard's "Magic Eye" Camera

THE detection of crime by finger-prints has been revolutionised by a camera with a "magic" lens, invented by Scotland Yard men. It is now being used for the detection of fingerprints in all crimes of major importance.

With the new camera experts can take a photograph of fingerprints invisible to the eye. Even if the fingerprint is on the highly coloured label of a tin, the colours can be eliminated and the fingerprint shown clearly on the negative.

By a system of prismatic mirrors and concentrated light rays, any background can be eliminated, leaving only the object that is to be photographed.

New Life-saving Jacket

FOR the use of seamen a new life-saving jacket has been introduced which is coloured bright orange for making it conspicuous in the water. It has been approved by the Technical Committees of the Chamber of Shipping and the Liverpool Steam Ship Owners' Association and provisionally approved by the Ministry of War Transport.

A short length of buoyant rope is attached to the waistcoat, forming a loop at the back of the wearer's neck to facilitate rescue.

Motor Vehicle Lights

MANY drivers and operators of motor vehicles are still not making full use of the lights permitted under the revised regulations. As a result drivers are exposed to needless strain, and the purpose of the concession, which is to promote road safety and facilitate transport operations in the blackout, has not yet been fully achieved.

More than half the road fatalities reported in the three months ending January 31st occurred during darkness, and among adult pedestrians the proportion was three-quarters. This is considered unduly high having regard to the comparatively small volumes of traffic at night.

All users of motor vehicles who have not yet availed themselves of the concessions are asked by the Government to do so, and in particular to use two headlamps wherever possible; see that their masks are properly adjusted so as to avoid dazzle and reduce visibility from the air; make sure that masks and lights are clean; and use the larger rear light now allowed (with a layer of tissue paper).

By acting on this advice drivers will make their own job easier, with advantage to the war effort and less danger to themselves and others.

The degree of lighting permitted under the revised regulations is indicated in the following paragraphs, which also give some hints on ways and means of getting the best results —

Two masked headlamps may be used and should be used wherever possible. You will find that the double beam makes night driving less tiring.

Masks must be properly aligned, and not tilted up or to the side. Those of the multi-slot type, however, should be tilted slightly downwards. Faulty alignment can cause considerable dazzle at or above headlamp height and be dangerous, as well as increasing visibility from the air. The dazzle produced helps nobody and reduces the efficiency of the driving light.

Keep your masks clean and tightly adjusted. They are liable to become bent or loosened very easily. Inspect them regularly. Clean out the slots with a hard brush. Wipe the talc and bulbs. Clean and polish reflectors. These are jobs which the private motorist can do without the assistance of his garage. If done weekly at home they take little time.

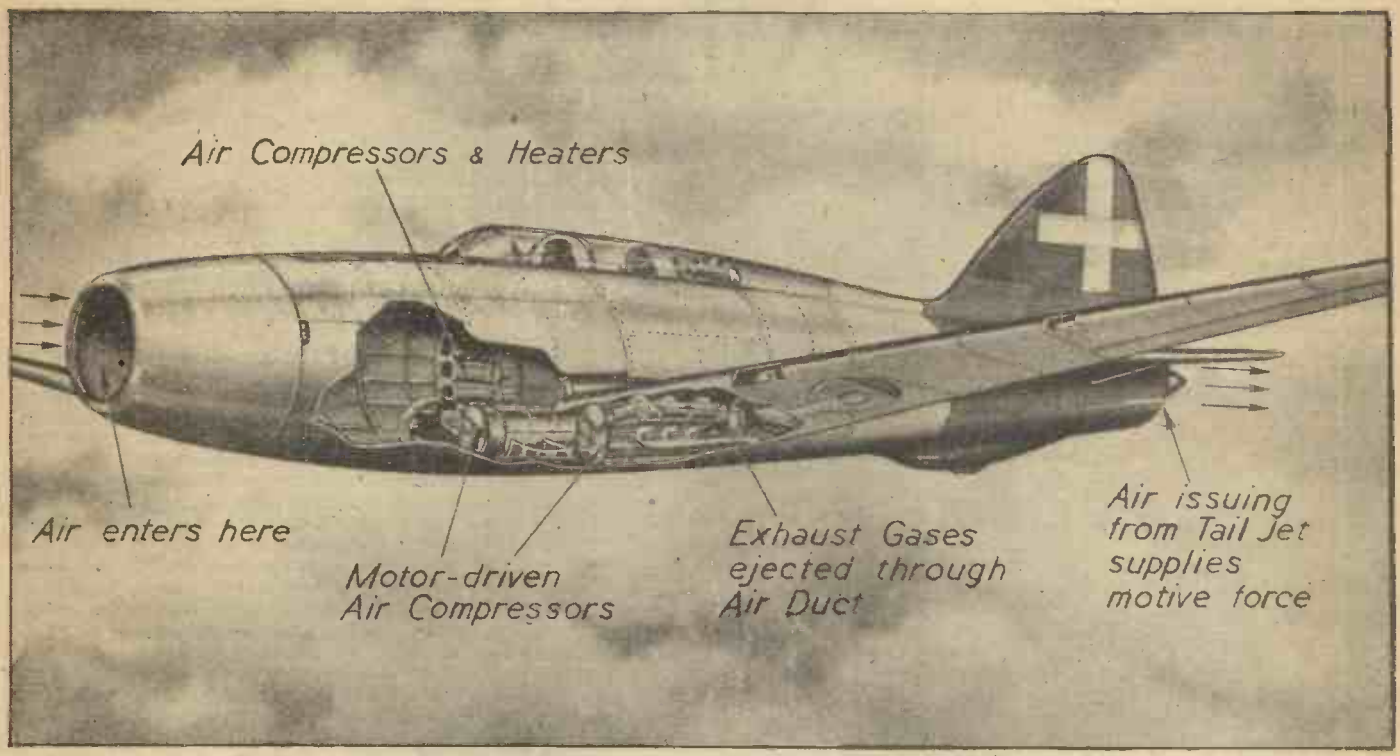
Side lights are liable to become dirty and to lose their efficiency. Remember that they must be clearly visible at 30 yards, but invisible at 300 yards.

Provided that the light is diffused by one layer of tissue paper, there is no longer any restriction on the size of a rear light. If you retain the undiffused 1in. light it *must* be clearly visible at 30 yards and invisible at 300 yards. The larger size of light, with tissue paper, is safer because less easily obscured by mud. You should, therefore, in the interests of road safety, change your rear light if necessary and keep it clean.

The Reaction Motor

Notes on the Possibilities of This Form of Propulsion for Aircraft of the Future

By K. W. GATLAND



The Italians in August, 1940, at the Taliedo Aerodrome, flew the Caproni-Campini C.C.1 jet-propelled aeroplane, and it was flown by Colonel Mario de Bernardi. Experiments have continued since that time, and in 1941 Signor Secondo Campini designed and constructed a jet-propelled aircraft on somewhat larger lines. The new machine is known as C.C.2, an illustration of which is given above. It is a two-seater aircraft with pilot and observer seated in tandem, and it is of low wing design with outward retracting undercarriage, and enclosed cockpit, and single fin and rudder. It has no airscrew, and weighs about 11,000lb.

FREIGHT transport in the post-war world will undoubtedly have vigorous competition between sea and airborne methods. Although it is true that under present-day conditions a small fleet of aircraft would be required to transport a cargo equivalent to the amount taken by a single merchant vessel, speed of transit is a factor high in consideration. Upon the cessation of hostilities it must be to a great measure the air freighter (which at first would probably be suitable converted heavy bombers and troop transports) that will bring relief to the subjected peoples of Europe and Asia. The advantages of air transport over the merchant vessel are truly considerable. High speed, coupled with the ability to bring supplies far inland without the trouble and time taken in unloading, reloading and conventional slow transport methods, are factors of great importance. For the aircraft to adequately serve humanity as the tool of progress, however, much further technical development is required to enable such machines to carry the heavier loads required for really practical freight transport operation, without sacrificing speed. Aircraft efficiencies much in excess of those realised to-day by the best machines in the class cannot be appreciably increased, due to the serious limitations of the engine-propeller combination. Various devices, such as the multi-blade and contra-rotating propeller and the supercharger, bring certain, but limited, gains in efficiency, mainly by enabling the aeroplane to operate at altitudes where the rarefied nature of the atmosphere presents less resistance to its passage.

Thermal-jet Propulsion

This deficiency in the orthodox power plant has brought an increasing amount of interest recently to the subject of thermal-jet propulsion. Already the principle has realised practical application as the motive drive for the Italian-built "Caproni Campini" monoplane which flew successfully, after initial tests at the Forlanini Airport, from Milan to Rome, a distance of 168 miles, in November, 1941. With the advent of the jet-propelled machine, communication is likely to be made more rapid, the aircraft gaining, with development, more and more advantage from high altitude operation in those regions of the stratosphere, economy in fuel expenditure, where air supplied to the jet unit under compression is still of sufficient density to support combustion, and where air resistance is so greatly diminished. The jet machine will, in all probability, initially evolve as the somewhat conventional type of aircraft—with wing installed motors. The layout of the jet plant lends admirably to snug installation, the compressors and operating motors (which may be exhaust driven turbines) being sunk deep within the wings, with the addition of an air scoop, possibly arranged in elliptical form, for a short length along the leading edge. The illustration on the front cover gives a conception of the possible form such transport aircraft will take—being not altogether dissimilar to the present-day machine, although streamlining is likely to be taken much farther on the considerably larger aircraft which can be confidently expected with the development of the more efficient jet motor.

While the thermal motor is confidently expected to produce greater efficiencies than the conventional internal-combustion engine, the limitations with regard to altitude are more or less parallel, due to the need for inducting sufficient air to support combustion. Consequently, the development of the thermal jet propulsion is not likely to produce great speed increases due to operation within relatively dense atmosphere, which is the main barrier to further progress. Speeds in the region of 750 m.p.h. appear to be the limit for atmosphere flight expectations, for it is at and around this velocity that "shock waves" (compressed air particles) are built up which set up prohibitive structural stresses, possibly even resulting in the complete fracture of the more vulnerable surfaces—tail plane, etc.

Jet-rocket Reaction Unit

A recent preliminary investigation into the problems of high altitude flight by the Astronautical Development Society, has ultimately produced a basic specification for a power unit, intended not merely for operation within the atmospheric region, but also capable of functioning at high efficiency in vacuum. This is proposed by means of an inter-combined thermal jet-rocket reaction unit—the thermal section operating to an altitude of approximately 45,000ft., at which height the rocket component commences to function to propel the craft still higher. The advantages of such a combination are considerable. High efficiency, with relatively low fuel expenditure, are formidable prophetic features of the design. By employing thermal-jet reaction within the bounds of the more dense regions, and true rocket propulsion above the thermal restricted regions, a high efficiency-economic ratio is maintained under all conditions of flight. The fuel for thermal power units need not be petrol, or in fact any of the highly refined spirits, for paraffin, tar oils and any similar product of the hydro-

carbon range would probably do equally as well. Even solid fuels, such as coal dust, cannot be ruled out as impossible alternative fuel forms. Rocket plant fuels can be either of the "liquid" or "solid" category—petrol, or similar fuel, being combusted with oxygen, stored in highly concentrated liquid form in the case of the former, and in the case of the latter, a combustible mixture (either powder, plastic or paste) with oxygen-bearing content. Due to the relatively high cost and the difficulties of storing oxygen in liquid form, greater attention has been paid in recent years to the development of the plastic "cartridge." These fuel cartridges can be injected into the reaction chamber by means of a specially designed feed. Groups of injector feeds working with alternate pulsating action would be able to maintain a constant propelling thrust. Thus by the further development of reaction power plants, the era of really cheap world-wide travel may soon be realised.

Rocket Bombs and Shells

Amongst other things, the rocket, useful in times of peace (as indeed in war) as the seaman's life-line has, for instance, been used extensively against aerial attack to enable high-explosive shells to be "shot" to ever increasing heights. This is an important factor when the increasingly higher operational altitudes of both fighter and bomber aircraft are considered. It is not altogether impossible, moreover, that the German 88-millimetre gun, used extensively in the early Middle East campaigns, was in reality a "projector" firing rocket shells. These guns were reported to be widely responsible for the destruction of many of the heavily armoured Allied tanks by the high penetrating force of the shells.

Rocket bombs also have been employed by both the Russians and Germans. The rocket principle applied to aerial bombs enables the missiles to strike hard on the target, gaining greater penetration and destructive power than the conventional type of similar weight. Another advantage of the rocket bomb is its ability to travel on a level parallel with the ground. It is possible, for instance, to pitch it ahead from an attacking aircraft without the need for getting within range of the anti-aircraft defences ringing the target.

Assisted Aircraft Take-off

The rocket principle, again, has been applied to the aeroplane for assisted and catapult take-off purposes, which enables defence machines to take off, and climb to the altitude of interception, within a much shorter space of time. Here again high-altitude bombing has to some great measure been made less effective.

Rocket Mails

Rocket mails, a practical solution to speedy delivery over difficult country, are yet another example of the versatility of the reaction principle. Although rocket mail services have not been used extensively in the past, it is no mere conjecture that with the further development of the reaction motor services will be established to enable mails to be projected with accuracy from country to country, the projectile and containers being landed gently by parachute when the "target" is reached. Perhaps the most successful example to date was the mail service instituted over mountainous country between the towns of Berne and Basle, Switzerland, which was in regular operation before the war. Hitherto rocket mail attempts have been made with relatively small projectiles, guided by fins, but experiments have shown that if the rocket is rotated about its axis, by either offsetting the exhaust tubes or by the addition of exhaust deflector vanes, a gyroscopic stabilisation force is set up, which enables the rocket to maintain its predetermined course, and is far less affected by atmospheric variation.

The Lunar Space-vessel

The moon rocket has been the subject of much fantastic speculation during the past decade or so, perhaps the most notable examples being given in novels by Jules Verne and H. G. Wells. Although such works make exceedingly interesting and exciting reading, however, for the most part the conceptions of such authors are completely devoid of technical reasoning, and consequently a completely false interpretation of the possibilities of inter-planetary communication has been built up which has resulted in the subject being regarded with ridicule by the general public. By the publication of the "Preliminary Investigation into the Problems of Space Flight," by the British Interplanetary Society, the subject has been considerably lifted out of the realm of the "fantastic."

The layout of the space vessel, which is the main feature of the investigation, gives a really convincing engineering conception of the project, which has been the subject of serious planning over a period of several years. Cellular construction is the chief feature of the design, which is in reality a series of closely packed tubes (honeycomb fashion) filled with plastic fuel compound. These tubes are fired in clusters, at the control of the operator in the pressure cabin at the nose of the "ship," and are automatically jettisoned with the completion of each firing phase. It can be readily appreciated that as the vessel continues out into space against the earth's diminishing gravitation, by the jettisoning of irrelevant material the "ship" is made constantly lighter and substantial economy in fuel expenditure is effected. The complete "ship" is designed to rotate about its axis, which, as well as providing stability, establishes an artificial gravitation within the vessel to enable the crew to function in a relatively normal manner under constantly changing natural gravitational conditions during the flight.

Landing

Landing is effected by a complete reversal of the vessel—end on to the lunar surface, which is commenced some way off from the satellite for the jets to sufficiently retard the "ship" against the not inconsiderable velocity which has been built up during the journey out. When the vessel is sufficiently close to the surface it descends, the lunar gravitational attraction and jet reaction striking a balance some few feet from the surface, whereupon retractable hydraulic shock absorbers come into play and the vessel is brought to rest.

After exploration, with the aid of special heated pressure suits, the crew are able to jack the machine into position for re-firing. The vessel is able to leave with far greater ease than from earth, due to the lower gravitational attraction.

Upon approaching the earth's atmosphere the "ship," having only the weight of the pressure cabin, auxiliary equipment, crew and the remaining rocket tubes, is once more reversed, the speed being retarded until contact with atmosphere is made, when the supporting parachute is released and the control cabin and crew float gently to earth.

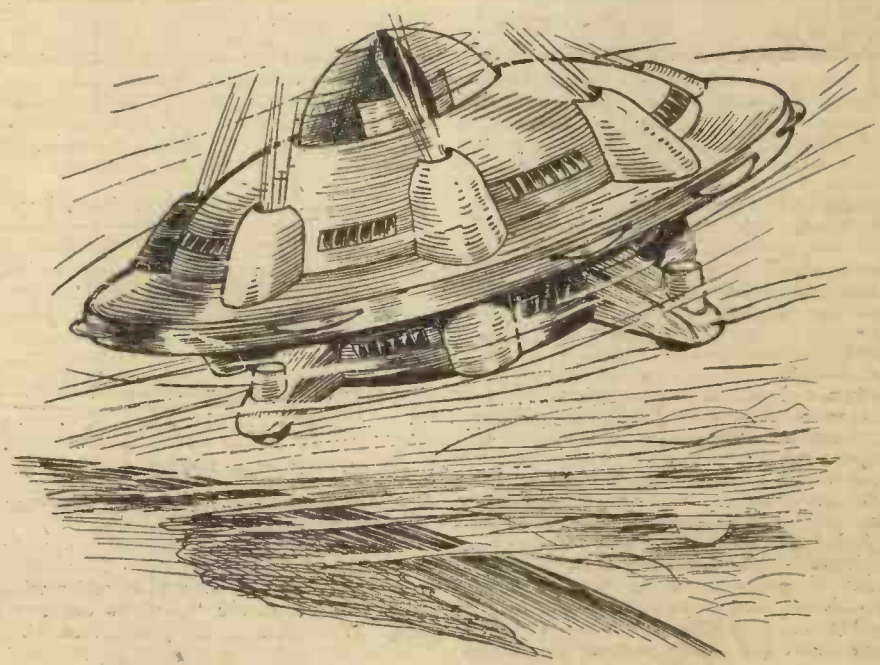
During the initial "climb" through atmosphere, at the commencement of the flight, a heat-resisting carapace is attached, moulded to the contour of the nose, to prevent excessive heat generation, due to friction.

Rotational braking when landing, manœuvring and course alignment can be effected by means of special steam reaction and rocket reaction units. Visual observation during the rotational condition can be made by means of the special "Coelostat" viewing apparatus, also designed by the B.I.S. This system, which is an adaptation of the stroboscope, has been demonstrated satisfactorily at South Kensington Museum.

Although the above brief summary of the project and the conception of operation leaves much to the imagination, it is apparent that the B.I.S. conception of an inter-planetary space vessel is based on a sober understanding of the subject.

Further research during post-war years by the combined efforts of the British Interplanetary Society, the Astronautical Development Society and the Manchester Astronautical Association should do much towards the realisation of interplanetary communication. A rocket test site is proposed for joint post-war research, where the new plastic fuels and reaction units can be proved.

When the day of the space-vessel finally arrives, the world will reap great benefit from the knowledge the reaction machine will unfold.



Our artist's impression of a "space-ship" of the future.

The Development of Aircraft Cabins

A Description of the Progress Made in Cockpit Enclosures, with Notes on Manufacturing Methods

By A. M. COLBRIDGE

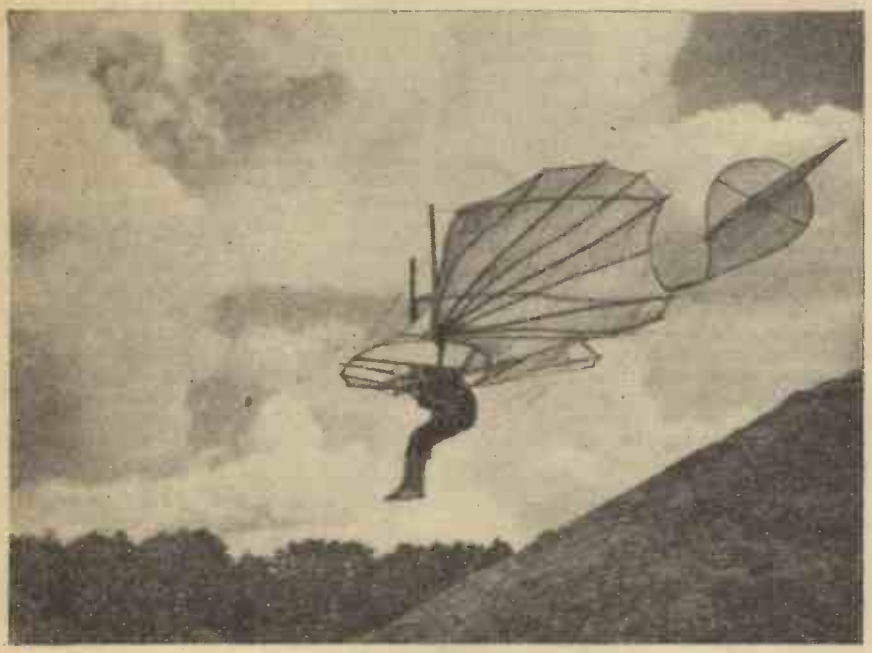


Fig. 1.—The Lilienthal hang glider.

THE early pioneers of aviation paid little or no attention to shielding themselves from the airstream produced by the machine they flew—the other pressing problems of stability and control more than outweighed any feeling toward personal comfort. Thus we see that in the original hang gliders of Lilienthal and Pilcher, and the crude biplane gliders of the Wright brothers, there was absolutely no protection for the unfortunate pilot (Fig. 1). True that this was probably the least of his worries, particularly as the flight velocity was extremely low, and thus it is a far cry to the modern and (reasonably) comfortable machines of to-day with their weatherproof cabins or cockpit enclosures.

Even so, I hesitate to say that we have reached finality. There are, or were before the war, a few commercial cabin machines with unfortunate "leaks," and one model in particular had, I recall, the habit of picking sheets of paper from off the rear seats and sticking them against the inside of the wind screen. Possibly in defence it could be argued that the private owner should not leave loose papers on the seats—but this is scant comfort for the draught in the back of the unfortunate pilot's neck!

It was some time before the hardy pioneers realised that some form of shield in front of them would be preferable to none, particularly when the pilot came to be exposed to the full blast of air, and not spreadeagled or perched precariously on outriggers or the main fuselage superstructure (Fig. 2). Right up to 1914, or later, begoggled and swathed heroes appeared to exhilarate in the blast of the airstream, generally freely mixed with thick, heavy lubricating oil if the engine was located in the front.

At this stage in development there was a general favouring of the tractor type of aeroplane, i.e., with the engine in the extreme front, as opposed to the pusher types. Some effort was also made to "clean up" the general lines, the pilot being almost totally enclosed and only his head sticking out into the slipstream. This meant a continuous backward pressure on the head and so a head-rest was added, fairing into the general lines of the fuselage.

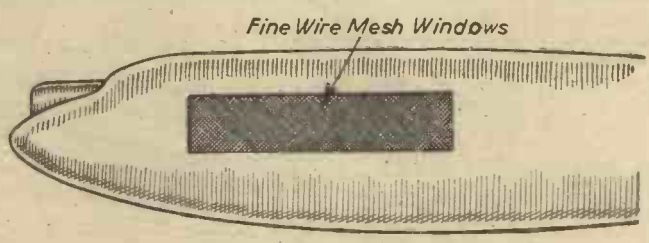


Fig. 4.—An early type of transparency.

Advent of Windshield

The next logical step was to add a windshield in front of the cockpit to deflect the airstream away from the pilot's face. The first windshields were made of aluminium; the impracticability of glass was realised, and it was not then appreciated that celluloid could be used. However, this latter substance was soon adopted with the object of giving a good forward view and avoiding the necessity of the pilot having to peer over this obstruction when he required a good forward view. Unfortunately this increase in visibility was extremely doubtful, particularly as the early types of engines, and especially the rotary types, threw back prodigious quantities of dirty lubricating oil which plastered the windshield. This latter trouble was relieved by further improvement in engine design (Fig. 3).

In a rotary engine castor oil had to be employed for lubrication. Since the petrol was injected directly into the crankcase in these types, mineral oil, if used, would readily mix with the petrol and thus be thinned down to possibly dangerous proportions. Hence castor oil, which did not mix with the petrol, was employed.

Further definite steps forward were made around 1912. In this country A. V. Roe (now Sir A. V. Roe) produced the first cabin biplane, complete with transparent windows, showing that one designer, at least, was aware of the need for considering the comfort of the passengers or air crew. At about the same time the Swallow, designed and built by Etrich, also featured an enclosed cabin, the windows in this case being of fine wire mesh (Fig. 4).

Cabin design then progressively developed, with generally a favouring of the passengers carried out at the expense of the pilot. The latter was generally perched in a semi-open cockpit, although this was by now far better than the earlier layouts, with the fortunate passengers accommodated in cabins within the fuselage proper with glazed (celluloid) windows.

Further problems presented themselves, one in particular being the tendency for the windshield to become obscured by rain or ice, restricting vision to a dangerous degree. In many cases windshield wipers, similar to those fitted to cars, were successfully employed, and this practice remains to this day on such machines as the Supermarine Walrus, and other similar types.

Deflector Plates

A simpler solution, and one which found favour on account of its suitability for low-speed aircraft, was the fitting of deflector

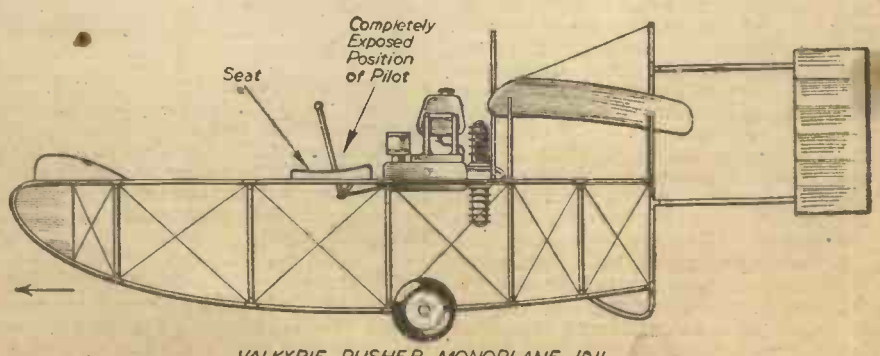


Fig. 2.—The pioneer's layout—completely exposed to the elements.

plates. The principle involved is that the airflow over a windshield will tend to follow its outline shape. Thus it is possible to introduce a gap, "guarded" by a plate known as a deflector, over which the airflow streams smoothly. Through this gap the pilot has a clear view in all weathers—his visibility being governed only by the weather conditions themselves. Such a scheme is illustrated in Fig. 5.

This system is not confined to direct forward vision and may be employed with equal success for side vision. At high speeds, however, this is impracticable, particularly as the drag increase is large. In such a case, then, a complete cockpit enclosure is desirable, and other methods must be employed to prevent obscuring vision. To this end special fluids or pastes—similar to anti-dim compounds familiarised with the introduction of the gas mask—are sprayed or applied to the windshields and these serve their purpose admirably.

Totally Enclosed Cockpits

A strong prejudice apparently existed in his country, particularly in regard to military tircraft, about the complete enclosure of a pilot's cockpit. The Siskins, Bulldogs, Furies, Harts and other similar biplanes of the R.A.F., early 1930 era, still stuck to the old layout of a windshield with a faired headrest, and many still remain to this day. America had less hesitation in adopting a complete "lid" and this is now general in most aircraft with but few exceptions—these being confined to the relatively low speed craft.

The Gloster "Gladiator" was the first example of a single seater fighter with a complete cockpit "lid" to go into production for the R.A.F. Some machines, such as the Blackburn "Shark" exist with and without such enclosures. The de Havilland "Tiger Moth," of which many thousands have been built for training purposes, is another case in point. Normally it is a two-seater biplane with open cockpits. In Canada, where it is again employed on training duties, a most elaborate cabin is fitted—ostensibly to combat the cold of a North American climate!

Not only has the pilot benefited from such developments—apart from the increases in aerodynamic efficiency—but the gunners have not been neglected. In the "good old days" of 1914-18 one particular machine had its gunner perched in an open cockpit right in the extreme nose of the fuselage. Behind him was the pilot and, behind him, the engine—the machine being a pusher biplane. Armament consisted of one gun on a "free" mounting firing forward and one fitted to the top of the upper plane firing backwards. To combat a rear attack the unfortunate gunner had to stand up in his cockpit, facing rearwards, manipulate and fire the gun mounted on the upper wing, hanging on as best he could! It is amazing that, in my records, at least, no gunner was known to have fallen overboard during this operation!

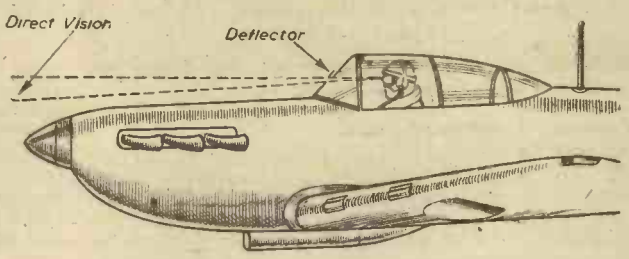


Fig. 5.—Direct vision panels in windscreen.

Until the early 'thirties little was done to protect the gunner. He had to aim and control his gun whilst almost fully exposed to the blast of a particularly vicious slipstream. Even more heroic was the tail gunner of the Vickers "Virginia." He was perched at the extreme rear end of a long, thin fuselage and an acquaintance of mine who has occupied this unenviable position swears that the fuselage bent round corners every time the machine banked into a turn!

Gun Turrets

The next step was the introduction of a gun turret such as those fitted to the Boulton and Paul "Sidestrand" and, later, the Boulton and Paul "Overstrand." Even so this was not generally adopted for some time. The first Hawker "Demon" two-seater fighter did provide some protection to the gunner and later one model, at least, was fitted with a definite shield, like an exaggerated windscreen. A further model had a manually controlled turret.

From then onwards, and particularly under the air expansion scheme, development was rapid. The modern trend was illustrated in the Fairey "Battle" in 1936 (Fig. 6). The pilot and observer-gunner were enclosed in one long "greenhouse." From his rearward position the gunner was able to manipulate a sliding flap or hood and remain fully protected from the airstream. This was typical of the time for the light bomber—but was only a pointer to future models.

The whole question of turret and cockpit enclosure design resolved itself into a compromise between sheer aerodynamic efficiency on the one hand and ease of operation and field of fire or vision on the other. The value of power-driven turrets carrying relatively heavy armament was appreciated, relieving as it did the gunner from a large amount of physical exertion and making for speed in bringing the guns to bear on the target.

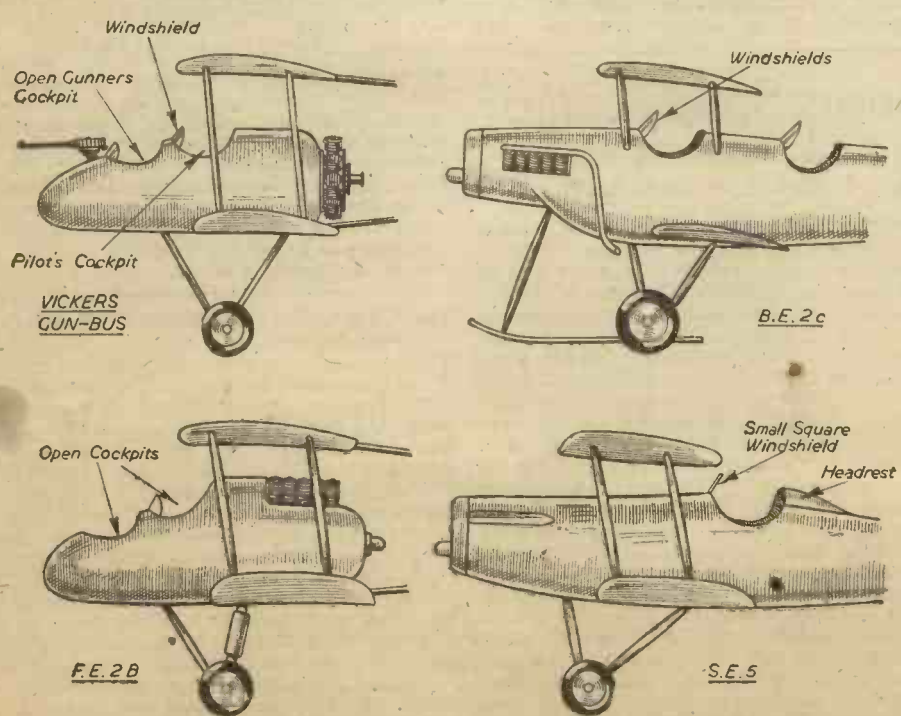


Fig. 3.—Open type cockpits with windshields affording partial protection. Later the fitting of a head-rest (S.E.5) was adopted.

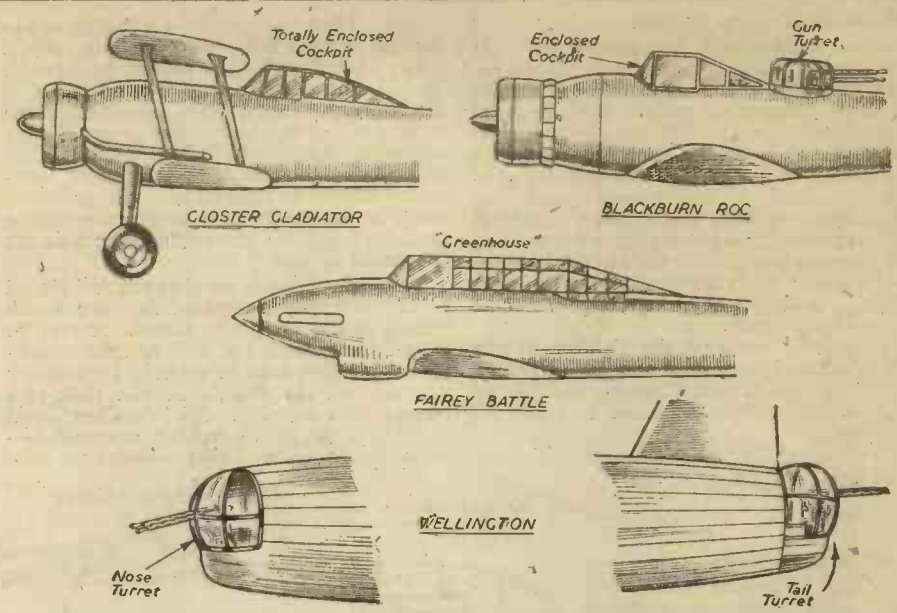


Fig. 6.—Totally enclosed cockpits and gun turrets, now standard on modern military aircraft.

Methods of Construction

First, dealing with transparent materials, Perspex is a name so widely known that it has become a part of the aeronautical dictionary of terms. Perspex is a product of the Imperial Chemical Industries, Ltd., and is essentially an acrylic-resin plastic. Many other plastics are employed in addition to laminated glass for such items as bullet-proof panels and direct vision panels, bomb aimers' windows, etc. All types of transparencies are now being produced in quantity for the aircraft industry and include such items as wing-tip light fairings, landing-light fairings, large and small cabin blisters, etc.

Perspex is amongst the lightest of the transparent plastics used and has, possibly, the widest application. Specific gravities of four typical transparencies are as follow:

Glass 2.5.

Safety glass, considerably heavier, 2.5 to 3.5.

Safety celluloids 2.35.

Perspex 1.19.

Moulding Process

Perspex is supplied flat in sheets of varying thickness, protected against accidental scratching by a layer of paper attached by a gelatine coating. Templates are made of the panels required—these being developed on to a flat surface, and the Perspex cut to this outline, leaving a generous margin which is trimmed off after the moulding process.

The actual moulds upon which the Perspex is formed are usually made of one of the hard woods. The Perspex is heated in an oven to a temperature of from 100 to 130 deg. C., when it becomes plastic and is quite easy to work. A better description would be to say that it is "elastic," for in this state it is quite "rubbery" in characteristics.

Usually one mould is sufficient, when the heated Perspex is pressed over this by hand. Occasionally it may be necessary to have a male and female mould for certain intricate shapes. During the moulding process the sheet stretches to a certain extent, and if brought to its "plastic temperature" again will return to its original flat form.

When removed from the ovens the moulding operation must be carried out swiftly as the sheet soon cools below its "minimum plastic temperature" and then cannot be worked. Should this occur before the operation is completed the sheet must be re-heated and the process repeated, this trouble generally only occurring with semi-skilled workers. In particular cases where on account of compound shapes or large moulds the operation must, of necessity, take longer then some means of applying heat to the Perspex on the spot must be used.

The formed panels are then cut and planed to shape, finally assembled into the actual frames of the cockpit or turret. It may be drilled fairly easily for bolt or rivet attachments, but care must be taken to avoid heavy pressures on the work, otherwise there is a danger of it splitting. All joints are sealed by means of plastic rubber compounds—their employment being likened to the puttying of window-panes after fitting into their respective frames.

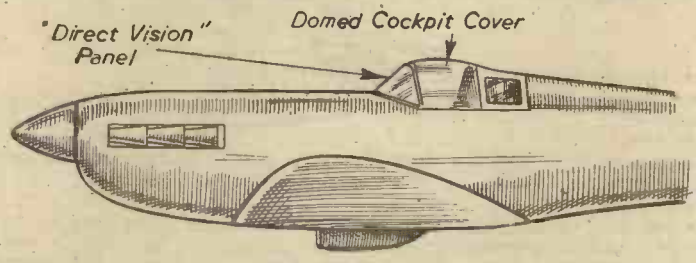


Fig. 7.—A typical fighter transparency with bullet-proof direct-vision panel.

Laminated Glass

Whereas laminated glass formerly had only a limited application to the aircraft industry, many units previously only possible in plastics may be made of this former material. For whatever purpose it is required the sheets pass through the same essential processes.

The sheets of glass are first cut to shape by means of diamond cutters or special machines and then washed, first in an alkaline solution and then in distilled water. They are then dried in an oven maintained at a constant, and fairly low, temperature, and are next sprayed with an adhesive compound and again dried in ovens. They are next treated with a special medium, which renders the adhesive "tacky," and mated up with layers of cellulose acetate. The glass and the cellulose acetate are put together in the form of large sandwiches and then passed through rollers to remove all moisture and air. This cellulose acetate has at first a cloudy appearance, but this later disappears as the process advances. When finally finished it is perfectly clear and is not affected by light or heat (within moderate limits) and thus there is little or no danger of discoloration with age.

These "sandwiches" are then carefully examined before being passed for the final stage, i.e., the actual bonding or sealing. This operation ensures that the whole is weather-proof and no moisture or injurious particles can penetrate the various layers. To do this about 3/32in. of the acetate layer is carefully gouged out—this operation being performed by hand—and the edges then sealed with a bitumen compound. This is actually applied by holding the plates against the periphery of a bitumen-covered wheel—similar to the familiar grindstone—which forces the compound into the crevices.

Bullet-resisting Panels

The strength of the finished product obviously depends upon its thickness—normal panels may be only ⅛in. For bullet-resisting panels this may be increased to 1½in. or even greater (Fig. 7).

The effect of a bullet striking such a panel is as follows. The bullet penetrates and shatters the first layer of glass, but this, being stuck to the cellulose acetate, does not "fly." When the bullet enters the acetate this, being soft, deflects it from its path and slows it down. This retardation is progressive through the layers and a .303 calibre machine-gun bullet fired from a range of 200yds. will only penetrate about half-way through a 1½in. panel.

Laminated glass products are not confined to flat panels; by an ingenious process it is quite possible to produce curved panels of almost any degree, and all practically free of distortion. For flat panels, when the pilot sights through them, distortion is reduced to very fine limits.

Who Invented the Miners' Safety Lamp?

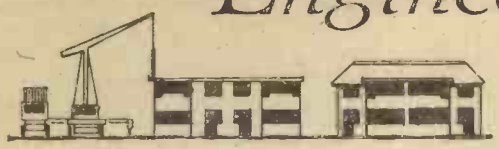
With reference to the above subject, we have received the following interesting letter from a reader, Mr. C. Davies, of Leek, Staffs.

I READ with interest the article on Sir H. Davy and his renowned discoveries, in the July, 1941, issue of PRACTICAL MECHANICS, and it occurred to me that other readers might be interested in the following extract, taken from the book, "The Life of George Stephenson," by Smiles, published in 1857. This appears to throw some light on the apparent controversy of the first man to invent the miners' safety lamp: "Mr. Stephenson, it will be remembered, placed the plan of his lamp in the hands of the Newcastle tinman in the beginning of October; and it was made and delivered to him on the 21st of October, after which it was tested at the blower in the Killingworth pit on the evening of the same day. Up to this time nothing was known of the nature or results of Sir. H. Davy's experiments. But on the 31st of October Davy communicated the fact which he had now discovered to the Rev. Dr. Gray, then Rector of Bishop Wearmouth (afterwards Bishop of Bristol), in a communication intended to be private, but which was inadvertently read at a public meeting of coal miners held at Newcastle on the 3rd of November following. In that letter he stated, 'When a lamp or candle is made to burn in a close vessel having apertures only above and below, an explosive mixture of gas admitted merely enlarges the light, and then gradually extinguishes it without explosion. Again, the gas mixed in any proportion with common air, I have discovered, will not explode in a small tube, the diameter of which is not less than one-eighth of an inch, or even a larger tube, if there is a mechanical force urging the gas through the tube.'" This was the first public intimation of the result of Sir H. Davy's investigations, and it has been stated as probable that the information was conveyed to Mr. Stephenson by some of his friends who might have attended the meeting. Supposing this to be so, it contained nothing which he had not already verified by repeated experiments. The fact that explosion would not pass through small tubes was by this time perfectly well known to him. He had been continuing his experiments during the end of October and the beginning of November; his record and improved lamp, constructed on this very principle, was already completed, and it was actually tried in the Killingworth mine on the 4th of November, the very day following the meeting at which Sir. H. Davy's discovery was first announced. Whereas the tube safety lamp, which the latter had constructed on the principle above stated, was not presented to the Royal Society until the 9th of November following.

The Explosive Incendiary Bomb: Correction

IN the issue for January a discrepancy occurs in the caption on page 115, which states that "The anti-personnel incendiary bomb is shown on the left." This referred to an incendiary bomb with an explosive nose, but the Ministry of Home Security point out that the description "anti-personnel" is now used officially only in relation to the 4lb. explosive bomb, which contains no incendiary matter at all, and is dropped with the main intention of causing casualties among firemen, civil defence workers and fire guards on the spot. In consequence, the instructions issued to members of the Services in respect of how this "anti-personnel" bomb should be treated differ considerably from those relating to the incendiary bomb with the explosive nose, the chief purpose of which is to start a fire.

Engineer-built Houses of the Future—4



Foundations and Bases

By R. V. BOUGHTON, A.I.Struct.E.

TECHNICAL subjects, combined with important and interesting supplementary general information, may now be the programme of this series on engineer-built houses. Technology, as applied to pre-built housing work, while having many differences in its approach when compared with the design and construction of ordinary houses, may be allowed as based on a great many of the principles and details which modern research has provided, particularly during the last decade. Very few designers and constructors of pre-war houses attempted to apply, or apply properly, much of the valuable information which was available during the few years just preceding the war. This lack of attempt may have been due to our national reluctance to break away from conservative principles and ideas, and, perhaps, to difficulties in overcoming various interests.

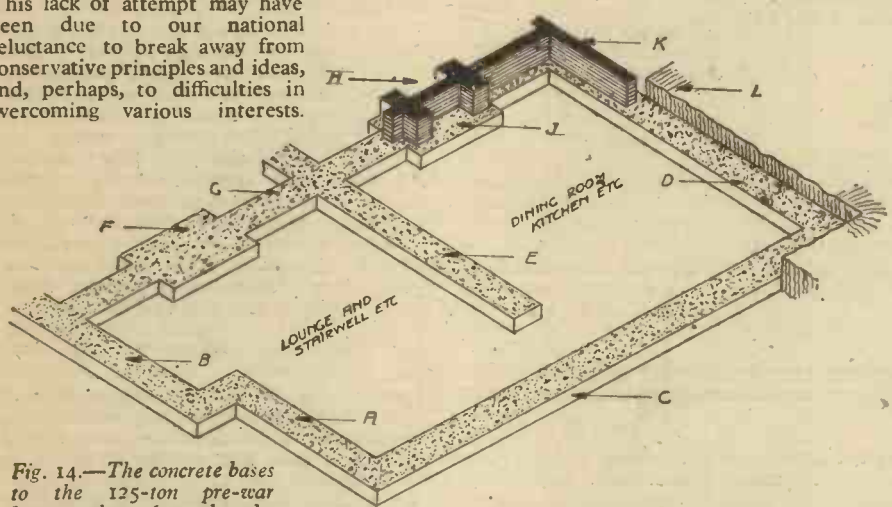


Fig. 14.—The concrete bases to the 125-ton pre-war house : about 6 yards cube of concrete, 60 feet cube brickwork to bring work up to ground-level, and considerable excavation.

A and B—Concrete bases 2ft. by 9in. to front wall and bay. C and D—Ditto to flank and rear walls. E—Concrete base to heavily-loaded partition. F and J—Concrete base to chimney. G—Concrete base to party wall. H—Fireplace. K—Brick wall. L—Ground excavated for bases.

While this is to be regretted, I am of strong opinion that this apathy in those who follow the "building-code" will assist in no mean extent the adherents of the "engineer-code" who have always impressed me, as they have many deep thinkers, of their readiness to try out anything new if it is obviously good. As will be understood, most technical and scientific subjects connected with building are not abtruse or difficult to master, and calculations and formula are usually much simpler for building than those necessary for solving engineering problems.

Foundations and Bases

The foundations and bases of a house are the important items on which to commence our technical investigations, and to make recommendations as to their proper consideration in design to suit various systems of pre-built work. As there is too much looseness in using the terms "*foundations and bases*" I will define their difference in accordance with a code which I have always used. In my opinion, the use of *concrete foundation* is wrong, and will not be used. The *foundation* is the ground, and anything similar on which a structure rests, and obviously can be, and usually is, of utmost importance to maintain a structure in equilibrium or as near thereto as possible if reasonable and equal settlement of a structure on the foundation is permitted to allow for certain natural laws. The *base* is that which is usually artificial, and the lowermost structural part which is in direct contact with, and derives support from, the *foundation* or ground. Therefore, the foundation is the ground, and it may be a clay foundation or a gravel, chalk or even rock foundation; and the base may be a concrete, reinforced concrete, brick, concrete pier, etc., base, the most common being the concrete base for housing work.

The really vast difference in the amount of foundation and base work in the ordinary pre-war "*125-ton house*," and the engineer-built "*40-ton house*," both of which types have been described previously in a general way, may now be studied with practical examples and methods explained which will ensure the correct and most economical design and construction of these very important fundamental parts. Fig. 14 shows in a very practical way typical concrete bases of the ordinary pre-war house with two rooms, kitchenette and hall and stairwell in ground storey. For purposes of clearness much of the ground work has been omitted. The concrete bases are in accordance with customary practice and building by-laws, and some interesting matters of inconsistent and unbalanced design and construction are brought to light, which to many may savour of crass stupidity on the part of designers of ordinary houses which would seldom occur with engineer work. Let it be assumed that the total weight consisting of the loads of and on the one semi-detached house is 125 tons. The length of the front, rear and flank wall is, say, 70ft., and, allowing for half only of the party-wall (the other half as belonging to the adjoining house) viz., say, 15ft., a total length of 85ft. is the result. Assume that the concrete base to the very greatly loaded partition between the chief front and back rooms, as Fig. 15, is of the same size as the main bases, which it seldom is, a further length of about 15ft. may be added to 85ft., making a total of 100 linear feet. As the bases are 2ft. wide, a total area of concrete bases of 200 super ft. is provided to transmit 125 tons to the foundations. Very simple calculations show that 125 tons divided by 200 gives a unit pressure per super foot on the foundations of 0.625 or $\frac{5}{8}$ ton. If this $\frac{5}{8}$ ton is related to the safe-bearing capacities of foundations or grounds as shown by Table A, it will be at once manifest that unless the foundation is of exceptionally poor bearing capacity the concrete bases err well on the side of safety. By following a good code of practice the character and bearing values of grounds should be ascertained for each individual site before the sizes of concrete or any other type of base is designed and constructed; then well-balanced and economical bases will result. Unfortunately the above does not deal with the crowning farce of the matter. Although I stated above an assumption *that the very greatly loaded partition between the chief front and back rooms has the same size of base as those to the main walls*, it is a fact that they are often made much smaller. If Fig. 16 is studied, it will be evident that this little partition carries more than half of the combined floor and roof loads, and more than double the floor and roof loads transmitted to each front and rear main wall. Simple calculations show that, despite the greater dead load of the thicker external walls, and allowing for the little floor and roof loads carried by them, the internal partition is

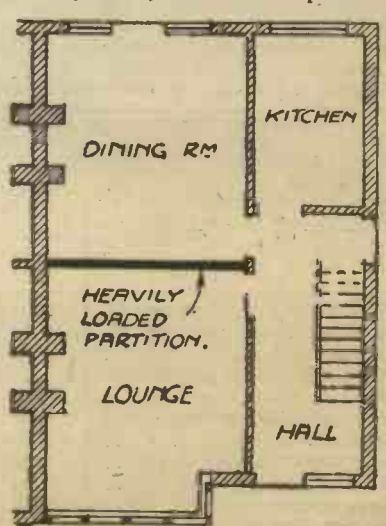


Fig. 15.—Plan of ground-storey of typical pre-war house with its heavily-loaded partition. First floor joists usually run from front to rear main walls and have intermediate support on partition. (See Fig. 16.)

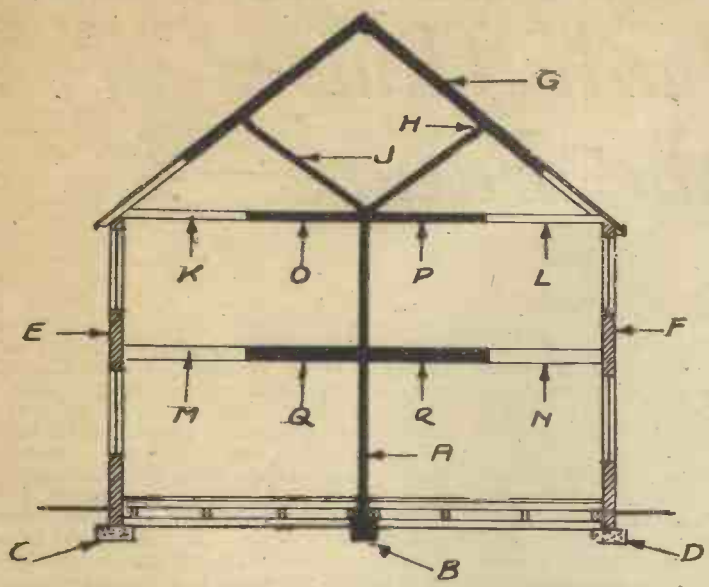


Fig. 16.—Section of pre-war 125-ton house showing in black the parts of main structure usually carried by the thin and often overloaded partition marked "A."

A—Partition. B—Concrete base often of smaller size than those to external walls which have less loads to transmit to foundations. C and D—Concrete bases to front and rear external walls. E and F—Front and rear external walls. G—Ordinary pitched roof covered with tiles or slates. H—Partition. J—Strut. K and L—Ceiling supported by external walls. O and P—Ceiling supported by partition. M and N—First floor supported by external walls. Q and R—First floor supported by partition.

saddled with a much greater load than either of the external front and rear walls. Manifestly, the farce of the matter lies in the fact of the size of the base to the internal partition being, in accordance with principles which dictate well-balanced and consistent strength in structures, of the same size as those to the main walls, and how much more farcical it is to make them smaller as they are so often made. Fig. 17 depicts a more reasonable proportion of the widths of concrete bases.

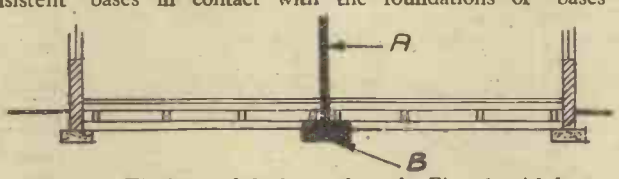


Fig. 17.—The bases of the house shown by Fig. 16, with base to partition of reasonable size.

A—Heavily-loaded partition. B—Base to partition about 25 per cent. wider than bases to external walls.

Foundations and Bases of Engineer-built Houses

An engineer-built house, which is only about 40 tons in weight, is a very different proposition to an ordinary one of about 125 tons and, obviously, the former requires much smaller, lighter, and consequently more economical bases than shown by Figs. 16 and 17. There is only about one-third the weight of the ordinary pre-war type of house requiring bases to support the superstructure and transmit its loads on to the foundations. A very simple preliminary to enable full appreciation of the importance of carrying safely about 40 tons on the foundations is to study Table A, from which it will be noted that common grounds will uphold safely 2 tons per sq. ft., and others more or less. Even allowing 1 ton per sq. ft., it is necessary to allow only 40 sq. ft. total area of concrete or similar bases to ensure 40 tons of building being supported safely on the foundations. These 40 sq. ft. of base work may be constructed or formed according to the continuous or pier-base system, both good, and both quite small in total if compared with the bulky concrete bases of ordinary pre-war houses. Fig. 18 shows continuous bases to an engineer-built house having normal accommodation, and the total area of the bases in contact with the foundations or ground is about 40 sq. ft., which allows for transmitting 40 tons on to ground capable of supporting safely 1 ton per sq. ft. Fig. 19 depicts alternative methods of pered bases to meet the same load and foundation conditions as allowed in Fig. 18. Twenty pier-bases each having an area of 2 sq. ft. at their lower part ensures a total area of 40 sq. ft. in the bases. In practice the number, size and disposition of the bases would be regulated by weight of building, the safe supporting capacity of the foundation and the structural requirements of the ground storey floor, wall and partition pre-built units. Fig. 20 shows a simple type of plain concrete pier-base cast-in-situ in holes excavated in the ground, which, to avoid waste of concrete or wrong size bases or any formwork or timbering, must be excavated to proper sizes, which is not always practicable with some classes of ground. Fig. 21 depicts types of pre-cast concrete piers or stools, all being scientifically and practically good. The tapering causes considerable economy in weight and money, and ensures ample strength. Concrete is a very strong material in compression, and therefore very little sectional area is required to withstand, say, a compression load of 2 tons and, therefore, the top of the tapering pier may be very small. The base of the pier is spread out for the very simple reason that it must be of sufficient area to spread the load of 2 tons (or whatever the calculated load is) over 2 sq. ft. (or other calculated area) of foundation or ground. Well-designed pre-cast pier-bases can be comparatively light, and may be made at works, or on site, as a study of the best conditions will regulate. Whatever type of base is used it is, of course, essential to make their tops in perfect alignment in direction and level, and their bottoms must be set on properly levelled firm foundation or ground. To ensure the latter it will be found in practice that it may be necessary to "level up" any inequalities of ground level with some hard form of packing or even concrete, the latter being of sufficient thickness to prevent it fracturing when under load.

The next article will explain how the bases of the various kinds described above carry the pre-built ground storey floor and wall and partition units.

TABLE A	APPROXIMATE SAFE RESISTANCES OF GROUNDS OR FOUNDATIONS
DESCRIPTION OF GROUND	MAX. SAFE LOAD IN TONS PER SUPER. FOOT
Ordinary earth, or soft clay ..	0.50
Made-up ground, well consolidated	0.50
Loamy soils (sand predominating)	0.75
Clay loams (clay predominating)	0.75
Soft chalk, dry	1.00
Loose sand	1.00
Solid and ordinary clay ..	2.00
Confined sand	2.00
Clayey or loamy gravel ..	2.00
Sandy gravel	3.00
London blue clay	4.00
Hard chalk	4.00
Compact gravel	4.00
Very hard chalk	5.00
Rock	8.00

Financial Interests: Building Societies

The pre-war methods adopted by some building societies in financing builders during the erection of houses, and eventually the purchasers of the houses, need to be understood clearly so as to make it possible to avoid in the post-war period any actions by the societies and builders which may affect adversely "the man in the street" and the common national interests. Far too many

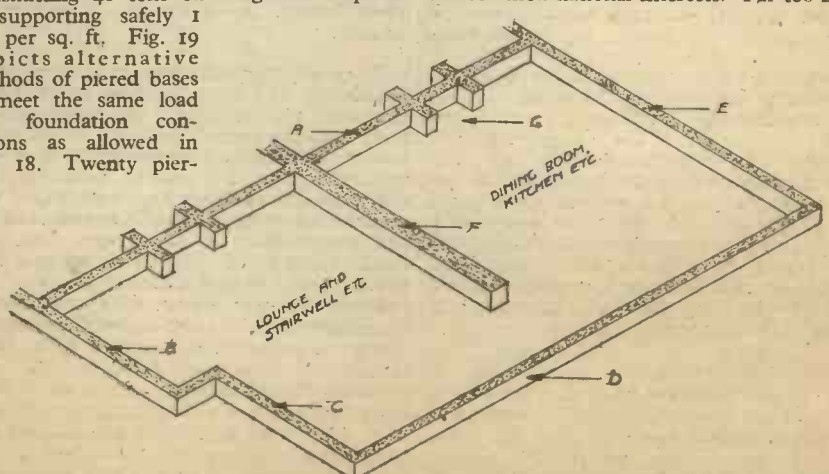


Fig. 18.—The engineer-built house. Concrete (or other material) bases of much smaller size than required for pre-war type of house as Fig. 14. About 3 yards cube concrete would be required to bring bases up to ground-level, thereby not only halving the quantity of concrete as Fig. 14 but saving 60 feet cube of brickwork.

A—Concrete base to party wall. B, C, D and E—Concrete bases to front bay, front wall, flank and rear walls respectively. F—Larger concrete base to heavily-loaded partition. G—Bases to fireplaces; such bases not necessary to many classes of work.

house purchasers think that building societies are philanthropists; they are not, but are strictly businesslike in their operations, and are not in business for the benefit of their health. There is no question as to the basic principles of building societies being of considerable advantage to every potential house owner who cannot pay "down" the total price of the house; nor is there any serious objection to reputable building societies who advance what is known as a "*straight-advance*," which, broadly interpreted, means about 80 per cent of the value of freehold property, the purchaser finding the remaining about 20 per cent. But, what all sane thinkers, as well as myself, do most definitely condemn is the "*excess-advance*" system if the purchaser is not informed as to what it means, and how it can seriously affect his interests. One of the old slogans of the jerry builder's salesman was "*The house must be good because the building society advances such a high percentage of the value of the house—90 or 92½ per cent. of its total value.*" This slogan was financial eye- or brain-wash and, as will be understood in a few minutes, is very misleading to anyone who does not understand the "hand-in-hand" working of some building societies and builders. It is the *difference* between the "*straight-advance*" of about 80 per cent., and the about 90 or 92½ per cent. *total advance*, which is the "*excess-advance*" of about 10 or 12½ per cent., and sometimes more, which can rather seriously affect the financial and other interests of the house purchaser. Building societies will not grant this *excess-advance* without some form of collateral security and, putting this into perfectly plain language, this means that, in addition to the house purchaser mortgaging (which is a type of pawning) his house and land (if freehold) to the building society as security for the ordinary 80 per cent. *straight advance*, the society requires further security from the *builder* (and not the purchaser) for the amount of the excess-advance of 10 or 12½ per cent. This collateral security is a subject of which every house purchaser should have complete knowledge, and a practical example of how this excess-advance is obtained is given below.

To prevent any doubt in any reader's mind as to why the subject of building society advances can be related differently to engineer-built houses from the ordinary type of builder's house, it may now be stated that there will not be the same scope for jerry building engineer houses as there will be ordinary houses. Therefore, as will be understood better after the following practical example is studied, there will not be much opportunity to adopt bad workmanship, and to use the poorest quality materials for the sake of reducing costs to assist in balancing certain expenditures which must be defrayed by the builder in connection with the provision of collateral security for the excess-advance.

Working of Building Society Pool System

Allow a freehold house costing £600, of which the purchaser pays only 10 per cent. down, viz. £60, the balance of £540 to be advanced by a building society.

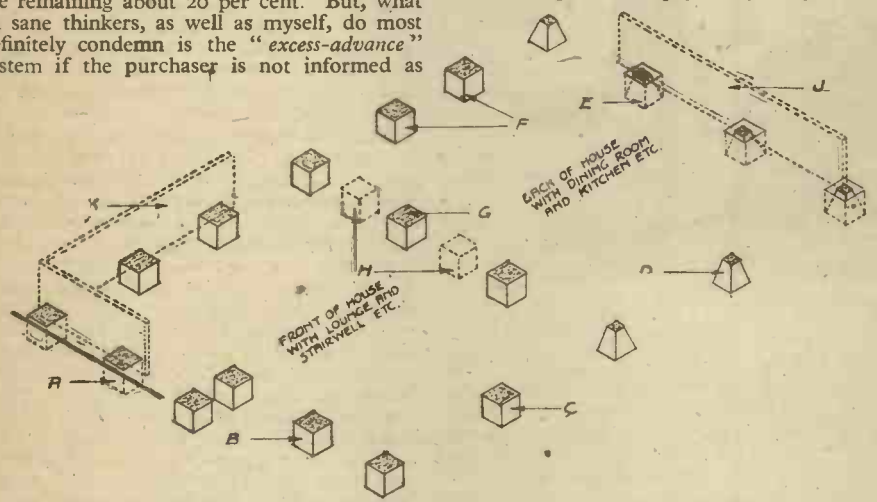


Fig. 19.—Piered or stooled bases will probably be favoured for engineer-built houses—small pier holes are excavated easily and although the cast-in-situ or pre-cast concrete piers or stools will be more costly bulk for bulk than continuous bases as Fig. 18, there will be only about 1½ to 2 yards cube concrete in them.

A, B and C—Cast-in-situ piers or stools to front and flank walls. D—Pre-cast stool. E—Pre-cast stool and excavated hole. F—Piers or stools to party wall. G and H—Piers or stools of suitable number to support heavily-loaded partition, additional piers as shown dotted may be necessary according to loading conditions. J and K—Parts of pre-built wall supported on piers; ground floor not shown. Next article will give details of ground-floor construction according to various practices.

	£
Purchase price of house	600
The straight-advance of building society very seldom exceeds 80 per cent.	480
Difference to be found	120
The purchaser finds or stakes 10 per cent. of purchase price	60
Leaving still to be found	60

The latter £60 is the *excess-advance* of the building society, who require collateral security for it. As the purchaser cannot find this security, and there is insufficient in the property to cover it, the builder steps into the breach and provides security under the *pool system*, which operates as follows:

A common system—there are variations to it—is known as the one-in-three pool system. The builder is building many houses and decides that all mortgage business is conducted through one building society, or at least sufficient houses are put through one society to permit the operation of the system. The building society stipulates that the builder provides collateral security by making a *cash* contribution to the society equal to one-third of the excess-advance, i.e., £20 of the £60 in the case of all houses in the pool system. It may now be thought that the society is taking a considerable risk in advancing £60 against only £20 security; but they are taking practically no risk at all, as will now be explained. Each £20 from each house goes into a common pool which, of course, is controlled by the building society; if there are, say, 20 houses in the pool, then there will be £400. This sum is held for a period to cover the building society against any loss which they may sustain through any one or more of the purchasers failing in their obligations to the society. Of course, if every one of the purchasers so failed and caused a loss exceeding £20 each, or a total of £400, then the society may lose. But statistics show that a rather small percentage of purchasers fail to meet their liabilities, and that most purchasers "stick it" for a number of years even if they find after taking possession of a house there are reasons for "throwing the house back at the society" even if they care to risk loss to themselves, or a legal action. By so "sticking it" it should be manifest that the capital amount of the mortgage is reduced by the repayments, and, with the amount of money paid down by the purchaser, coupled with the pool held by the building society, the latter has but little to risk. This risk is minimised by the fact that, whereas the house may depreciate in value to a rather considerable extent owing to it being built badly, the land has a tendency either to remain at its original or to appreciate in value. Therefore it is almost certain that if a house purchaser fails after a few years the building society will be in a comparatively strong position as there will be a sufficient margin of money left between the original purchase price and the amount of indebtedness to the society to permit expenditure on repairs, law charges, etc., to ensure the house being sold at its original price, a little less, or, at any rate, at a price to cover the society. If this cannot be done, then they have the pool deposits to draw upon to cover any loss.

(*To be continued.*)

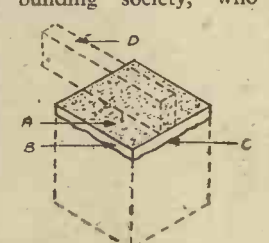


Fig. 20.—Simple cast-in-situ concrete pier or stool of size suitable to transmit loads to foundations.

A—Concrete pier, etc. B—Top of pier an inch or so above ground-level if necessary. C—Ground-level. D—Light beam to support wall and floor units, if units in themselves do not act as beams.

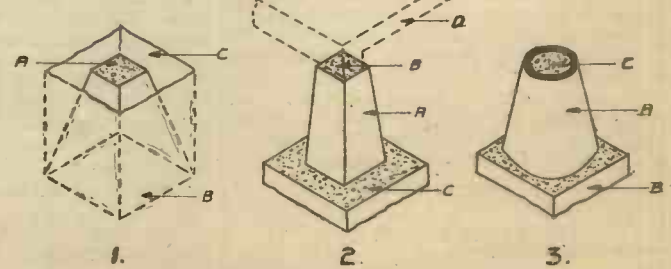


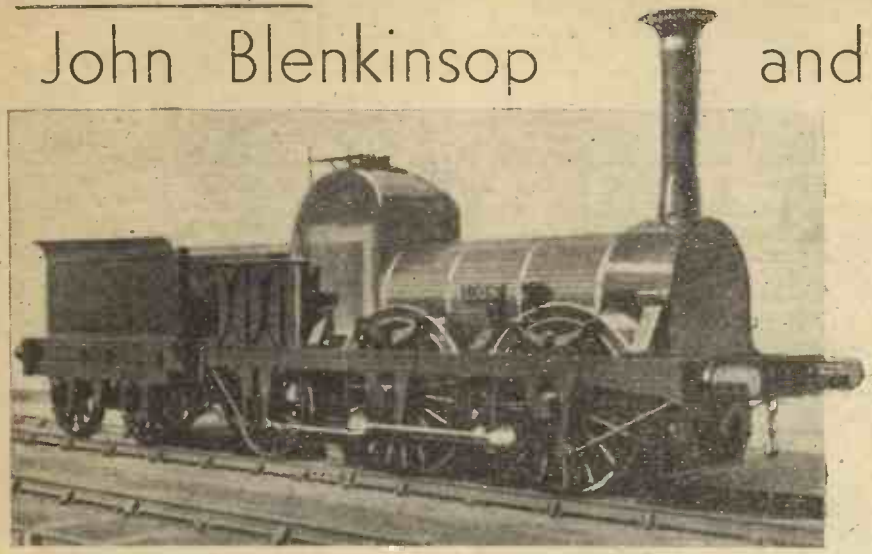
Fig. 21.—A few of many types of pre-cast piers or stools to support safely and economically engineer-built houses.

1—Tapered stool: A—Area sufficient as bearing for floor and wall units. B—Area of size suitable to transmit load to foundation. C—Excavated hole. 2.—Small pre-cast stool on cast-in-situ concrete base: A—Pre-cast stool. B—Area sufficient as bearing for floor and wall units. C—Concrete base acts as good packing to make up irregularities in ground-levels. D—Floor units. 3.—Taper tubes on concrete base: A—concrete taper tube. B—Concrete base as 2. C—Concrete filling.

Masters of Mechanics

John Blenkinsop and His Locomotives

The Introduction of the Rack-rail System, and Toothed-wheeled Drive



" The Lion," one of the early passenger locomotives, made about 20 years after Blenkinsop.

THE schoolroom legend crediting George Stephenson with the invention of the steam locomotive dies hard. True it is that Stephenson was the most spectacularly successful of all the locomotive pioneers, yet, at the same time, he neither originated nor in any way actually introduced the working locomotive to the world in general.

Half a dozen inventive and constructive minds had been given over to the problem of creating a successful locomotive engine before Stephenson entered the arena of railroad engineering. Stephenson's success, therefore, was to no small extent consequent upon his being the right man on the right job at the right time—a formula which, many times over in industrial and engineering history, has proved itself to be almost indispensable to commercial success in the development of an invention.

There were, of course, railroads before Stephenson was born. Wooden tram rails are reputed to have been used as early as 1630, and at the beginning of the ensuing century both metal and wooden rails were, in certain districts, used fairly extensively for the purpose of facilitating the passage of coal wagons from coal pits to main roads and, subsequently, to canal heads. Needless to say, all wagon traffic on these tram roads was horse drawn, and it was the contemplation of such traffic which gave to the early steam-power pioneers their first notions of a portable steam engine which would propel itself (and, incidentally, a train of wagons attached to it) from place to place, thereby enormously facilitating speeding-up and cheapening the transport of goods from area to area.

Thus was born the steam locomotive, an engine which, let it be noted, that arrant rogue, James Watt, the falsly-supposed " inventor " of the steam engine, consistently decried, and even made efforts to prohibit by Act of Parliament.

Unsuccessful Locos

Richard Trevithick, a Cornish engineering genius, may be considered to be the " father " of the locomotive, since it was he who first obtained practical success with a locomotive operating upon the high-pressure steam principle, which the scoundrelly Watt endeavoured so strenuously to suppress. Trevithick's locomotives, however, were not a commercial success for, owing to the weakness of the rails upon which they ran, the allowable weight per wheel of Trevithick's locos had to be restricted severely. This gave rise to lack of adhesion between the wheels and the rails, and it led to the general opinion that the grip of a locomotive's wheels upon a smooth rail would always be inadequate for the tractive power generated by the engine.

Before the first working locomotive was designed or, perhaps, ever thought of, there was born near Leeds in 1783, one John Blenkinsop, who, in after life, was destined to become one of the first successful pioneers of steam locomotion in this country.

Little is known about the Blenkinsop family of Leeds. The earlier days of John Blenkinsop, together with his education, upbringing and the commencement of his career, are matters which apparently local historians have not yet fully investigated. Suffice it, therefore, for this John Blenkinsop to enter into our present picture towards the end of the first decade of the 19th century. At that time he occupied the dual position of principal agent of the Brandling family, which owned extensive colliery workings in the Middleton district of Leeds, and manager of the Brandling coal pits of that district.

It has been asserted, upon somewhat dubious authorities, that Blenkinsop was neither an engineer nor even a mechanic. He is said to have received no apprenticeship or training in the mechanical arts. Yet if such was actually the case, it is remarkable that such an untutored individual should have received the important post of colliery manager in which he laboured with much practical success during a large portion of his working life.

The story runs that Charles Brandling, of Leeds, whose coal mines Blenkinsop managed, being a Member of Parliament, made frequent journeys to London. During one of his visits to the metropolis he witnessed a demonstration of Richard Trevithick's pioneer locomotive in a field near to where Euston station now stands. Brandling was so struck with the possibilities of steam locomotion that he returned post-haste to Middleton and there and then entered into discussion with his manager, Blenkinsop, as to the possibility of constructing a similar locomotive for use at the Middleton collieries.

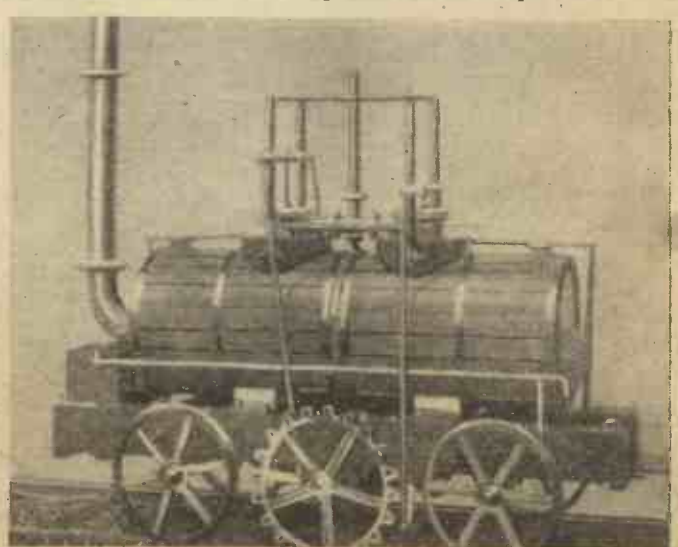
Evidently Blenkinsop received a more or less overriding commission to proceed at once with the task of locomotive development, for he seems immediately to have set to work upon the task, and to have evolved ideas which were definitely his own.

Blenkinsop figured out that a light locomotive running on plain rails could haul (on the level) about four times its own weight. Hence, a steam locomotive working on Trevithick's principle and weighing about 3 tons could not be expected to transport a greater load than 12 tons, even if it managed to perform that feat satisfactorily. Charles Brandling, M.P., the colliery owner, held the view that such a locomotive would not be an economical proposition at the Middleton coal pits. He wanted a loco which would haul a 20-ton load, not merely on a dead level, but up an incline as well.

Blenkinsop and Brandling

Blenkinsop concurred in Brandling's views, and since the prevailing opinion of the day was against the use of a smooth rail for locomotive running, Blenkinsop determined that he would operate his locomotive over a rack, or a toothed rail.

Having taken such decisions, John Blenkinsop got busy. He designed a new type of locomotive using the high-pressure steam of the day (about 80 lb. per sq. in. pressure), and since he was busy with the main management of the Brandling collieries, he commissioned Matthew Murray, of the firm of Teuton, Murray and Wood, Engineers, of Leeds, to make it. Matthew Murray was an engineer and an inventor of high ability. He played a great part in steam-power development, and there is no doubt that Blenkinsop owed much of his practical success



Blenkinsop's rack-rail locomotive, 1811.

to Murray's sound advice and practical assistance.

On April 10th, 1811, John Blenkinsop was granted a patent (No. 3431) for his locomotive, and for his system of rack rails.

The precise share which Blenkinsop had in the working out of the ideas contained in this patent is disputed. There are some authorities who claim that the locomotive in question was designed and constructed solely by Matthew Murray, the latter working to a specification formulated, or rather outlined, by Blenkinsop. On the other hand, however, Patent No. 3431, of 1811, makes no mention of Matthew Murray. The patent names John Blenkinsop as being the inventor, "aided by John Straker." Who this John Straker was, and what part, if any, he had in the evolution of the locomotive in question is as yet quite an unsolved problem.

Blenkinsop's locomotive, to us moderns, had a quaint and an almost picturesque appearance. It embodied a plain cylindrical cast-iron boiler with a single flue. The boiler assembly was supported on an underframe or carriage which rested, without the intervention of any springing or shock-absorbing devices, upon two pairs of wheels, which latter merely served to support the locomotive upon a pair of smooth rails, and were entirely unconnected with any of the working parts of the locomotive.

The engine possessed a pair of cylinders, which detail was an obvious improvement upon the one-cylindered locomotive of Richard Trevithick. This double cylinder has been asserted to have been the sole idea and invention of Matthew Murray, and not to have been due to John Blenkinsop.

The progress of the locomotive was effected by means of a large toothed wheel or cog which meshed with a single rack or toothed rail placed on the left-hand side of the pair of smooth rails, the cog being set in motion by means of two long connecting rods attached to the piston assemblies.

The rack rail which Blenkinsop laid down comprised 6ft. lengths in some places, whilst 3ft. lengths were laid in other portions of the line. The rack rails had solid teeth, each tooth measuring about 3in. by 2in. by 2½in. One of these now historic rails has managed to survive the passage of time, and it is to be seen in the Leeds Museum, whilst a fair copy of it is preserved in the Science Museum at South Kensington.

First Trials

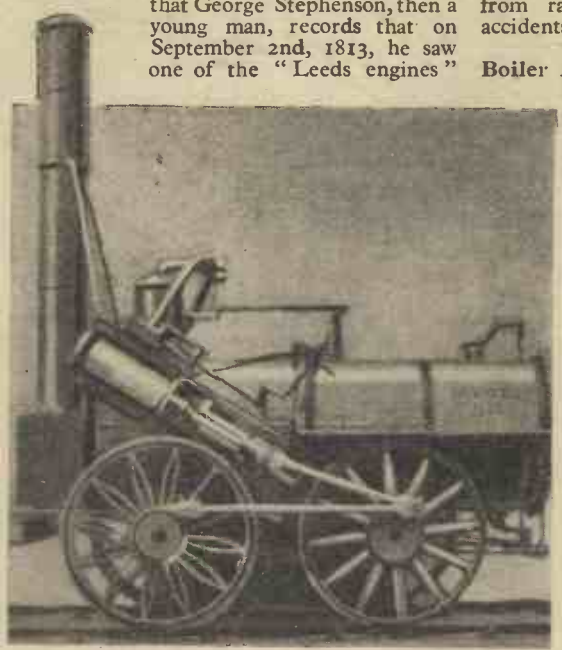
John Blenkinsop made his first practical trial with the rack-rail loco on Wednesday afternoon, June 24th, 1812. Describing the trial, the *Leeds Mercury* for June 27th, 1812, gives the following account:

"At four o'clock in the afternoon, the machine ran from the coal staith to the top of Hunslet Moor, where six and afterwards eight waggons of coal, each weighing 3¼ tons, were hooked to the back part. With this immense weight, to which, as it approached the town, was added about 50 of the spectators mounted upon the waggons, it set off on its return journey to the coal staith, and performed the journey, a distance of about a mile and a half, in 23 minutes without the slightest accident."

Seemingly, therefore, despite its obvious imperfections, in spite even of its rack-rail cumberousness, the Blenkinsop engine acquitted itself satisfactorily and pleased greatly its owner, its designer and its builder. Indeed, within a very small space of time, the locomotive rose to a good degree of popularity. It travelled at the then "enormous velocity" of no less than 10 miles per hour even when it had a load behind it, a fact which so pleased its owner, Charles Brandling, that he had several more engines constructed to a similar pattern.

For a wide district around Leeds the locos were named "Blenkinsops," this appellation then being synonymous with the last thing in steam-power development.

In August, 1812, several "Blenkinsops" were working regularly on their one-sided rack-rails in the Middleton colliery district of Leeds. On an average, each locomotive hauled 30 coal wagons over a distance of about four miles in a little less than an hour. The Middleton "Blenkinsops" began to constitute one of the curiosities, and even one of the adornments, of the Leeds area. Notable people travelled miles to see them. Even the Grand Duke of Russia (afterwards Nicholas, Czar of Russia), whilst in this country, paid a visit of inspection to them and expressed his great admiration of their capabilities. And it is further to be noted that George Stephenson, then a young man, records that on September 2nd, 1813, he saw one of the "Leeds engines" and noted its working. The enthusiasm and the wonderment over the "Blenkinsops" went so far as to affect a number of pottery makers, for some of these manufacturers turned out from their factories pottery plaques and other ornamental objects which bore on their sides a fairly faithful representation of the original 1811 Blenkinsop locomotive.



"The Invicta"—a pioneer steam locomotive built in 1830.

There is little doubt of the fact that John Blenkinsop was the first *successful* locomotive patentee. It was his original engine which established, once and for all, the eminent practicability of utilising the services of the locomotive principle for the haulage of goods. Apparently, Blenkinsop never gave a serious thought to the transport of passengers, or, at any rate, if he did do so, he contented himself with leaving such developments to others.

The pounding which the Blenkinsop locomotives gave to the teeth of their rack rails caused many and frequent breakages of the latter. So much so that Blenkinsop was eventually compelled to have a foundry erected by the side of the line from which fresh lengths of rail could be obtained with the least delay.

Considering the inherent crudities of the Blenkinsop locomotives, their lop-sided mode of rack-rail progression, and the altogether excessive amount of vibration which they must have set up, it is, for us, rather astonishing to be confronted with the fact that these engines ran, day in and day out, for many years at a then economical rate and, apart from rail breakages, with singularly few accidents.

Boiler Accident

Only once was there a really serious accident with a "Blenkinsop," and that happened when a boiler burst under excessive steam pressure and killed the driver. A big official inquiry was set up into the cause of the accident, when it transpired that the loco driver in question had, to his own unfortunate undoing, put an overload on the safety-valve of the boiler.

The one constitutional defect of the Blenkinsop locomotive was that all the driving-power was applied on one side of the engine only. If Blenkinsop had incorporated *two* oppositely-placed driving wheels into his locomotive design, and if he had provided for a *pair* of rack rails, much expense in the frequent renewal of rails would have been saved. The locomotive itself would have proceeded with greater speed and more economically, for the unequal application of driving power had always a great tendency to force the flanges of the running-wheels against the sides of their rails and thereby to create a good deal of extra and unnecessary friction, to say nothing of subsequent rail wear and tear.

However, the 1811 locomotive brought lasting success to John Blenkinsop and to his employer, Charles Brandling, M.P. Unfortunately, Blenkinsop's success was not to be, for himself, one of long duration, for this praiseworthy pioneer died at Leeds on January 22nd, 1831, at the comparatively early age of 48, and "after a tedious illness."

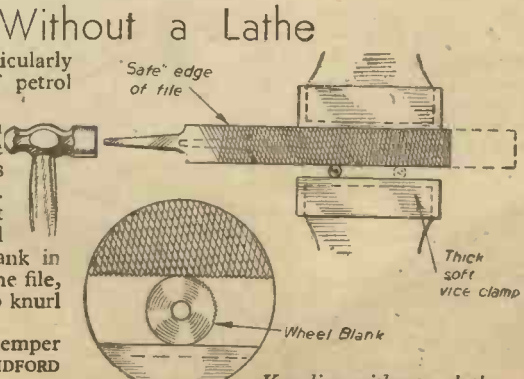
From Blenkinsop's successes, other engineers, George Stephenson among them, rose to greater developments and ultimately made practical the passenger locomotive, and our present-day railway system.

Knurling Without a Lathe

THIS method of knurling is particularly applicable to the manufacture of petrol lighter wheels, using only hand tools.

To make a wheel cut off and drill a disc from a silver-steel rod of suitable diameter. Then cover the vice-jaws with thick soft sheet-metal vice clamps. Select a hand-safe-edge file with a cut on its edge the same as the knurl required. Put the file and wheel-blank in the vice (as shown in sketch). Drive the file, with a hammer, across the vice, and so knurl the wheel.

Repeat if necessary. Harden and temper by normal methods.—P. W. BLANDFORD (Bristol).



Knurling without a lathe.

Making Garden Frames

Constructional Details of Two Useful Garden Accessories

By "HANDYMAN"

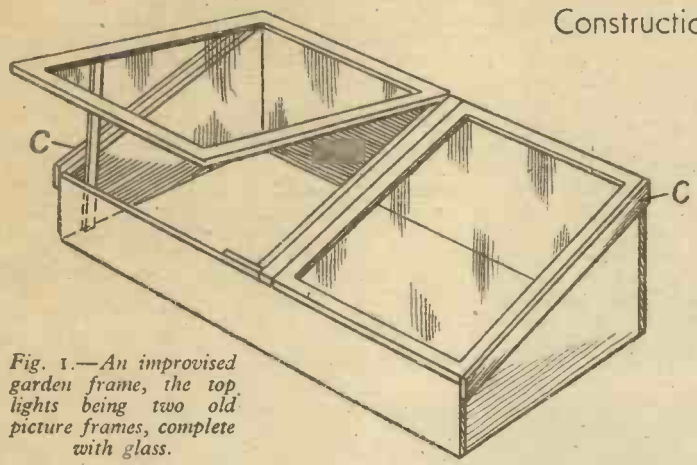


Fig. 1.—An improvised garden frame, the top lights being two old picture frames, complete with glass.

A GARDEN frame is a necessity in a small garden for forcing on and protecting young plants, and this article describes the construction of two of these garden accessories.

As timber is difficult to obtain these days, the first frame described is intended to be made with wood obtained from a packing case knocked apart. The glazed top is formed with two old picture frames, complete with glass. The dimensions given are suitable for two picture frames measuring 20ins. by 16ins., but these measurements can be altered to suit the frames available, which must, of course, be the same size. It will be seen, with reference to Fig. 1, that the top lights are hinged, and can be propped up at any angle by means of a suitable stick.

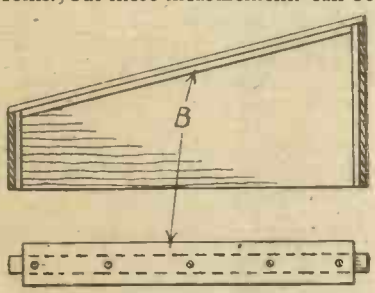


Fig. 4.—Section of frame and detail of cross-member.

Framework

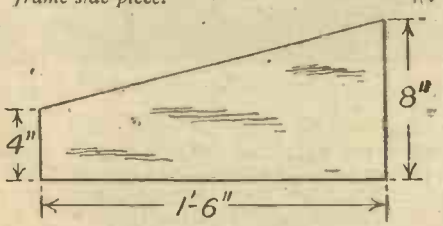
The front and back of the frame each consist of two pieces of wood nailed to a third piece, as shown in Fig. 2. The two sides are each shown as one piece, but if wood of sufficient length is not available, these can also be made with two short pieces, joined in the same way as the back and front. After nailing the front, back and sides together, the four corners can be strengthened, on the inside, by pieces of 1½in. square batten, as at A, Fig. 2. The top edges of the front and back parts should be planed to the same angle as the top edges of the sides, so that when the framed lights are in position they will rest flat on these edges.

Cross-member

The centre sloping member, B, is made with two pieces of wood screwed or nailed together, as shown in Fig. 4, and then nailed in position across the centre of the frame. This sloping member provides the necessary rigidity and also forms the inner edges for the top lights to rest on. The back edges of the top lights are hinged to the back of the frame, as in Fig. 5.

Fig. 5 (right).—Detail of hinged joint.

Fig. 3 (below).—Dimensions of frame side piece.



The two sloping side strips, C, C (Fig. 1), are optional, but if nailed on, as shown, they help to exclude cold night air from the interior of the frame.

The finished frame can either be painted, or treated with creosote.

An Alternative Design

In cases where two or three pieces of ordinary picture glass are available, and also the necessary wood, a serviceable frame can be constructed, as in Fig. 6. Three pieces of glass 1ft. wide are used, arranged to slide sideways to provide openings for ventilating purposes. The same method of construction holds good for two or four sheets of glass.

For the front, back and sides, deal ⅝in. thick can be used, the back and front being cut to the dimensions given in Fig. 7. To the inside of the back nail a strip of 1½in. by ⅝in. wood, as indicated, so that the top comes about ¼in. below the top edge of the back board. After cutting the two sides to the dimensions required, nail the parts together, the sides being fixed between the front and back parts, as in Fig. 6. To strengthen the frame nail a piece of 1½in. square batten in each corner, as in Fig. 8.

Housing the Glass

Across the front of the frame screw on a strip of 2in. by ½in. wood, allowing it to project ½in. above the top edge of the board to form a ledge for the glass to rest against. Another strip is nailed on to the top edge of the back board, to form a groove for the glass, as shown in Fig. 6. Before nailing this strip in place, plane the top edge of the back board to the same slope as the sides. The top edge of the front board should also be similarly planed before fixing the front strip in place, so that the glass will rest flat.

A suitable handle, either of wood or metal, can be screwed to each side, as shown, after which the frame can be painted.

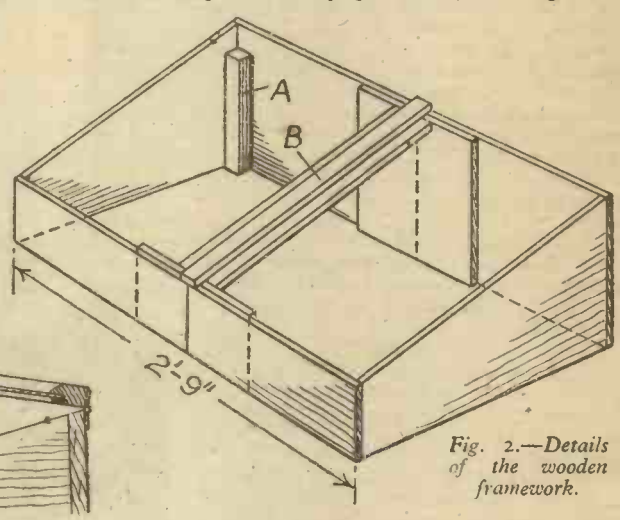


Fig. 2.—Details of the wooden framework.

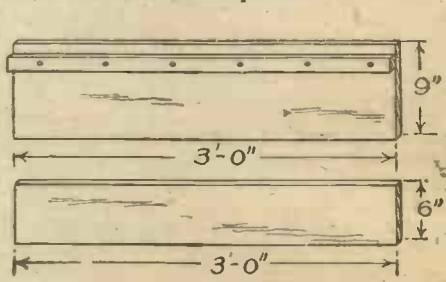


Fig. 7.—Front and back boards.

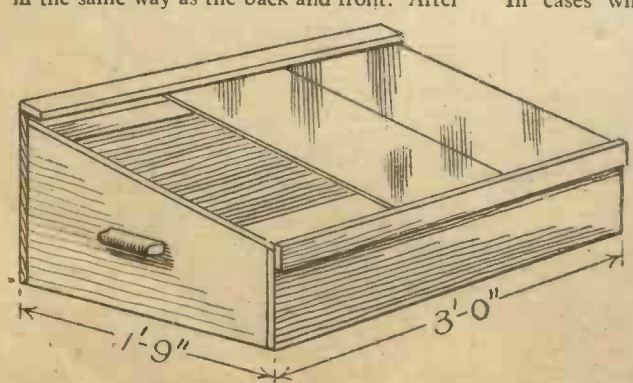


Fig. 6.—A small frame with sliding top lights.

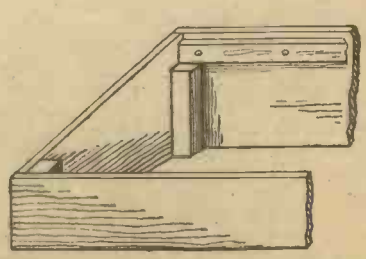


Fig. 8.—Showing corner fillets for strengthening the framework.

Flower Photography

The Choosing and Arrangement of Subjects

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

IT has been said that if an amateur photographer is hard put to it to find a subject for his camera he always falls back on flowers. There is a fair amount of truth in this because, for obvious reasons, flowers must appeal to all enthusiastic and artistic workers with their keen eye for natural beauty. Flowers are decorative, and therefore are attractive to the pictorialist; they are an excellent medium for the individual to display her or his ability in the art of arranging. There is also another reason, and it is one which, in some directions, has a greater influence than any other, and that is we have flowers with us nearly all the year round in an ever varying range, in our gardens or allotments, in the woods and hedges; in the blossom on fruit trees or flowering shrubs and finally, if through circumstances we cannot reach out to the country or do not possess a garden, it is still possible to obtain a bunch or two from a local florist, and to arrange the blooms in our own particular way, and photograph them as indoor subjects.

It is small wonder then that flower studies are to be found in almost every competition or photographic exhibition, not in abundance, but in sufficient quantities to indicate that the subject is fairly popular, and it is to be noted that these entries appear to attract the eyes of the judges for a deeper and longer consideration than the more commonplace subjects as landscapes, river scenes, and figure studies.

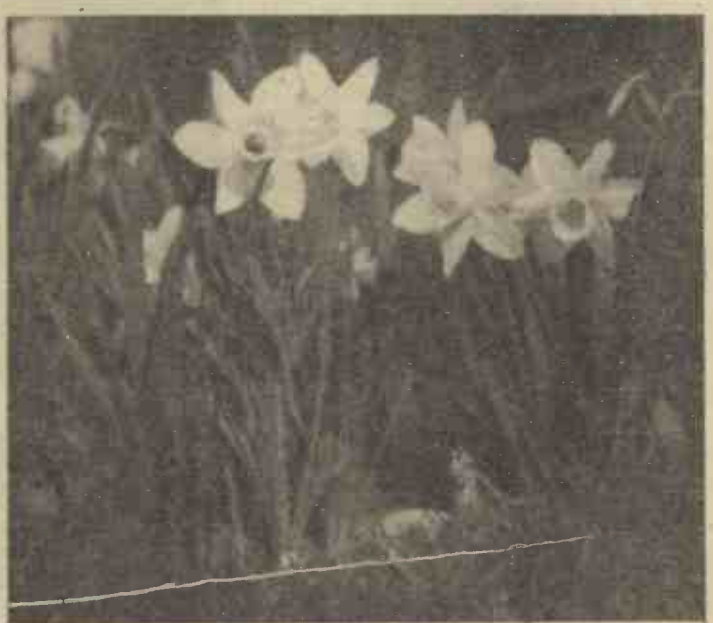
You will agree that at this time of the year the facilities for flower studies are perhaps greater than at any other; hedges and woods are alive with early wild flowers while our gardens are at their best with tulips, narcissi, etc., and fruit trees are resplendent in their wonderful beauty of blossom time. It should be realised that at this time there is not a superabundance of foliage to overpower the delicacy and individual character of the bloom itself.

Simplicity of Arrangement

There is one very important hint which I think should be carefully learned by all who intend making photographic studies of flowers, and if it is put into practice it will go a long way to making your efforts successful; it will certainly help you to acquire something which is so often missing in this branch of our hobby, and that is simplicity. If you examine and consider flowers for the purpose of making records you will quickly recognise that it is often due to the simple unaffectiveness of the single bloom or bunch that makes them so attractive. While one does not wish to discourage the work of those responsible for the excellent beds of flowers in our parks and open spaces, yet the very artificial way of arranging groups of one colour or of perhaps three or four different types of plants in colours which blend, rather cultivates in us the desire to seek the beauty of flowers in their natural surroundings.

Those who are fortunate to live near some of those spots belonging to the National Trust are to be envied, for it is a simple matter for you to take the camera out and to make a study of that little bunch of primroses or anemones, to take your time, to pick off that faded bloom, and to give a little touch here and there; you can afford to wait a few minutes till a better light happens on the bunch, or till that shadow of an overhanging branch has moved away from the group; maybe there is too much moisture on the ground surrounding the bunch, and you can postpone the exposure for about an hour.

These are some of the little points to watch when taking flowers in the hedges or woods; don't be in a hurry but give a little thought to your subject, examine the group from this and that side, look down on it and then get down to its level—on the ground—and you will probably be very surprised how beautiful it looks at a low angle. Try to remember that a few blooms can look much more artistic than a crowd of even twenty; be particularly careful to measure the distance between the lens and the nearest bloom. The exposure time is not easy to calculate, and you must satisfy yourself as to the value of the light in such a place; on an open hedge it might be quite good if there is no heavy foliage immediately above the bunch. Be sure that the main light is coming from the back of the camera, and do not attempt to expose if there happens to be a strong spot of light at the back of the little group; it will pay you to fill this "hole" with some twigs and dead leaves.



A pleasing group of daffodils in their natural element.

If you can get all the fine detail of the flowers and their leaves by using a fairly large stop such as F8 or 6.5, you will find it is an advantage as it will tend to give a soft diffused background which will help and enhance the final print, seeing that with such a background you are able to centre attention on the subject. You must also be careful to avoid spottiness, those white spots which can occur through too great a contrast in blooms and foliage with patches of light are fatal to any picture.

Avoiding Artificiality

Studies of flowers growing in ordinary suburban gardens are often not as successful as they might be if a little more thought was given at the time when the bulbs or roots were planted. I have already hinted that I dislike anything that suggests the "artificial" in flowers; I like to see, for instance daffodils growing in the grass; give me a dozen so planted in preference to six dozen in rows in a prepared bed, or take a small batch of five or six "jonquils" or other narcissus growing just in front of the apple tree in a small bed. Such a patch will enable you to make quite an interesting and pleasant study; of course, you will have to very carefully watch the light. I have found the early morning, say before 11 a.m., very good; it is lacking the hard light of midday or the early afternoon and the blooms are at their best, they have had their refreshing drink of dew, and are turning their heads to the sun in that wonderful way they have of showing their appreciation of its warmth and light.

Do not stoop over those flowers, but get down on your knees to them and examine their beauty just for a few moments before exposing; usually they have arranged themselves for the photograph, but that rubbish which is around the roots should be removed, and those two or three lumps of mould and stones should be broken up into fine stuff. If the ground is very dry there is need for the watering can; only a slight sprinkling, and do not overdo the drops on the plants. If there happens to be one or two of the blooms awkwardly turned or too close to one of its neighbours, all you require is a piece of thin flower wire, a turn or two of this near the head will put it right, but see that the wire is not showing. If you have a pleasing indoor bowl of the spring flowers, and you want to have a shot at it, make a shallow hole in one of the beds and insert the whole bowl; you can find a twig or two and some leaves to place near the bunch so as to give it the right atmosphere, and usually for such a study it is necessary to make use of the wire.

Fruit Blossom

Let us now turn our attention to that most fascinating part of this subject, fruit blossom. Some of the most beautiful results which I have seen have been of a single branch or twig of a tree with the bunches or clusters of blossom carefully selected, and I will suggest two methods of taking such subjects. The first is to mount a pair of household steps and select a branch which is outstanding from all others and having nothing between it and the sky; focusing must be very carefully done and the exposure particularly quick, as it is actually the sky that is being taken. Again, do not be in a hurry, but wait for a cloud to appear in the sky and to be the background for your branch; the alternative way is to cut a branch from the tree and take this suspended against a suitable

background of black cloth or a piece of fairly stout card on which you have sketched a cloud-scape, which is best done with stumps and chalk on a grey coloured card. You will understand that by taking a photograph of a single branch, the objective is a decorative frieze, and some very pleasing effects can be obtained in this way for greeting cards and calendars. Taking a "shot" of the whole tree is a very natural thing to do because of the beauty of it as a whole, but I am inclined to think that in this case sufficient care is sometimes not given to the surroundings; some results are spoiled by the presence in the picture of garden implements or an old shed or even part of the house. Others will have an obtrusive figure reaching up to the blossom or in some other position equally distracting. We must get back to the idea of simplicity to avoid anything butting in on the subject; one very choice print sent in for a recent competition was of a portion of a tree and it was taken from a bathroom window. It was something between a frieze and a tree study, with the lawn serving as a background.

Cut Flower Subjects

I cannot think of any better hint than that of a home-made background, similar to that mentioned in the last paragraph. If you propose taking several studies during the next few months, get a piece of three-ply or cardboard, and with stump and crayon make some designs, such as clouds, trellis, curtains or a window; place the vase of flowers in front of the design at such a distance that the background is not dead sharp. The exposing can be done either outdoors or inside the room, but for the latter a good strong light is necessary. The arrangement of the blooms is one where personal taste will play the most important part, and if this is lacking then I should be wrong if I did not advise you to give up this branch of the work and wait until you could get some experience in "design." It is surprising how many persons are unable to place a dozen blooms in a vase in an artistic manner; how often have you seen some delightful flowers just dropped into a pot in a bunch. When arranging, try to reproduce them as they would be growing in their natural surroundings, each head reaching for the sunlight and doing its utmost not to intrude on any of its fellows; no crushing or overcrowding. If you have got two or three blooms more than you really want, do not spoil the look of the whole, but put those extra ones in another bowl or glass, then take one or two more out of the group you propose photographing and you will probably like the setting better with its fewer heads, thus proving the need for simplicity.

About Coalbursting

A New Method of Mining Coal which Eliminates the Danger of Explosion

By A. HARVEY, F.Inst.P.

SINCE the 1914-18 war the coal-mines of Great Britain have been almost entirely mechanised and coal is now very rarely hand hewn. This has involved a great increase in the use of explosives. In practice the coal seam is undercut by means of a mechanical coal cutter and then the coal is brought down by drilling holes in it, inserting shots (charges of explosives) in these holes and then detonating the shots. However, every shot that is fired is a potential explosion and, in view of the gassy nature of many of the British mines, stringent precautions have to be taken.

Fig. 1.—(Above) Drilling the coal ready for insertion of the burster. Note that the coal is already undercut and is supported.
Fig. 2.—(Right) Inserting the burster.

The "Coalburster"

Any device that will eliminate the danger of explosion is eagerly welcomed, and given a thorough trial, by the British mining engineer. The "Coalburster" is a hydraulic device for dislodging coal which has now been in use for several years, and can thus truly be said to have passed the experimental or trial stage.

The coalburster is a stout steel cylinder some 3ft. long and 3in. in diameter, chambered at intervals to accommodate a number of telescopic pistons, each about 2in. long. Suitable ports are bored to convey water to the underside of the pistons so that they can be forced out radially by means of hydraulic pressure. After the seam has been undercut the coalburster is inserted in a hole drilled in the coal (just as for a shot), this hole being a snug fit for the cylinder, so that if the pistons are forced out something must give way, and this will be the coal.

Fig. 3.—Building up pressure by means of a hand pump.

Hydraulic Pump

The burster is connected to a pump by means of a quick make-and-break coupling attached to a small bore ball-jointed tube of a length sufficient to enable the miner to work the pump from a safe distance. There are two types of pump available, manual or power operated, both being of simple and robust construction. The manual pump consists of a light steel box into which fits the pump barrel, plunger and rocking

shaft, the latter being supported between two bearings with the handle attached to the projecting end. The power pump has the three-plunger type barrel and cam shaft in a similar light steel box, and is driven through suitable gearing by a small "vane" type compressed-air motor. In each case the light steel pump box acts as a reservoir for water, a small quantity of soluble oil being mixed with this to provide lubrication for the leathers. A pressure of 6 tons per square inch is developed by the pump and communicated to the pistons. Several tons of coal are brought down in one burst, to build up the pressure for which takes about two minutes. The pistons should then have reached the end of their travel and the coal should be ready to roll over with picks or crowbars, and to be placed on the conveyor or into the tubs.

Advantages

This new technique of bursting coal seems to have very few limitations and can be employed for all types of coal, hard or soft. It can also be used for rock bursting. Obviously the action is different from the shattering one of an explosive, being in the nature of a slow, steady thrust. This results in an improved product being produced, chunky coal that has not been shattered or rendered "tender" by an explosion, and which will therefore travel better and bring an improved price. Again, the effect of this slower action of the burster

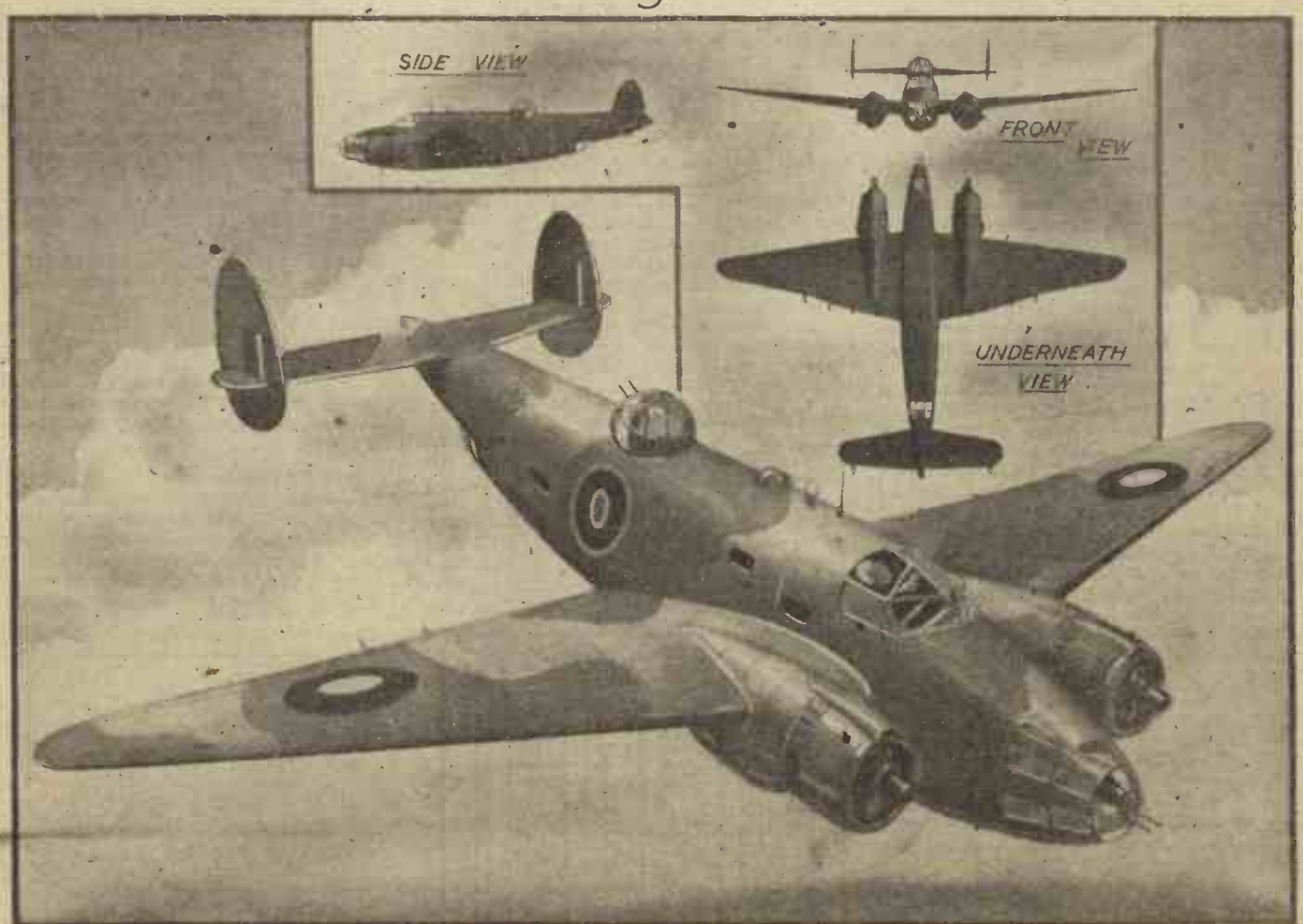
Fig. 4.—After the bursting has taken place, showing the manner in which the coal is brought down. Note the size of the lumps brought down and the pistons now fully extended.

spreads and carries farther than that of explosives, so that it is found that fewer holes are required for dislodging the coal from a given length of coal face.

These advantages, however, are minor ones compared with some of the others. With this method there is no risk of an explosion. Also, the mine atmosphere is less dangerous, since little coal dust is produced. This, again, is much healthier and pleasanter for the workmen. Less coal dust, too, means lowered expense, because less stone dusting need be done.

Again, when explosives are being used the men have to be withdrawn from the coal face to a safe distance. This interrupts the work, but, something much more serious, the men come back to conditions which may have changed radically as a result of the explosion. The roof, for example, may have cracked and been rendered unsafe. The use of a coal-burster does not require the men to be withdrawn more than a few feet and, as the burster is silent in operation, movements of the roof can be heard. In addition, damage to the roof is much less common, since there is no concussion from an explosion.

Lockheed-Vega Ventura 1



This Reconnaissance Bomber is powered by two 2,000 h.p. Pratt and Whitney engines and has a maximum speed of 275 m.p.h. Armament consists of four machine-guns in the nose, two in top turret, and two under the fuselage. The machine has a span of 65ft. 6in., and carries a crew of five.

Aero-engine Instruments

How They Operate, and Their Importance on Modern Aircraft

By T. E. G. BOWDEN

TO enable the pilot to extract the maximum amount of power from his engine(s), without causing any damage, accurate recording instruments indicating the exact internal conditions are required. These instruments are subject to extreme vibrations and variations in temperature. The following readings are required on a high-powered aircraft: engine revolutions, oil temperature, oil pressure, coolant temperature, boost pressure, petrol pressure and fuel contents. An engine cylinder thermometer is sometimes fitted, although it is usually confined to prototype aircraft for testing purposes, and air-cooled engines. Fig 1 illustrates a pilot's dashboard fitted with the engine instruments only, and a description of the various instruments now follows.

Engine Revolution Indicator

The engine revolution indicator is of primary importance, and was the first

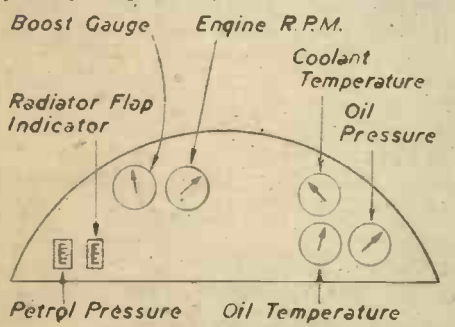


Fig. 1.—Instrument panel.

instrument to be fitted to aircraft for engine recording purposes. This instrument indicates to the pilot the revolutions per minute of the crankshaft, thus allowing the amount of power being generated by the engine to be estimated. There are two types of revolution indicators or tachometers, as they are sometimes called. Firstly, there is the centrifugal type, which is used in many branches of engineering; and, secondly, a more modern development is the electrical recorder.

A sketch of the centrifugal engine revolution indicator is given in Fig. 2, and, as shown, it depends on the movement of a weight which alters in position as the crankshaft speed of rotation varies. When the r.p.m. increase the weight tends to move to a horizontal position. Springs are fitted to resist this tendency. The movement of the weight is transmitted to an indicating needle which travels over a scale usually marked in steps of 100 r.p.m. Various designs of dials are available, and the one selected depends upon the engine used and the amount of panel space available. It is usual for this instrument to record r.p.m. over 1,000 as speeds of rotation lower than this figure are not accurately recorded. Modern aircraft engines run at anything up to 3,000 r.p.m., and, in consequence, very careful construction of this type of instrument is required.

The drive from the engine is by means of a flexible shaft constructed as follows: A shaft consisting of layers of wound wire is enclosed in a metal case and fitted with square ends which connect up to the engine at one end and the recording instrument at the other. The connecting fitting is usually swaged on to the shaft. To provide for sharp bends right-angle drive gear-boxes are available, and when other bends are made it is essential that they should be as gradual as possible. The shaft is lubricated with grease, the anti-freezing type being generally used.

The electrical engine revolution indicator has several advantages over the old centrifugal type, owing to the fact that no flexible shaft is required, and the distance between the engine and the pilot's cockpit is immaterial. An electrical generator is mounted on the engine and driven by means of a shaft and gears. The amount of current generated is indicated on the instrument in the pilot's cockpit by means of a small electric motor connected to a pointer. This type is especially suitable for large multi-engine aircraft, and

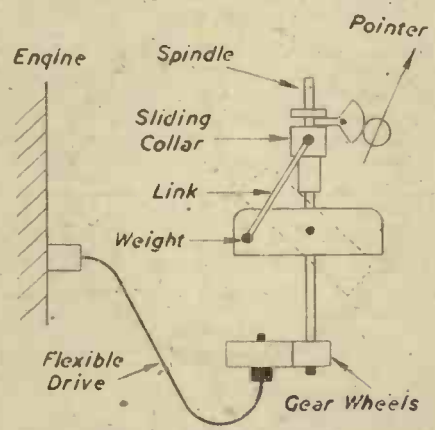


Fig. 2.—R.P.M. indicator.

the indicating dials for such aircraft are usually arranged as shown in Fig. 3.

An alternative design is a combination of the two methods just described, i.e., a flexible shaft running from the engine to the instrument drives the motor. The electrical type of tachometer is extremely accurate and dependable. Readings of + or —5 r.p.m. may be obtained, and very little maintenance is necessary.

Oil Temperature Gauge

The oil temperature gauge is used to indicate the temperature of the oil used to lubricate the engine after it has left the engine sump and is being pumped back to the reservoir. Should the temperature rise above the normal figure the pilot is warned that something is wrong. This is especially important in the case of air-cooled engines, as no other indication of engine temperature

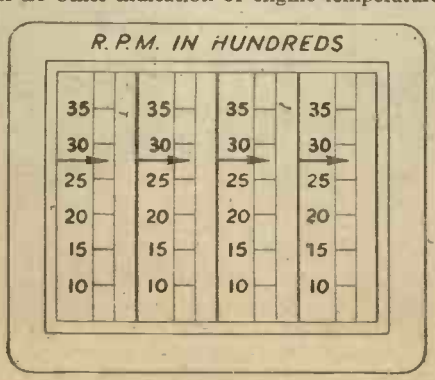


Fig. 3.—R.P.M. dial (four-engine).

is usually fitted. In the case of liquid-cooled engines, coolant temperature thermometers (described later) are fitted in addition to the oil temperature gauge.

The usual temperature range is approximately 20 to 70 deg. C., and the instrument dial records up to 100 deg. C. This instrument depends upon the expansion of mercury acting on a bourdon tube which is connected to a pointer. A steel bulb is inserted in the pipe line, as shown in Fig. 4. A small pocket is arranged for the bulb, so as not to impede the normal flow of the oil. To connect the bulb to the recording instrument a capillary tube is fitted, and this last piece of equipment requires careful handling. As it cannot be shortened in length any excess must be carefully coiled as shown, and also, it must be supported by means of cleats and clips at frequent intervals. Should the tube be cut the instrument is rendered useless, and will have to be returned to the manufacturers for re-sealing. The bore of a typical capillary tube measures only five thousandths of an inch.

Oil Pressure Gauge

As the efficiency of the engine depends upon an ample supply of lubricating oil the oil-pressure gauge is installed in the pipe leading from the delivery pump to the engine itself.

A capsule is connected to the pipe line and operates as indicated in Fig. 5. When the oil pressure fluctuates, the capsule expands or contracts accordingly and the fluid in the capsule is forced through the capillary tube to the recording instrument which, as in the case of the oil temperature gauge, consists of a bourdon tube suitably connected to a pointer. The liquid used is usually ethyl alcohol as it possesses a low freezing-point. Copper tubing is commonly used for constructing the capillary tube.

The reasons why the oil itself is not used to operate the recording instrument are as follow: First, should the transmitting pipe break, the oil will leak out and possibly cause the engine to overheat and to finally seize up. Secondly, variation in the viscosity of the oil would lead to inaccurate and unreliable readings. Pressures varying from 60 to 100lb. per sq. in. are usual and vary with the type of engine fitted.

Coolant Thermometer

Liquid-cooled engines require a coolant thermometer to indicate the temperature of the cooling liquid (usually ethylene glycol) after it has passed through the engine and is being returned via the radiator to the tank.

A diagram illustrating the manner in which

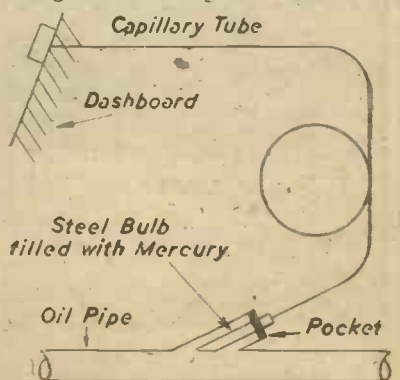


Fig. 4.—Oil temperature gauge.

the instrument functions is shown in Fig. 6. As will be seen, a brass bulb containing a volatile liquid is connected to the recording instrument by means of the usual capillary bourdon tube method. The liquid chosen varies, but ethyl ether is commonly used as the pressure change which occurs with alteration in temperature does not depend upon the actual volume of the liquid. As the temperature of the coolant increases the vapour pressure in the bulb also increases and is transmitted via the capillary to the instrument on the pilot's dashboard.

The disadvantage of this type of instrument is the fact that errors occur when the aircraft is being flown at great heights due to the fact that the air pressure acting on the bourdon tube is less than that at ground level.

Copper or brass are used for manufacturing the bulb, and the capillary tube which is filled with fluid must always be submerged as shown in the sketch.

Boost Gauge

As many modern engines are supercharged, i.e., air is forced into the engine induction system by means of impellors, it is extremely important for the pilot to know the pressure in the induction pipe. The instrument which gives him this information is known as the boost gauge. Should the pressure exceed the safe figure, e.g., if full boost was given at sea-level for a long period of time, the engine would suffer damage. The actual pressure recorded by the instrument is the pressure in the induction system minus 14.7lb. per sq. in. (the atmospheric pressure).

The method of operation is similar to that of an altimeter. A hollow capsule is fitted in the airtight case which forms part of the recording instrument. By connecting the case to the induction pipe by means of a metal tube any variation in pressure causes the capsule to deflect and this movement is magnified by means of levers and gear wheels so that a very small pressure change may be noted. A typical dial for a boost gauge is illustrated in Fig. 7. To prevent particles of dirt entering this instrument and fouling the mechanism a small filter, which requires periodical attention, is incorporated in the inlet connection. A marker is fitted on the dial to indicate the maximum safe boost and it is usually coloured red.

Boost pressures varying from approximately −5 to +16lb. per sq. in. are catered for in this type of gauge and in the near future higher readings will probably be required.

On a normal unsupercharged engine the pressure in the induction systems cannot be above the pressure of the normal atmosphere, and in actual fact is usually slightly lower due to the air being sucked into the cylinders by the downwards stroke of the piston. A gauge designed for this type of engine would consequently have a maximum reading of 15lb. per sq. in. and the readings indicated in flight would all be below this figure. Instead of measuring in lb. per sq. in. this type of instrument, known as the Manifold Pressure Gauge, often records the pressure in inches of mercury.

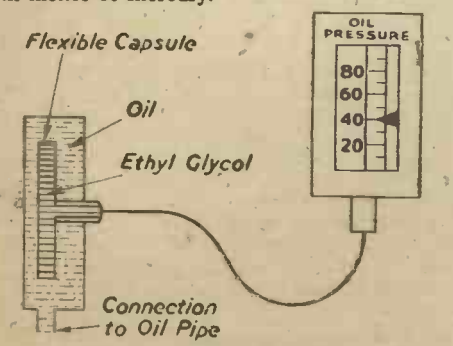


Fig. 5.—Oil pressure gauge.

Fuel Pressure Gauge

A fuel pressure gauge is nearly always fitted to aircraft which depend upon pumps for the supply of petrol from the tanks to the carburettor. Gravity-fed systems which do not involve the use of mechanical pumps are not usually fitted with a pressure gauge. This instrument functions in a similar manner to the oil pressure gauge, i.e., the petrol itself is not allowed to flow to the recording instrument on the dashboard, as the pressure is transmitted via a capillary tube filled with liquid. The same precautions as outlined previously are necessary when fitting this instrument. The pressure indicated varies from zero to a maximum of 10lb. per sq. in., the normal working pressure being approximately 2½ to 3½lb. per sq. in.

An extremely useful development of the normal fuel pressure gauge is the type in which a warning light is illuminated on the pilot's dashboard when the delivery pressure falls below a safe figure. Instead of recording the change in pressure by means of a dial, an electrical circuit is completed by the diaphragm thus causing a bulb to be illuminated. Anything which reduces the number of dials requiring the pilot's attention

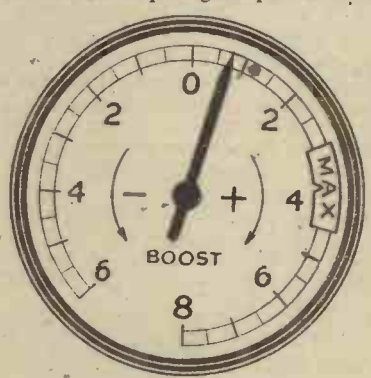


Fig. 7.—Boost gauge dial.

is all to the good, and by fitting this type of warning device considerable panel space is saved. This instrument may also be used for other systems, e.g., the oil system.

Fuel Contents Gauge

An instrument which does not actually record conditions inside the engine, but at the same time is vitally important to the functioning of the power unit, is the fuel contents gauge. There are several types of gauge which have been developed for this purpose, and the one chiefly used at the present time is the electrical type, which functions as described below.

A float which alters in position according to the level of the petrol in the tank is connected to a resistance, and this movement is transmitted via an electrical circuit to the dashboard indicator. One dial giving the amount of fuel available in gallons is often utilised for several tanks. A switch by the side of

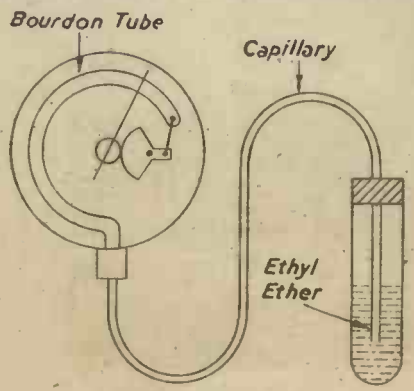


Fig. 6.—Coolant temperature gauge.

the gauge is turned to certain definite positions for each tank, and when the electrical circuit is completed the fuel contents of any tank may be noted. It is important that the position of the aircraft, i.e., whether the tail is up or down, should be observed as the level of the petrol varies in the two positions and the gauge is only correct for level flying.

An alternative method of determining the fuel contents is by hydrostatic means. In this design a metal diaphragm is positioned under the tank base, and as the head of fuel varies so the diaphragm fluctuates. The movement of the diaphragm is transmitted to an indicator by means of a capillary tube acting in the normal manner. As in the electrical type of recording instrument, care must be taken, when observing the gauge, to ensure that the aircraft is in the correct attitude, otherwise varying heads of fluid will cause incorrect readings.

Of the two types described the electrical design is more suitable for the larger type of aircraft owing to the ease of running cables from the tank to the pilot's cockpit. Excessive lengths of capillary are not desirable and are more liable to damage than are electric cables.

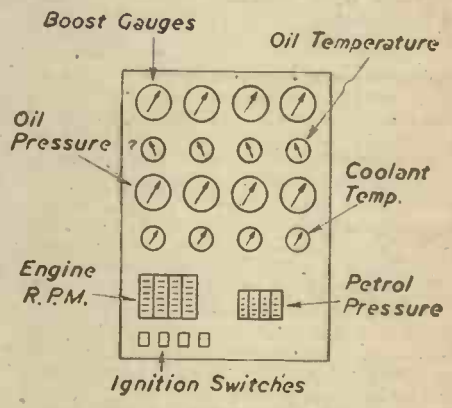


Fig. 8.—Engineer's panel.

Cylinder Temperature Gauge

A temperature gauge for indicating cylinder temperatures is usually fitted to air-cooled engines only, as there is no coolant temperature gauge on this type of engine. As a rule, several gauges are fitted to various cylinders and are of the thermo-couple type. The principle on which they work is as follows: An electro-motive force (E.M.F.) is produced when heat is applied to two dissimilar metals which are joined together at each end. The E.M.F. is measured by means of a voltmeter and indicated on a dial by a pointer. The scale usually reads in degrees centigrade and a normal maximum of 250 deg. C. may be expected.

In the case of liquid-cooled engines incorporating a radiator with a movable flap at the rear end which is used to control the amount of cooling, an indicating gauge giving the position of the flap is often fitted.

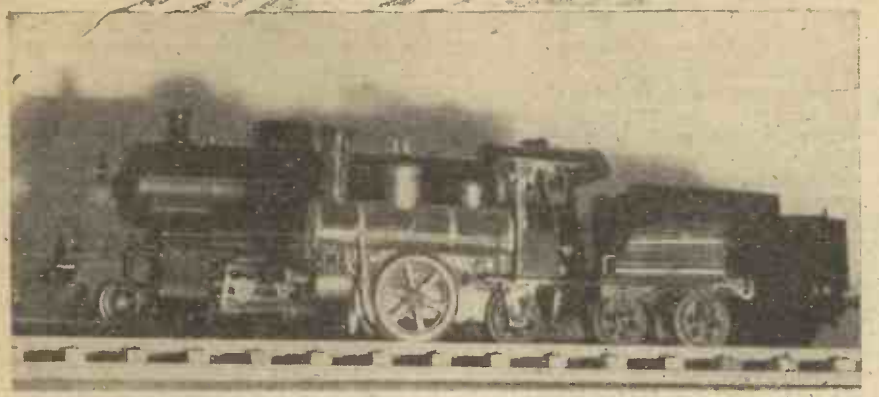
In machines having four engines, four engine rev-indicators, four sets of temperature gauges, etc., are required, resulting in a very complicated lay-out.

To relieve the pilot of the stress caused by continually checking up on the conditions of the engines, it is now common practice to transfer all the engine instruments to a special panel situated away from the cockpit and looked after by an engineer whose sole job is to ensure that the engines are functioning correctly. A typical lay-out of such an instrument panel is shown in Fig. 8. The pilot has usually duplicate sets of boost gauges and engine revolutions for reference, but the responsibility of the engine temperatures, etc., is taken over by the engineer. Thus the pilot is allowed to concentrate on the flying of the aircraft, and his instrument panel is very much simplified.

THE WORLD OF MODELS

By "MOTILUS"

Model News from Abroad : Au Revoir to a Famous Model Railway



A postcard from Switzerland, showing one of the early Swiss toy locomotives in clockwork, and beside it a very fine scale model of one of their latest steam locomotives.

Model Making in Switzerland

THE war has not only caused an upset in the ordinary habits of the people of this island, but also it has practically turned the model railway world (as far as Great Britain is concerned) topsy turvy.

In view of this state of affairs here, it is interesting to note that I have just received a picture postcard from the Schweiz Eisenbahn-Amateur-Klub, headed by the signature of their president, Mr. Walter Siegwart and signed by other members, which goes to prove that neutral countries can still carry on. The postcard—reproduced herewith—shows one of the early Swiss toy locomotives in clockwork, and against it is a very fine scale model of one of their latest steam locomotives, which are very rare now as the "real thing" because the Swiss railways have been electrified.

The card was signed by 26 members of the club, including one of the Brast Brothers (famous model makers), Willie Gassmann, and Hugo Hurlimann, who in all probability took the picture. It was sent me on the occasion of their tenth annual meeting, which took place on January 10th last.

A Fine "O" Gauge Layout

But to return to my leading theme—the position of model railways in this country to-day. Some enthusiasts are still retaining their lines for relaxation and recreation, and have been able, by obtaining second-hand goods, to add to their equipment and rolling stock. Others less fortunate have been bombed out, and their railways lost and destroyed. Yet others, who have joined the Forces, have either had to pack up and store their railways for the duration, or dispose of them.

Lieut.-Colonel E. Stewart Law, whom many model men will know as the owner of some very fine model railway layouts—the finest of which was, until very recently, installed at his late home on the island of Caldy, near Birkenhead—belongs to this last category.

He tells me this is the third model railway he has disposed of. "My No. 1 railway," he said, "ceased to be when I left for the last war. My No. 2 was 'in between' wars. My No. 3 goes because of this war, and my being away on service."

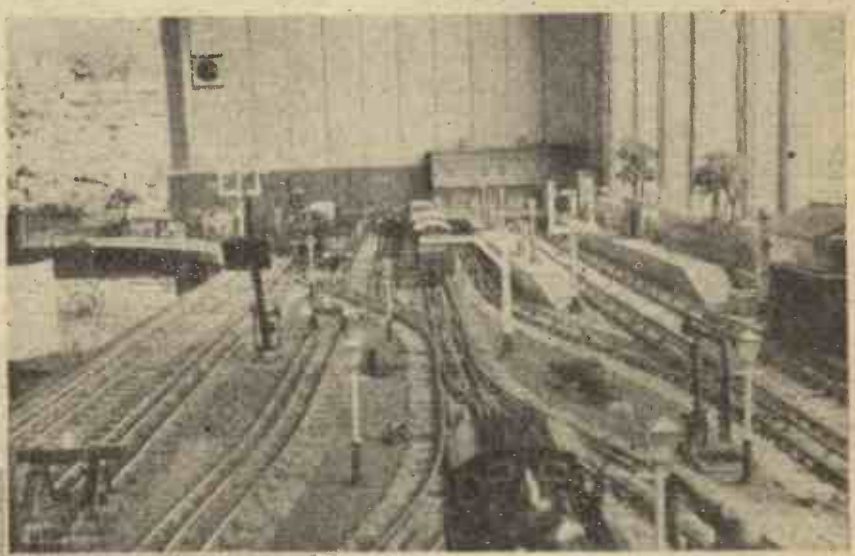
"No. 3 Railway"

This third railway of his is deserving of special reference, as the detail in it was second to none. It seems a thousand pities that such a fine piece of craftsmanship should have to be entirely dismantled, but no other way was possible. There is one consolation however, in that its purchaser, Mr. I. I. Boswell, of Newport Pagnell, is a very keen and discriminating model enthusiast, and will appreciate the quality of the layout he has acquired. When time and circumstances permit of his re-erecting the layout at his home, it may yet again be worthy of a high place among the model railways of this country.

"Westpoint-Seaview" Line

Lieut.-Colonel Stewart Law's railway was called the Westport-Seaview Branch Line (L.M.S./G.W.R. Joint Line) and was meant to represent a suburban branch single line (Westport to Seaview) with considerable daily passenger traffic at rush hours, also mineral and perishable goods traffic—at night mostly.

It did not immediately come into being when he moved to Caldy. "When No. 2 railway was dismantled in moving house," he told me, "there seemed to be no means of starting an 'O' gauge line at Caldy, so I decided to sell my No. 2 railway and intended to replace it with an H.O. gauge line. A garden hut, 14ft. x 10ft., was erected to house the H.O. gauge layout planned and many fine H.O. locomotives and coaches were made. However, the H.O. gauge layout was never delivered, so just the hut, locos and coaches existed.

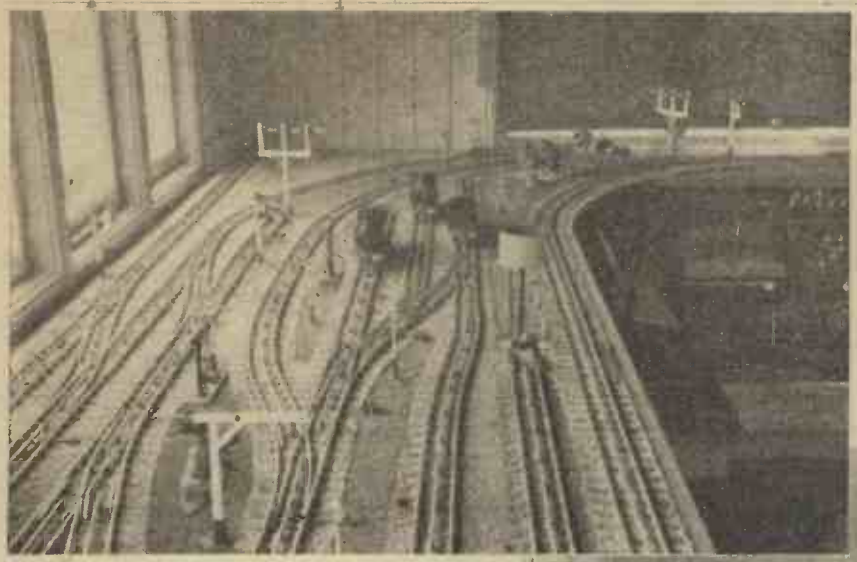


A view on Colonel Stewart Law's No. 3 Railway. Westport, a busy country town with some industry. The loco sheds of the branch line are shown here and also a large goods yard. Serves Seaview by single line, main line station some few hundred yards away.

Another view on Colonel Stewart Law's No. 3 railway. Seaview Station, a residential seaside resort with busy daily business traffic from Westport (single line).

Super-detail Accessories

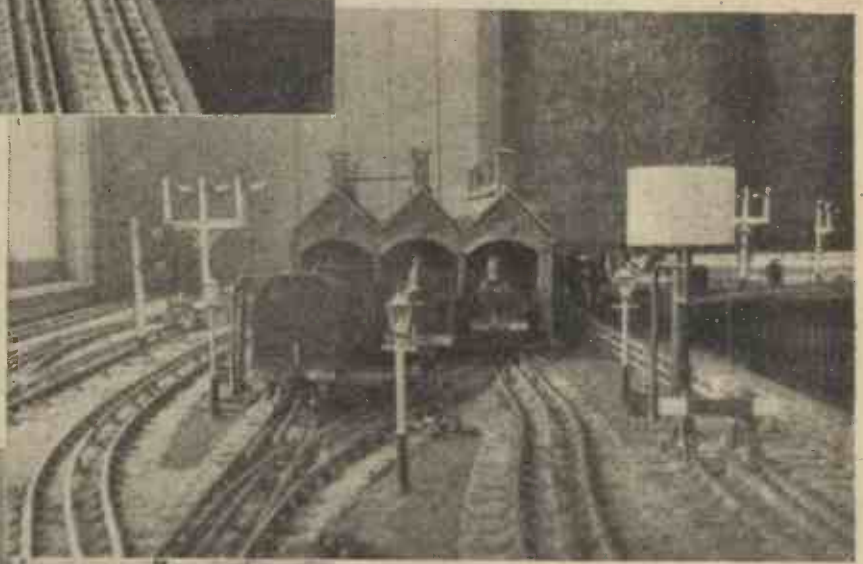
"Then one Sunday afternoon on my



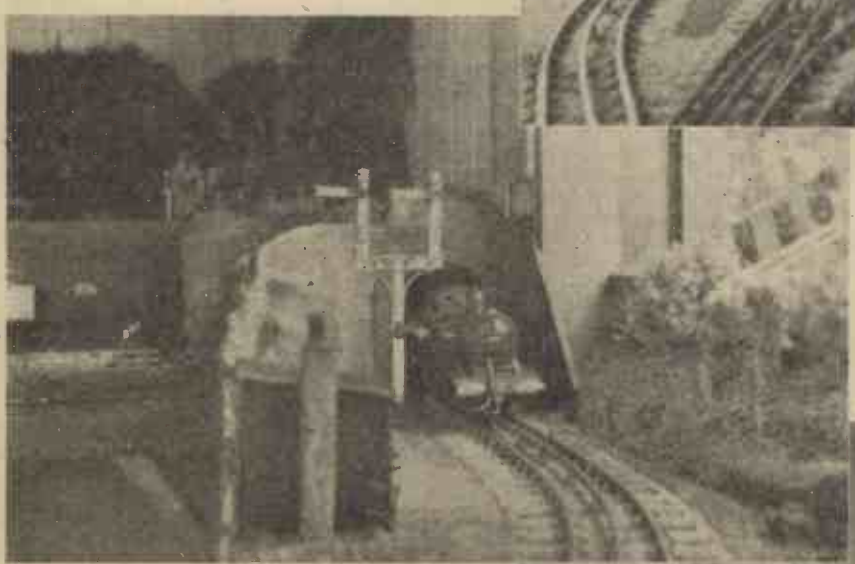
Loco shed sidings and coach siding on the Westport–Seaview model railway.

nursery table I, with a pencil and paper, tried to design an 'O' gauge railway for a hut 14ft. x 10ft. I really didn't think it was possible when I started, but No. 3 railway was the result."

Then the pencil plan was sent to Bassett-Lowke, Ltd., who soon produced the blueprint and supplied the super-detail track, scale signals, ground signals, and signal frames. All signals were made to light up, including the scale size ground signals,



Westport loco sheds, having six tank locos—3 L.M.S. and 3 G.W.R.; "Coaling" and watering sidings adjacent.



Local leaving Seaview tunnel. Loco., Stanier 0–4–4, by James S. Beeson.

station lamps, and even the buffer stop lamps.

Track and Controllers

The track was laid directly on to the base board and all points and signals connected to signal frames on the Bowden wire principle. All the levers interlocked.

There were four controllers, one for each station, one for goods and loco yard, and one for main line.

Eight Tank Locos

The line was served entirely by tank locomotives, eight in number, five L.M.S. and three G.W.R., all the super-detail work of James S. Beeson. They were: 0–6–2 L.M.S. (ex L.N.W.R.) Webb, 2–6–2 L.M.S. (ex L.N.W.R.) Cauliflower, 0–4–4 L.M.S. Stanier, two 0–6–0 L.M.S. Tanks (for goods), 0–6–0 G.W.R. Pannier, 2–4–0 G.W.R. Tank and 0–4–2 G.W.R. Tank. The coaches were L.M.S. 3-coach suburban and G.W.R. 3-coach suburban, and there were fifty goods wagons, all super-detail with brakes. This rolling stock was made to special order—the coaches with doors to open—and with all fittings.

Stations

The stations too were specially made, as was all the scenic work, the effect of which was amazingly realistic. Some small idea of this fine accessory work can be gleaned from the illustrations on these pages.

The whole layout, Colonel Law considers, was easy to handle, interesting to work, and very useful timetable running—station to station—was possible, and a continuous main line run if desired. Although comparatively small in size it was full of interest.

"And so," says its former owner, "No. 3 has gone the way of No. 1 railway, because of another war."

But when hostilities cease, who knows? Once a model man, always a model man!

Westport-Seaview Branch, L.M.S./G.W. Joint Line. Control panels: 1, controller, Westport station; 2, controller, Westport goods yard; 3, controller, main line; 4, controller, Seaview station. Signal lever frames interlocked. Signal cabins are replicas of large frames.

An early Marconi 1½ kw. field-cart station on the march. Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

Pioneers of Aircraft Radio

Interesting Particulars of the Work of R.F.C. Wireless Operators During 1914-18

By W. T. LOWE

LIKE many other applications of an invention, simple or great, aircraft-radio developed from a very crude stage. Compared with the present day, its use in 1914-18 was very limited; although none the less important, or intriguing.

The construction of what an old R.F.C. pilot would call "Banana Crates," contributed in no small measure to lack of experiment. could only carry a small transmitter about the size of a cardboard bootbox, and that messages were limited to code signals, even pilots could, and often did, combine their normal jobs with that of radioing to the ground. Both observers and pilots were taught—mostly by ground station receiving staff—to send morse. They practised in barracks, huts, tents, barns, and anywhere else convenient.

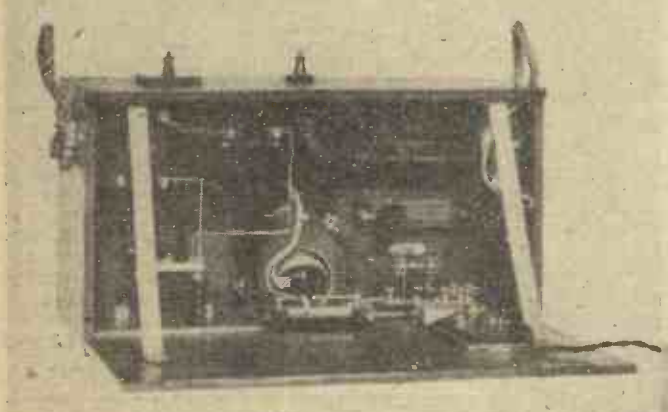
Wireless operators themselves did not do any actual flying, but, if available at a squadron, they were liable to, and often did, ascend for experimental purposes. The journey was not always confined to the, comparatively speaking, safe limits of an airfield. In any case, any man of any rank in the Royal Flying Corps was liable for flying duties.

At that time, the primary duty of a wireless operator was to receive messages from aircraft on his small trench set, at a battery site stationed in dugout, tent, broken-down war-shattered house, hut, or perhaps the sky for a roof. He stayed at that battery night and day, eating and sleeping, reading, or perhaps playing a sly game of crown and anchor with the gunners when not in action. He might perhaps remain with "Field," "Howitzer," or "Heavy," for many months. On the other hand, his sojourn may not have lasted many days. The pioneer expected to be always on the move.

His kit was never really unpacked. On occasion, he arrived at a battery one day, only to find that the unit was moving on the next. In the first place, the operator would return to the squadron. Later, he had orders to move with the battery wherever bound—Russia, Italy, or some other part of the line in France or Belgium.

Battery Station

An R.F.C. battery station consisted, roughly, of the receiver (officially called a "Tuner");



Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

An early Marconi trench set.

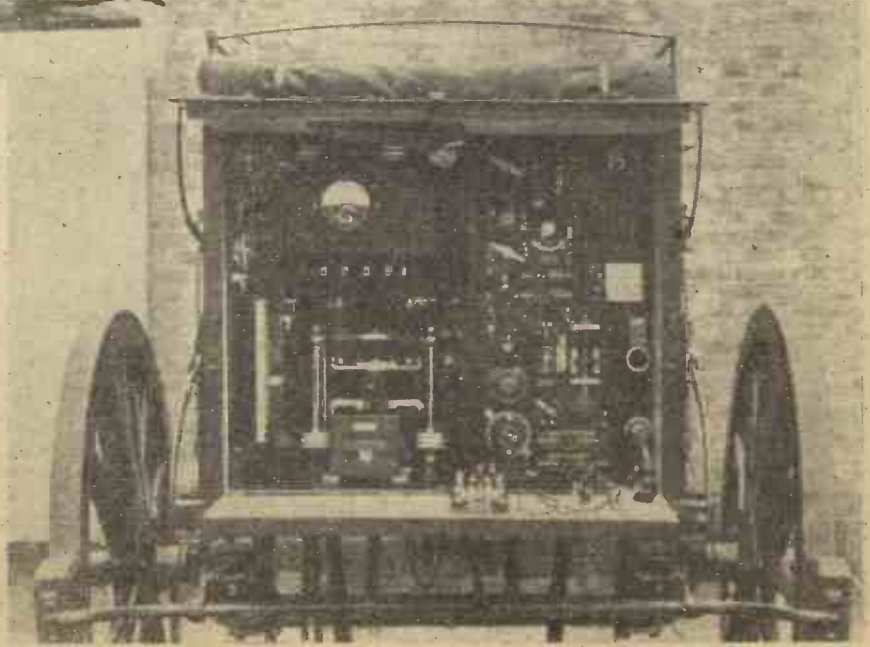
Even up to the end of 1918, artillery-aircraft co-operation machines were generally unable to accommodate a radio receiver. Ground stations at batteries, airfields and elsewhere, could not contact aircraft in flight. Neither could the 'planes intercommunicate as at the present day. In those days, although we pioneers on extremely rare occasions heard music (it has been stated that Caruso's voice was heard on a ship's radio in 1906), we would have been startled to hear, "Over to you," vocally expressed.

Crystal Receivers

What actually reached our trench crystal receivers were nothing more than mixed groups of letters and figures, at about twelve words per minute in morse.

This does not mean that a higher rate of speed could not be sent or received. Indeed, almost up to the end of 1915, only qualified commercial land-line or radio telegraphists, men who could easily cope with 25 w.p.m., were accepted for enlistment in the R.F.C. as wireless operators.

But, remembering that the old "buses"



Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

A Marconi 1½ kw. field set—the instrument cart. (1914-18.)

a forty-foot steel mast in six sections; a six-foot picket; a meshed copper earth mat—about a yard wide and twelve feet in length; seven-pound sledge hammer; pickets; guy-ropes; 125 feet of seven-strand aerial wire; a packet of white American cloth ground slips (of which I will write later); and a pair of Brown's headphones, the finest product of their kind at that period. I believe they cost three guineas per pair.

Our first type of tuner was a cumbersome unit. A substantial strap was attached for carrying; but that didn't make it any lighter. Just imagine promenading over slippery duck boards and shell holes with about a half hundredweight slung over one shoulder, and perhaps a few sections of the mast on the other—ignoring the "temperature," of course! This type of "tuner" was eventually replaced by a smart little piece of work known as the "Mark III Star." Much smaller, lighter, and more compact. It was carried, when closed, by a leather handle. In addition to a perikon crystal detector we now had the alternative of a carborundum detector. The fact that provision was also made for linking up a valve amplifier, although crude compared with to-day, showed that things were progressing. But I never heard of amplifier extensions being made use of at the batteries. They could be seen in action at squadrons, however, and, anyway, the tuners were a vast improvement on what we had hitherto been using.

These smaller sets were especially suitable for R.F.C. operators, who, with a gas pipe "aerial," were attached to cavalry, or for those detailed to trench-mortar batteries.

Usually, the crew of an aircraft—artillery co-operation machine—consisted of pilot and observer. But sometimes the pilot flew "solo." He then controlled everything—aeroplane, gun (if not two bricks and revolver), and radio. Sometimes he carried an aerial-gunner, who rarely knew anything about radio, or even morse.

By the way, it might be interesting to know that aerial-gunners of those days did not wear any distinguishing badge on the breast of their tunics. And they might perhaps have been the equivalent of A.C.2 (2nd Class Air Mechanic) for the whole of their service. On my rare visits to a squadron from the gun-line, I saw quite a number of observers' brevets on the tunics of other ranks—not even L.A.C.s, or rather, its equivalent—1st A.M.s. As a matter of fact, it was not until the war had pursued much of its course that an arm-badge was introduced for R.F.C. wireless operators. The design of that badge exists to-day, except that, being worn on a khaki uniform, its colour was red.

Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

Early Marconi portable wireless telegraph station (0.5 kw.) packed for transport.

Amusement Programme

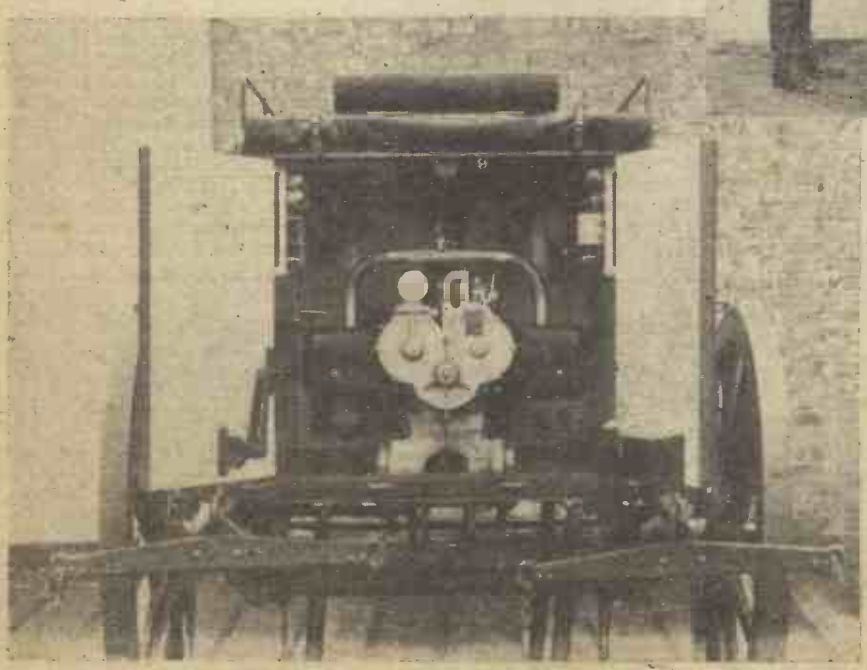
During winter months, when observation was difficult and the days short, our job would have been monotonous unless we found something to do to pass the time away. Amid a depopulated, devastated, shell-scarred area for many miles around, this was no easy matter. One particular item on our "amusement" programme greatly interested battery commanders. The maximum receptive wavelength of our tuners did not exceed 800-900 metres. To increase this, we constructed an inductance coil from a length of insulated wire (might perhaps have been some of the gunner-signallers' D5 telephone wire) wound round a block of wood, empty jar, or bottle. The "coil" would then be connected to aerial and earth terminals, so that we could receive press news which used to be transmitted from Eiffel Tower, Poldhu, Norddeich, and other large radio stations which broadcast in morse at specified hours of the day and night. In dud weather, or during darkness, we would take this press news and hand it to the major, or, if stationed at Brigade H.Q., to the colonel. The pukkha gunners thought a lot of that.

Otherwise, light duties compensated for flooded dugouts and the perishing cold. The matter of a brazier was easy, but we were not always allowed to have a fire. Even so, smoke inside that hole in the earth—a sort of crude Anderson shelter—prohibited such a luxury.

In summer and winter our "watch" consisted of from dawn to dusk. So that about Christmas time we would arise from two blankets and a ground sheet, dividing our bodies from Mother Earth, about 7.30 a.m. With boots unlaced, putteeless, and breeches unbuttoned at the knees, either one of us slipped on the 'phones, whilst the other went to the cook's dugout for rum issue. About 4.30 saw the end of a winter's day.

Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

Portable Marconi wireless transmitter (0.5 kw.) for pack transport, and using a high resistance crystal receiver.



Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

An early Marconi 1½ kw. field set—the engine cart.

"Listening-in" at 4 a.m.

But of the summer months we had a different story to tell. Woe betide you if those 'phones were not on your head by 4 a.m., or if you closed down before 10 p.m. Long before the sun showed itself over the horizon, you would hear a machine sending down targets or working a calibration shoot with a battery. Your own call, perhaps, would come spluttering into the 'phones. Then you would have to wait for your breakfast.

Two R.F.C. men were usually stationed at a battery. They would arrange their hours

on watch, but during the "busy season" both hung around; because, when an aeroplane called, the man off watch would signal to the observer by placing large code letters, made from the white strips of American cloth, on the ground. Thus we told the observer that his signals were "being received"; that we were "ready for action"; that he was to "go home"; and so forth.

Most of the work consisted of registering shots on spots where targets were known to exist. The maximum time limit for these shoots was about three hours—with one machine. During clear weather one shoot followed another in rapid succession. Perhaps this lasted all day. Meals were then very rushed affairs.

German Jamming Station

But just imagine numerous other machines (including French and German) all doing the same thing in the same vicinity! In addition to that, other aeroplanes sending targets to your own, and other stations! There was also a *beautiful* German portable "jamming" station, mounted, so reconnaissance reported, on a lorry. Right bang on one of your wavelengths, he would send a string of "V's"; then pass a remark in English which, by the way, was not always devoid of humour.

The instruments on French machines were flatly tuned. We could not get rid of that deep bass musical note. All this and *other* noises contributed to a life of questionable pleasure.

We soon discovered that efficient work did not merely mean slick reception. An operator who showed by his log that he could select, from all the jamming, the greatest possible number of signals intended for his station; he who timed his relayed signals to the battery commander so that the observer saw where the shots fell every time; he who could almost hold a conversation with his observer by the medium of the ground strips; the man who intercepted targets with absolute accuracy whilst explosives of all calibre rained about his dugout—such an operator soon got into the limelight.

Artillery Co-operation Aircraft

Whilst observing, artillery co-operation aircraft flew in the shape of a figure 8. Flying the left bend of the lower half, the observer signalled a code-letter for "stand-by." Then approaching the top half he morsed another code signal for "Fire." By the time he arrived at the "head," the shot should have fallen, and as the aircraft came back down the cross of the "figure," we should have received the result of the observation. This was immediately called out or telephoned (sometimes over only a distance of a few yards) to the commander, himself stationed a few yards behind the guns.

This involved much turning and banking. Now the aerial, which was weighted, trailed from the machine when in flight. From the earth terminal on the transmitter, a wire ran to one of the engine pipes. This formed the "earth" of the transmitting circuit. So that, as the machine banked or turned, the aerial would close up to the machine and the "earth," giving the same effect as when you lower your domestic aerial to the ground. Naturally, every time this happened, our signals faded. The pilot interested in our side of the job knew this, and collaborated with the observer accordingly; or if working "solo" transmitted signals—as far as possible—when not turning or banking.

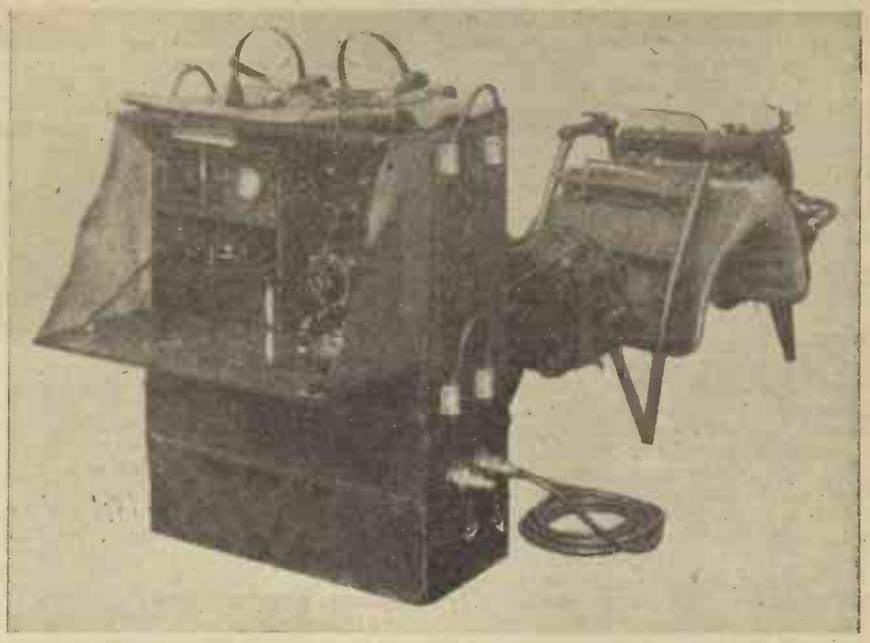
Sometimes the second operator would be shifted to another battery. The senior man would then have to work "solo." Usually, however, the commander came to our assistance by detailing a gunner-signaller who could read morse sufficiently to detect a call—sometimes a little more.

Quite a number were "regulars," and it was an education for a homebird like myself to listen to their tales of Gib., India, Bermuda and other far-off stations.

Erecting Stations

In addition to our normal duties we might perhaps be detailed to assist in erection of stations. Sometimes an operator would be picked up from a battery by the equipment officer in the morning, assist in installing half a dozen stations miles apart, perhaps, and then be dumped at another battery for duty.

One fine spring morning, an officer interrupted my breakfast at an advanced "Field" Brigade H.Q. to say "Pack immediately." I boarded the motor-tender which waited half a mile away. After about two hours' ride we stopped to unload the mast equipment of a station and erected it in a field. Coming down a bank at the side of the road with a seven-pound sledgehammer in hand, I caught my foot in a tuft of grass and went sprawling face downwards into a pool of black mud. The officer and sergeant assisted me to my feet, or rather one foot, for I had sprained an ankle. In that tender from about 11 a.m. with my leg feeling about four times its normal size, and in excruciating pain, I rode for many miles, halting at various batteries for inspection and erection of stations.

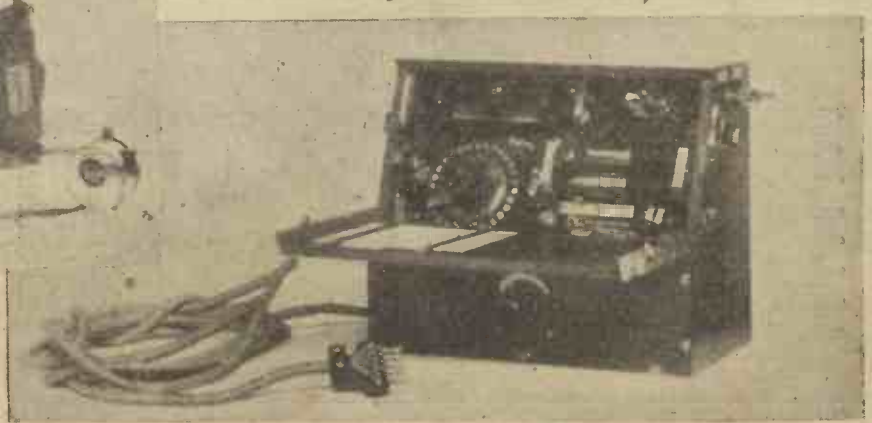


Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

Early Marconi portable wireless telegraph station (0.5 kw.) as arranged for pack transport.

Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

General arrangement of an early Marconi 350-watt aircraft transmitter.



Courtesy of Marconi's Wireless Telegraph Coy., Ltd.

An early Marconi 350-watt aircraft receiver.

About 6 p.m. we rolled back into the squadron. I limped to the mess, in a barn, to get my tea. In the middle of the meal an operator from the wireless hut rushed in and said, "Officer wants you for a battery!" My kit lay outside the hut where I had left it on arrival, unpacked. Struggling past the E.O. I expected to hear him say "Report to the M.O." But watching my frantic attempts to board the rear of the tender, he merely said, "You had better sit up at the front!"

Actually, I believe that not to report sick in such circumstances was a military crime. However, after many miles we arrived at a place where four huge guns lay almost hidden from passers-by—9.2 howitzers. And so another man (boil on back) and myself (sprained ankle) erected and manned a station which served the Somme offensive of 1916.

At the squadrons operators kept a check, as far as possible, on signals transmitted from the machines and intercepted important messages for all stations, or from enemy aircraft.

Experiments

Here, in this hut nestling close to the hangars, numerous experiments were carried out. Also in this hut in close proximity to a French or Belgian or some other hamlet overseas, were born some of the marvellous results of modern aircraft-radio.

It has recently been publicly stated that radio-location began early in 1935. I do not profess to know anything—except its function—about the system. Admitted that great strides must have been made in the last few years; but I do know that in 1917, or thereabouts, small aerials constructed on triangular-shaped frames were connected to circuits for the purpose of tracking the direction of aircraft. It was then, and for some years after, called "direction finding." Wearing a pair of 'phones connected to the apparatus, the operator turned the aerial—which stood on a pivot—until he received the maximum strength signals from a particular machine. Frequent adjustment would indicate in which direction the aircraft was travelling.

Of course, such a simple affair could not be compared with modern radio-location apparatus. But the foundation of an idea had been laid. As time passed, this simple piece of wood and wire gradually grew into a more imposing, complicated, and a thousand times more valuable instrument.

At South Farnborough

At the beginning of 1918, at South Farnborough, birthplace of the R.F.C., a few long-service, experienced operators from the gun-line were detailed to fly in bombers and practise wireless telephony to a ground station. You would hear something like this: "One, two, three, four, five, six, seven, eight—can you hear me?"

Much more could be written by an abler pen than mine regarding the experiences of aircraft radio-pioneers (not forgetting our old chums of the R.N.A.S.); of their food, which greatly varied from battery to battery; their travels, trials and tribulations which they shared with the gunners, and with a pilot or observer—when they obtained a commission as either.

THE MONTH IN THE WORLD OF

Science and Invention

Oil from Weeds

AN oil, closely resembling soya bean oil, has been produced at Pardue University, Indiana, from the seeds of ragweed.

New Cargo 'Plane

IT is reported that the Lockheed Aircraft Corporation, builders of the Hudson bomber and the Lightning fighter, will soon be producing a giant four-engined cargo 'plane called the Constellation.

Huge Iron Ore Output

ACCORDING to a recent report from the United States about 1,000,000 tons of iron ore a year, with a total eventually reaching 100,000,000 tons, is the estimated production of a big-scale mining development plan rapidly nearing completion at Steep Rock, Lake Ontario, about 100 miles north of the Canadian-U.S. border.

Concrete Barges

VLADIMIR YOURKEVITCH, the man who designed the hull of the *Normandie*, proposes to use specially designed concrete barges to carry fuel oil along inland waterways to New York and New England. The barges could be built in a month by unskilled labour, he says.

Australia's New Machine-gun

THE Austen sub-machine-gun, the Australian adaptation of the British Sten gun, has now gone into quantity production in New South Wales. It weighs 8½lb. and fires 500 rounds a minute in bursts of 28. The new gun has a high muzzle velocity and is extremely accurate. More than 50 per cent. of the parts of the original Sten gun were modified. The calibre is 9 millimetres.

All-synthetic Tyres

AMERICAN scientists have overcome the need for including natural rubber in synthetic tyres. Army tyres are now being made out of the Dupont Company's neoprene synthetic rubber, without adding a drop of natural rubber.

A vivid illustration of Britain's great steelworks. The perpetual roar of the furnaces, the continuous avalanche of sparks, and the glow of red-hot metal, give a deep impression of the tremendous forces which are brought to bear for crushing the enemy. Note the white-hot billets cooling off, and the hot saw at work in the background.

Glass Frying-pan

A FRYING-PAN made of glass was one of the exhibits of new uses for glass illustrating a lecture by Professor W. E. S. Turner at the Royal Society of Arts recently.

Chinese Gas Unit

A CHINESE engineer, Hsu Chu-Fei, has developed a new high-efficiency unit for producing gas from coal for the operation of lorries and cars. The new unit, which has passed initial tests satisfactorily, produces gas so rapidly that the test car was put in motion within 56 seconds after the fire in the furnace was started.

It is stated that the average lorry equipped with this unit would be able to travel 80 miles without re-fuelling.

Soap and Varnish from Tobacco

A BROWN soap said to possess excellent cleaning qualities, and a varnish giving a highly polished surface are among the new uses of tobacco reported from the Kentucky Agricultural Experiment Station, following research by scientists to find profitable uses for low-grade tobacco. Another use to which this low-grade tobacco can be put is the manufacture of fibre boards for walls and ceilings of huts.

New 'Plane Fuel

THE construction of refineries utilising a new process for the production of aviation petrol is under way in America. The new petrol is said to be so far ahead of existing high octane fuel that present-day aircraft engines cannot fully utilise its capabilities.

The way is therefore open for the designing of vastly more powerful and faster aircraft combining greater manœuvrability with increased flying range and heavier loading capacity.

Our Busy Inventors

By "Dynamo"

Parachute Harness

A RECENT invention relates to the caparison of the parachute.

It has been customary to equip the parachutist with a pad extending across his back. This acts as an anti-impact cushion in the event of his failing to alight on his feet or on his hands and knees.

The harness also has been covered with shield sheets made of canvas or similar material, in order to reduce to a minimum the likelihood of the harness straps becoming entangled with each other or caught up in any projecting parts of the aircraft.

The inventor of the new device above alluded to states that the shield sheets used hitherto have been defective, as they do not allow for ready access to the quick-release box which, when a landing is made, enables the parachutist by a simple manipulation to free himself from the harness and canopy.

In some instances, it is asserted, where shield sheets are used a quick-release box is dispensed with. In such cases means are provided whereby the parachutist is enabled to disconnect the canopy and shroud line assembly from the main suspension straps. However, it is affirmed that this expedient does not arrange for the release of the wearer from the harness. Consequently, considerable inconvenience and even danger are caused, especially if the parachutist alights in the sea.

Anti-entanglement Shield

THE new invention has been devised with the object of furnishing simple means for effectively shielding parachute harness without loss of access to a quick-release box; for compactly retaining the suspension straps in a required folded position prior to making a descent; for ensuring proper opening or straightening of the suspension straps when a jump is begun, and generally for providing a safeguard against entanglement of the parts of the complete parachute assembly, either with each other or with the 'plane from which the descent is effected.

The device in question consists of the combination with parachute harness and a back pad of a shield sheet practically identical in shape with the back pad. On this pad are fasteners which attach it to the sheets in such a manner as to form a complete enclosure for the harness portions in contact with the pad. And there are a pair of tubular encasements with open ends for the suspension straps.

To Stimulate the Skin

ACCORDING to an inventor who has been devoting his attention to cosmetics, the human skin not only perspires but respires—to use a simple expression, it breathes. In so doing apparently it takes up oxygen as a function of the cell life in the skin tissue. He remarks that one difference between old and young skin is that the rate of respiration declines with age. Young skin respires more rapidly than old and greater quantities of oxygen are absorbed by the epidermis of the youthful. And it appears that skin which has not been exposed to stimulating influence such as light, wind and massage, does not respire normally.

Hitherto apparently no practical way has been discovered to stimulate skin respiration

by the application of cosmetics. In fact, it has been found that many cosmetics, although they may possess, in some respects, beneficial properties, result in the undesirable action of depressing the respiration of the skin, and thus they accentuate the normal decline in respiration which occurs with advanced age.

Workers in a Naval dockyard pouring molten metal into moulds. The Naval dockyards are now working at full speed to produce more ships to beat the U-boats.

The aim of the aforementioned inventor has been to produce an agent which, added to a cosmetic, renders the product capable of stimulating the breathing of the skin.

The process proposed is one in which yeast is subjected for several hours to heat treatment in ethyl alcohol at a temperature below boiling point of the alcohol, thereby injuring the yeast cells over a prolonged period.

The author of this process declares that factors obtained in the above manner have been found to have marked capacity for stimulating the respiration of both human and animal skin. The agent may be added to cosmetic preparations, including lotions, creams, oils and toilet soaps.

Goggles for Observers

IN modern warfare any method of increasing visibility is of supreme importance. This is especially the case in reconnaissance by observers in the air, at sea, or on land. It is essential thereby to spot hostile 'planes and submarines and to detect natural or artificial camouflage. By the use of special light filters or screens much can be achieved. It appears that generally such filters have consisted of sheets of coloured glass or other transparent material. But it is stated that difficulties arise in using glass, partly owing to the fact that many translucent colours cannot readily be embodied in glass. Moreover, the special glass may not be available or may present obstacles to the optical manufacturer.

Bearing these facts in mind, an inventor has constructed a light filter consisting of laminated glass having, in addition to an ordinary interlayer, one or more intermediate layers of gelatine in which is incorporated a dye or dyes providing a strong transmission in two or three separated parts of the visible spectrum. Laminated glass of this description may easily be made into observers' goggles.

Non-swaying Bomb

IT is maintained by an inventor that an aerial bomb, when discharged from the aircraft, has a bad habit of swaying from side to side with more or less violence. The longitudinal axis, he avers, constantly assumes a different angle, until the bomb has gathered sufficient momentum to eliminate such swaying. The effect of this swaying is to reduce the accuracy with which the bomb may be discharged on to a target.

The inventor has provided improvements whereby this swaying is prevented or substantially reduced. His idea is an aerial bomb with three or more spherical or other shaped members of appreciable weight attached to the exterior of the bomb at or near its lower end.

Leveller for Vehicles

VEHICLES carrying an extensible platform or ladders and fire-fighting apparatus, when used upon roads having a sharp camber or upon uneven ground, are liable to be unstable. To counteract this danger an invention, which is the subject of an application to the British Patent Office, has means whereby the chassis frame may be approximately levelled when the vehicle occupies uneven ground.

For Rough Roads

THE device equips the vehicle at one or both sides with an extensible and contractile combined strut and tie adapted to operate between the side of the frame and the end portion of the axle. As a consequence, the distance between the axle and the frame can be increased or decreased, and the parts locked in the adjusted position. By this means the chassis frame can be fixed in a practically horizontal position irrespective of the contour of the road or ground on which the vehicle stands.

The Story of Chemical Discovery

From Natural Silk to Nylon

No. 22.—The Development of Artificial Fibre Production

NATURAL silk, the product of the larva or caterpillar of the silkworm moth, has constituted a mark of affluence and prestige for thousands of years. For that reason, perhaps, numberless people during the ages have dreamt of producing silk without the intervention of the silkworm. It was always silk which they wished to produce, not cotton. For silk possesses properties of lustre, strength, "feel" and warmth which are denied to cotton, one of the humblest of the natural fibres.

So far as can now be ascertained, the first individual to moot any proposition concerning the artificial production of a silk-like fibre was Robert Hooke (1635-1703), the first secretary of the Royal Society, and a man of great genius, albeit of strange, morose and unpleasant temperament. Hooke suggested that it might be possible to imitate the action of the silkworm in ejecting a viscous material through a spinneret or fine orifice, and later, R. A. F. Reaumur, whose name is associated with a special type of thermometer scale, suggested that natural resins and gums might be spun into filaments on Hooke's plan. Such notions, however, were much too intangible to materialise in any practical sense. Consequently, they became quickly forgotten.

It was about a century ago (in 1840 to be exact) that a Manchester silk manufacturer named Louis Schwabe began to amuse himself with some spare-time experiments with the drawing of various substances into threads. He attempted to construct machines which would draw out egg albumen, gelatine, glue, agar-agar, carragheen moss and other viscid matefials into stable filaments. At that time, however, John Mercer, the Lancashire calico-printer, began his experiments upon the action of alkalies and acids on cotton, which investigations ultimately gave rise to the well-known "mercerisation" process, whereby cotton fabrics are given a greatly heightened lustre and appearance.

Mercer's achievements rendered it so easy to obtain cotton fabrics with a silk-like appearance that they spelt the death-knell of Schwabe's essays to produce artificial filaments which could be spun into yarns.

Chardonnet Silk

Towards the end of the last century, Count Hilaire de Chardonnet, a French scientist who had been trained under Louis Pasteur, the famous biologist, and who, it is said, assisted Pasteur in his researches into the cause of a mysterious silkworm disease which at one time ravaged the South of France, turned his attention to the age-old problem of producing an artificial fibre. The Count de Chardonnet was fairly successful in his quest. He found that purified cotton or cellulose, when acted upon by strong nitric and sulphuric acids, and consequently converted into nitro-celluloses, could be dissolved in certain ether-alcohol mixtures, and that by squirting such solutions through very fine orifices he was able to produce a fine thread which could be spun into fabric.

The Count de Chardonnet patented his process and he exhibited samples of the new "Chardonnet silk" at the Paris Exposition of 1889. That year was an epochal one in the annals of artificial fibres. Not long afterwards, de Chardonnet set up the first artificial silk factory in the world. He sited it at Besançon,

John Mercer, F.R.S., the originator of "mercerised cottons," the first practical step towards artificial silk.

in France, and, for a start, it turned out about 50 kilogrammes of thread per day. Nowadays such a quantity is produced by the world's artificial silk factories in less than a minute.

Although de Chardonnet spent his life and a considerable fortune upon his artificial silk process, the product did not meet with any extraordinary success. The material was weak, uncertain in properties, and it possessed many other failings. Furthermore, competitors soon rose up against it.

Viscose

Of these, the most successful was the "viscose" process devised originally by Cross and Bevan, a couple of London cellulose experts, who, in 1892, discovered that when cotton is treated with caustic soda solution in the presence of carbon disulphide, it dissolves to a yellow, viscous liquid. This viscid solution, on being extruded through fine orifices into baths of acidified water, immediately coagulated into an insoluble thread which could be spun and woven, and which proved more satisfactory than the "artificial silk" of the French Count de Chardonnet. By way of reference to the viscid nature of the parent solution from which the artificial thread was derived, the latter material was dubbed "viscose," a name which has remained with it ever since.

About this time, too, another artificial silk process, based upon a previous chemical discovery, was tried. If copper hydroxide is dissolved in strong ammonia, a deep blue solution is obtained. This is sometimes known as *Schweitzer's reagent*. It has the notable property of being able to dissolve cotton, paper and many other forms of cellulose. When Schweitzer's reagent containing dissolved cellulose is acidified, the whole of the cellulose is precipitated in its original form.

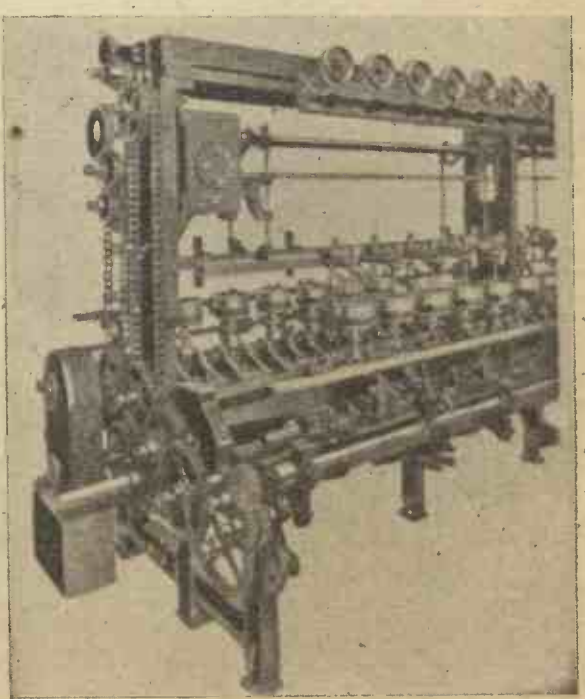
This discovery developed into the basis of the "cuprammonium" process for artificial fibre production. Cellulose was dissolved in the ammoniacal copper solution, and, subsequently, the solution was forced through a series of fine orifices into a bath of weak acid. The extruded threads at once coagulated, forming fine filaments which responded satisfactorily to spinning and weaving operations.

At a still later date, it was found that cellulose acetate (obtained by treating paper, cotton or other cellulose material with acetic acid and acetic anhydride) was freely soluble in certain selected liquids, and that from such solutions it could be precipitated in thread form by means of various chemical coagulating baths.

Previous to the commencement of the last war, the artificial silk industry was beginning to establish itself. Chardonnet silk had not done very well, but the new "acetate silk" was coming along, and rayon had just arisen. Rayon, the newly-introduced "chemical" fibre, was a product of the old Cross and Bevan "viscose" process. It was "viscose silk" brought up to date by means of certain modifications and refinements.

Rayon Silk

The first rayon plant set up operations in America in 1910. For a time, the feminine public looked askance at the new, toughened silk-like material. "Consumer acceptance," as the Americans put it, was slow and difficult. Indeed, it took the 1914-18 war to popularise rayon and the other artificial fibres, but after that conflict the new chemical industry of artificial fibre production found itself firmly



A "pot-spinning" frame used for the drawing and twisting of artificial silk.

established in almost every one of the larger nations.

The new chemical processes were applied not only for fibre production. They were found to be adaptable to many other uses. For instance, viscose threads were found capable of replacing the more expensive natural ramie fibre in the manufacture of gas mantles. Even viscose sausage skins were devised, and found to be cheap, economical and popular. Perhaps, however, the most important non-fibrous product of the "viscose" artificial silk process has been the nowadays well-known and deservedly popular transparent material which is known by the name of "cellophane." This is essentially "artificial silk in sheet form." It is produced by extruding the viscose solution through narrow slits and by taking the extruded material up on to hot polished steel rollers between which it is passed under considerable pressures.

Cellophane is at once a tough, enduring, waterproof and, in many respects, a perfectly unique material. It is practically insoluble in any solvent, and it resists abrasion to the utmost. It is, indeed, a triumph of practical chemical skill.

Despite the present-day popularity of "artificial silk," whether it be rayon, viscose or acetate "silk," the fact should always be borne in mind that all these materials do not actually constitute true silk. Essentially, all these filaments and fabrics comprise merely cellulose, the basic constituent of ordinary paper or cotton, in a more or less modified form. To a large extent they still manifest the same characteristics as ordinary cotton.

It is quite a truism, therefore, to state that the real artificial silk is still as hypothetical a material as ever it was. So far, no scientist, chemist or other investigator has ever been able to produce a fibrous material having anything like the same inherent composition and extrinsic properties as those possessed by the natural silk of the silkworm. Our boasted "artificial silks" are, at the best, colourful and ingenious imitations of the real thing. Inwardly, they are nothing more than cotton (or cellulose) in its various camouflaged forms. They are not even truly synthetic fibres, since they have all to be produced from one form or other of cellulose (wood, paper or cotton), which is, of course, a natural product. Theoretically, therefore, the present-day "artificial silks," although comprising miracles of chemical and engineering ingenuity, are really in the nature of a compromise.

Du Pont de Nemours

In 1929 a new and original line of research towards the production of novel types of artificial fibres was struck out by the well-known American chemical organisation of E. I. du Pont de Nemours and Company, of Wilmington, Delaware. This rich and influential corporation had attracted to itself many chemists of renown and, in spite of the steady progress of the "artificial silks" based upon cellulose, the du Pont company

Count Hilaire de Chardonnet, the first successful creator of artificial silk.

seems to have consistently set itself towards the goal of artificial fibre production by genuinely synthetic means.

It was during the above-mentioned year that Dr. Wallace H. Carothers began his long series of chemical investigations which eventually culminated in the introduction of "Nylon" to the world. Carothers was at that time extremely interested in the synthesis of compounds of exceptionally high molecular weight, that is, of compounds which are built up of a very large number of component atoms.

This investigator chose, as one of his first lines of work, the building up of new compounds from ethylene glycol, which, both in this country and in America, is well known as an anti-freeze agent for car radiators. By acting upon ethylene glycol and similar products with sebacic, maleic, fumaric and phthalic acids, he obtained compounds of very high molecular weight in which the component groups of atoms (as revealed by X-ray analysis) were hooked up together in long chains like a string of metal paper-clips.

The next step in Carothers' investigations was to produce like materials containing nitrogen, since the latter element is a constituent of natural silk. By a series of highly complex chemical reactions, he eventually succeeded in his task, and he obtained a material, which he called a "poly-amide," which looked like hard wax and which was insoluble in most solvents. In the molten condition this material could be drawn into coarse threads, but such threads were useless because they were brittle.

When, however, Carothers' "poly-amide" was cold drawn, like wire, through fine orifices into threads, it was found to produce a much more satisfactory fibre. Such cold-drawn fibres had lustre, toughness, elasticity and tensile strength. They were so pliable that they could be tied into knots.

X-ray analysis was again called into operation, and it was discovered that the cold-drawing of the "poly-amide" so arranged and interlocked its component atom-groups that they became capable of standing up to very considerable amounts of stress and strain without parting from one another.

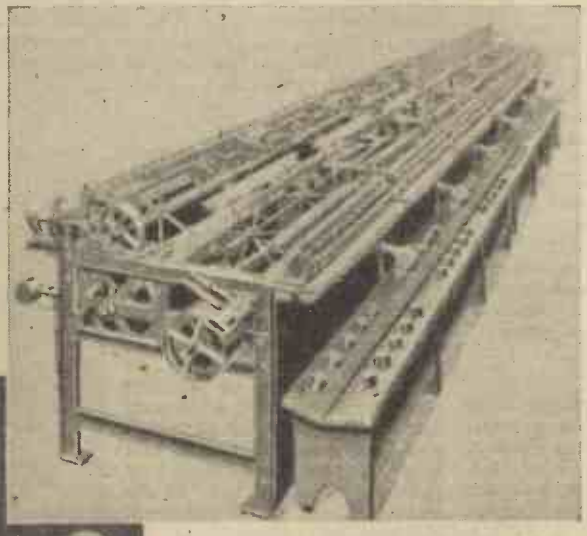
"66"

It was by the subsequent careful study of this "poly-amide" production that Carothers produced by the combination and chemical condensation of two chemical materials known respectively as adipic acid and hexamethylenediamine, a new "poly-amide" which was given the laboratory number "66."

It was on February 28th, 1935—now an historic date—that Dr. Wallace H. Carothers first produced his "66" in the du Pont laboratories at Wilmington.

"66," after much time and trouble, was chemically analysed, and it was found to comprise a nitrogen-containing material (or, rather, a mixture of materials) known as *poly-hexamethylene adipamides*. Such material proved excellent in the matter of fibre production. The cold-drawn poly-hexamethylene adipamide, or "66," fibres were strong, tough, resilient, insoluble, non-shrinking, light-proof, acid- and alkali-resistent, and they were capable of being dyed. The material did not melt until it reached a temperature of 263 deg. C., so that there could be no question of fabric made from such fibres melting under the heat of domestic or laundry irons.

Convinced of the intrinsic usefulness of Carothers' laboratory-produced "66," the du Pont de Nemours company decided to embark upon its commercial manufacture and exploitation. At once a host of difficult technical questions, chemical and engineering, cropped up. The raw materials (adepic acid and hexamethylenediamine) had to be produced in commercial quantities. Then the necessary engineering plant for the cold-drawing of the manufactured "66" had to be designed by an army of technicians. And finally it was necessary to find a market for the new material.



A "ruling" machine used for the winding of artificial silk.

A simple pneumatic apparatus used for testing the breaking strength of paper and cellulose fabrics, the fabric being ruptured by a certain recorded air pressure consequent upon turning the hand-wheel.

Such tasks occupied more than three years in their accomplishment, but ultimately, in 1938, the du Pont company began to turn out its first continuous threads of Carothers' erstwhile "66" at the rate of some 2,500ft. per minute.

The New Nylon

The development of "66" had succeeded, and the new material was given the name "Nylon" and forthwith introduced to civilisation.

"Nylon" is a material which cuts across the path of the older "artificial silks" based on cellulose. In the first place, nylon is truly a synthetic fibre, for it is produced from raw materials which themselves are built up from hydrogen and carbon, together with a little ammonia. Furthermore, nylon, although it is by no means chemically identical with natural silk, nor equal to it in some physical properties, is, so far, the nearest synthetic approach which has ever been made to the latter product.

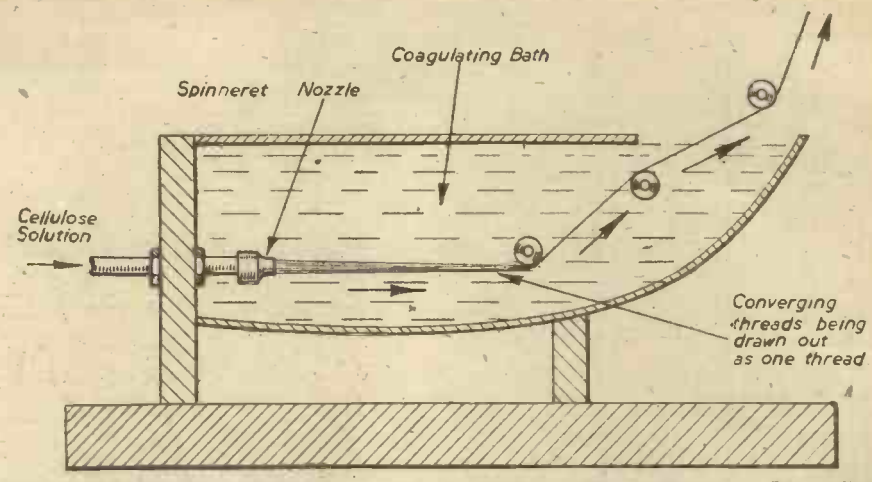


Diagram illustrating the operational principle of artificial silk production. The cellulose solution is forced through a series of fine orifices into a coagulating bath, from which it is drawn and twisted into a single thread by mechanical means.

Nylon threads and filaments of any size can be produced. Anything from coarse bristles to ultra-fine gossamer-like filaments can be obtained in nylon. Hence, before the war, this material was being made into racquet strings, fishing lines, shoe-laces, surgical guts and numerous other articles of a like nature.

Nylon, therefore, represents the latest chemical triumph in the scientific quest after the perfect fibre. That it will eventually be superseded by other and still more perfect materials is, perhaps, undoubted. But for the time being, at least, it is a synthetic material to excite some degree of wonderment. It comprises one of the most modern and successful creations of the chemist and his industrial brother, the factory engineer.

Toy Manufacture: Principles and Practice

Further Methods of Operation, and Constructional Details

(*Continued from page 241, April issue*)

Fig. 58. "Mr. Nobody."

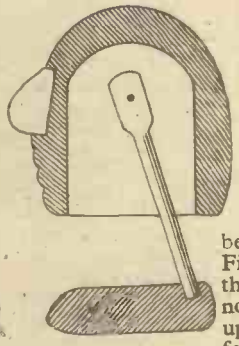


Fig. 59.—Section of figure.

Walking Figures

THESE grotesque toys afford much amusement to the smaller members of the family, as they may be made to walk quite naturally down a slightly inclined board. Those who have no lathe can carve the figures, but the hollow interior may be worked with a twist bit and finished with the gouge, boring, say, four holes and breaking down the intervening material with the gouge.

There is plenty of scope for quaint designs, which need not be confined to the biped type. Fig. 58, which may be named "Mr. Nobody," is a favourite with the children. Its construction is sufficiently explained by the sectional view, Fig. 59. The wire pivot on which the legs are secured must be placed vertically above the centre of gravity of the body, and the top expansions of the legs must be drilled slightly on the skew, as shown in Fig. 60, to allow the feet to spread and give the requisite lateral stability. It should be noted that the soles of the feet have an upward curve at the toes, and this may call for adjustment when the figure is put to the test, by paring away some of the toe sole.

The tortoise shown in Fig. 61 has four legs, each pair being accommodated in a separate cavity. The body must be carved to shape, and head and tail more easily may be made as separate units and glued into place.

Fig. 61.—A walking tortoise.

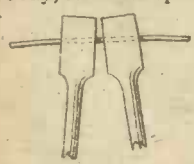


Fig. 60.—How to drill the legs of the figure shown in Fig. 59.

Fig. 62.—Suggestions for further designs for walking toys.

The attractiveness of these figures is increased if they are enamelled. The example, Fig. 58, may be black, with red lips and yellow eyes. It may be given tan coloured shoes. The tortoise should imitate the natural colouring of that reptile.

Suggestions for further designs are given in Fig. 62.

Tumbling Acrobat

The tumbling acrobat, shown in the sketches and photograph (Fig. 63), is a novel and entertaining toy, and is quite easy to make, provided that you have a fretsaw. The arms and legs of the acrobat are hinged, and when you squeeze together the bottom ends of the frame, holding it as shown in the photograph, the acrobat turns somersaults and can be made to perform all sorts of laughable

Fig. 63.—The completed acrobat.

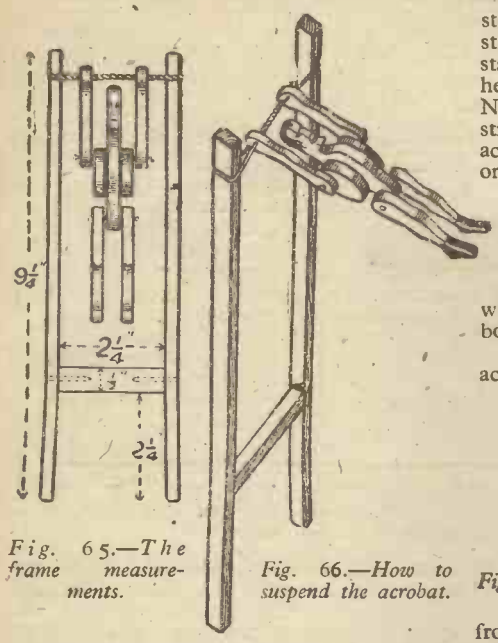


Fig. 65.—The frame measurements.

Fig. 66.—How to suspend the acrobat.

tricks. First make the acrobat. Cut him out of three-ply wood, drawing the parts out from the outlines, Fig. 64. Cut two pieces of shape A, one of B, two of C, and two of D. Make the holes in each piece, for the joints, with a fretwork drill or a bradawl, and fasten the parts together by means of pieces of thin wire. A strong hairpin can be utilised for this purpose. The ends of the wire are turned over, as you can see in Fig. 65. It is essential that the holes must be big enough to allow the wire to make a very loose fit, as the acrobat will not perform properly if his joints are at all stiff.

The Frame.—The frame in which the acrobat performs is made from strip-wood. The uprights are 9¼in. long by ½in. by ¼in. The crosspiece is 2¼in. by ½in. square. They are fastened together with two wire nails, as illustrated in Fig. 65. Cut a notch in the side of each upright, near the top, for the string to pass over.

The acrobat is suspended in his cage by standing him on his head and threading strong string, as shown in Fig. 66. The acrobat must stand on his head when this is being done, or he will not be able to perform properly. Note that in Fig. 66 there are no twists of the string between the sides of the frame and the acrobat's hands, but the string is twisted three or four times between his hands. The correct tension of the string between the uprights is best found by experiment.

The Clown on Ladder

Here is an easily constructed toy that will afford amusement to the youngsters of both sexes.

Fig. 67 is a side view of the "man," who actually is two, one on each side. Cut him

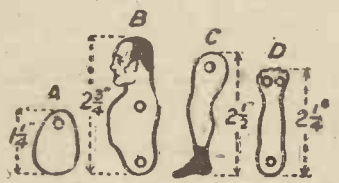


Fig. 64.—The various parts that make the acrobat.

from a block of beech or other hard wood. It is not essential that the sides be curved, but the man looks better that way. Keep strictly to the dimensions on the drawing to

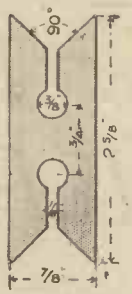


Fig. 67.—A side view of the ladder acrobat.

Fig. 68.—How to mark out and colour the figure.

ensure that the man will go through his performance without a hitch. Make all surfaces smooth with glasspaper.

Fig. 68 gives suggestions for painting the two sides of the block. Use bright colours. As the man has to perform a series of somersaults, the two figures must be drawn reversed, i.e. the head of one must be at the end of the block where the feet of the other are.

The Ladder.—Fig. 69 shows a portion of the ladder. The rungs are strips of wood ¼in. wide and 3/32in. thick. Glue and pin them to the cheeks.

Make the ladder as high as you like, and space all rungs accurately to the dimension given in Fig. 69. Mount the ladder on a block, as shown in Fig. 70, giving it no more inclination than that shown, and less if necessary. Test with the "man" before fixing the ladder.

The man may be started on the topmost rung and will descend head-over-heels, rung at a time, till he reaches the bottom, showing each side alternately.

Fig. 70 shows the toy in action in side view. If you are unequal to copying the grotesque

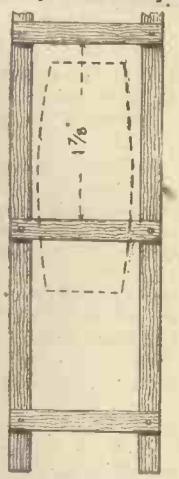


Fig. 69.—A portion of the ladder on which the acrobat performs.

Fig. 70.—The ladder should be mounted on a block of wood.

figures shown here, you might cut out suitable figures from an illustrated magazine, or from the advertisement pages of a newspaper, colour them, and stick them on to the wood block.

A Novelty Money-box

Here is a novel and interesting money-box.

First of all you will require a base-piece of three-ply wood, 11½in. by 3½in., as in Fig. 72, and also two blocks of wood 3in. by 3in. by ½in. These can be screwed to the base from the underside, so as to

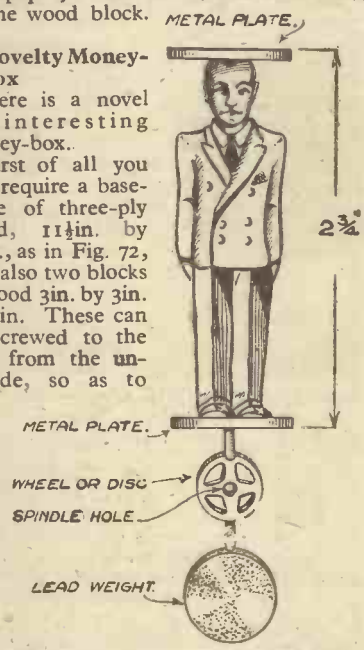


Fig. 74.—Details of the figure.

leave a ¼in. border protruding all the way round, when the castle is mounted upon it.

The Castle.—Cut out the front and back

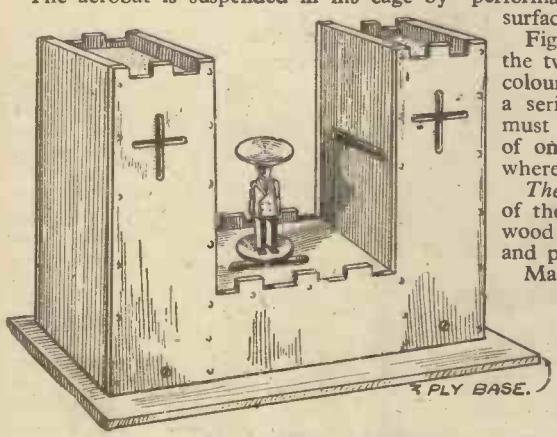


Fig. 71.—The completed money-box.

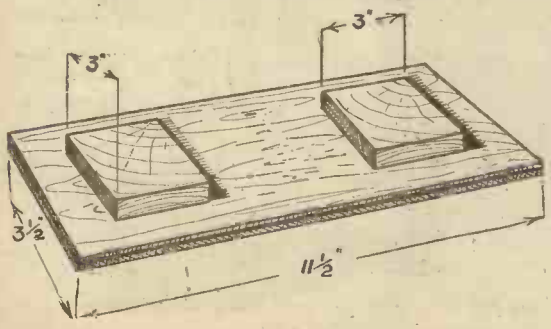
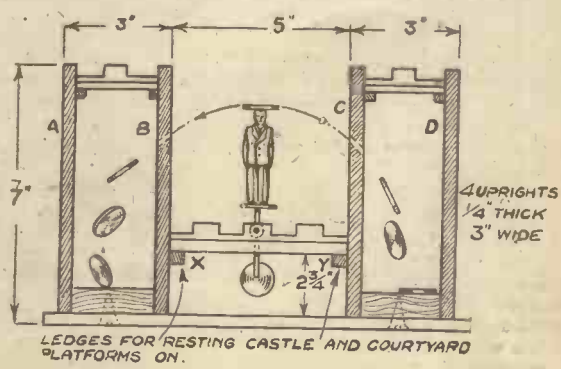


Fig. 72 (left).—The base of the money-box.

Fig. 73 (right).—A sectional view showing how it works.



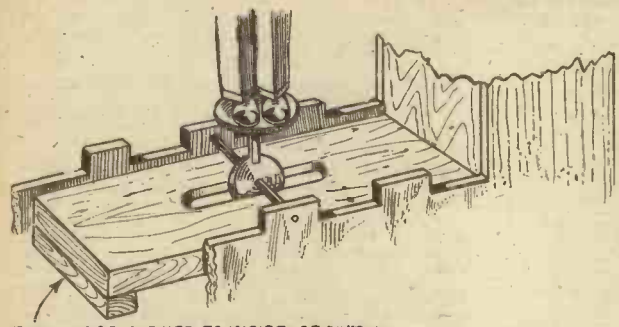


Fig. 75.—Method of suspension.

of the castle. These are exactly the same, so you can tack them together and cut them as if they were one thick piece, the overall measurements being 11in. by 7in.

Proceed to make four upright pieces, A, B, C, D (Fig. 73), two to be for the outside of the castle, the remaining two to complete the two towers, support the pendulum, and to have slots cut in them to receive all contributions. Strips X and Y are tacked and glued to the inside of the pieces marked B, C, 2¾in. from the bottom.

The Cork Figure.—Fig. 79 shows the position of the slots in each tower. To make the figure, obtain two good pint-bottle corks and clean them carefully with fine glasspaper, then stick them together with glue, making a cork about 2¾in. long, as shown in Fig. 74. When dry, cut the cork to the required shape. When cutting cork it is best to use the knife wet, because it then produces a smooth, fine surface. Now cut two tinplate discs: one for his head or hat, and one to solder to the wheel to support the cork man. The wheel can be made out of brass or tinplate, and possibly a small clock wheel will serve your purpose. This must be fixed by solder to a weight of lead to act as a pendulum. Fig. 78 illustrates how you can fix the lead to the wire.

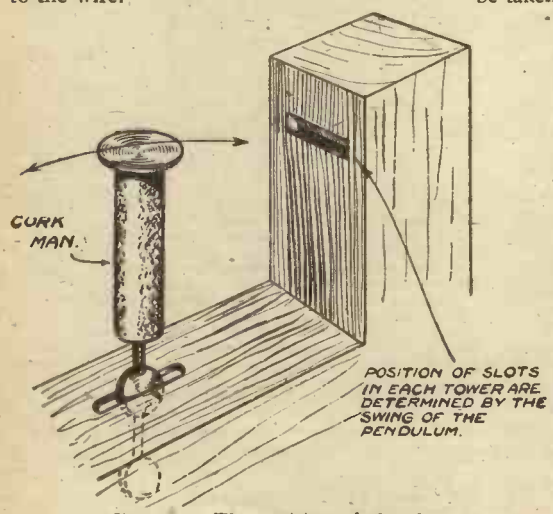


Fig. 79.—The position of the slots.

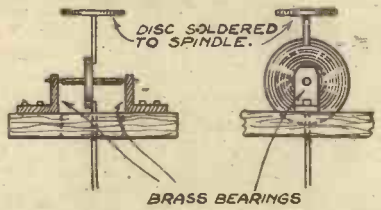
Suspending the Cork Figure.—A platform, as shown in Fig. 75, is needed. This measures 5ins. by 3ins. by ¼in., and has a slot cut in it to allow the pendulum to swing freely. Now that the platform is finished, choose either of the methods shown in Fig. 75, 76, and 77, for suspending the figure. You can paint or stain and varnish the finished money-box, and then interest all your friends at their expense. A word of advice: The castle is fixed as one piece, and is mounted on the base-piece by means of four round-headed screws, as shown at Fig. 71. By this method you can undo the money-box and so preserve the mechanism.

A Model Land Yacht

It is probable that many readers will have a spare unit of sails and spars which can readily be adapted to fit the land yacht illustrated by Figs. 80 and 81, and all that needs to be done will be to make a suitable chassis or hull.

On a hard surface, such as macadam road, or a strip of asphalt, speeds of from seven to ten "knots" are possible with a good wind.

The Construction of the Body.—For the body, which is the equivalent of the deck of a sailing yacht, a piece of yellow deal, or similar wood, is required, measuring 12½in. by 5in. by ¾in. To give the ship a pleasing line the deck should be shaped as shown, but this is not absolutely necessary, and an oblong-shaped piece will serve quite as well. This is mounted on two cross bearers, measuring 8ins. by ⅝in. by ⅜in., and fixed with screws. Take care to have the bearers parallel or the boat will run round in circles.



Figs. 76 and 77.—Another method of suspension.

The mast block, 2ins. by ⅜in. by ⅜in., is screwed from under the deck, and is bored to receive the foot of the mast, which may be stayed on each side by a shroud from the top to a pin in the edge of the deck.

The Bowsprit.—This is screwed at the end nearest to the mast, and if a small eyelet screw is inserted, as at A, Fig. 81, this can be taken out when required, and the bowsprit swung across the deck to make the jib act as a spinnaker when the boat is running with the wind.

The unusual gadget shown at B is a ballast box. In strong winds the yacht may capsize before she has "got way on her," and the risk is minimised if the box, containing a piece or two of lead, is swung over to windward. It acts just in the same way as the smart crew of a lively small-rater in a breeze. When "running," that is, when the wind is aft, the box is haulted astern and rests between the rear wheels. The boom moves freely in the "goose-neck" formed from a brass eyelet screw which has been opened a little to pass through an eyelet screwed into the mast. The gaff may have the usual jaws and be held up by a halyard, but it is much simpler and just as handy if it is swivelled in the same way as the boom.

The Wheels.—Attention must be paid to the smooth running of the wheels if the yacht is to sail well. The simplest method is to use solid wood wheels mounted on the shank (smooth part) of a fine, round-headed screw, which is driven into the ends of the cross-bearers. To eliminate as much of the friction as possible, put two small metal washers between the wheel and the wood, and one between the head of the screw and the wheel, tightening the screw gently until the wheel is not slack but still free to revolve.

The ideal mounting is achieved when 2in. grooved pulley wheels, with model Dunlop tyres, are set on a spindle which is secured to the underside of the bearers with right-angle brackets screwed in position.

Sailing the Yacht.—To sail the yacht, begin by trying her on a beam wind, that is, to send her in a direction at right angles across the breeze. A boat will make little or no progress if the sails are set tight and flat. To do this is to invite a certain capsize. Slack away the main and jib sheets a little and allow the sails to draw nicely, i.e., to fill with the wind. If the boat tends to point up into the wind, haul the jib sheet a little tighter and pay off a little more on the main sheet. To make her "beat," that is, to sail as close up into the wind as possible, tighten both sheets a little more than when set for a beam wind. A little

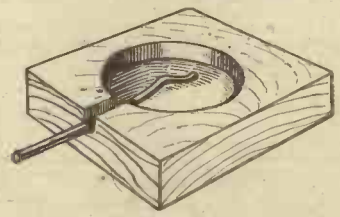
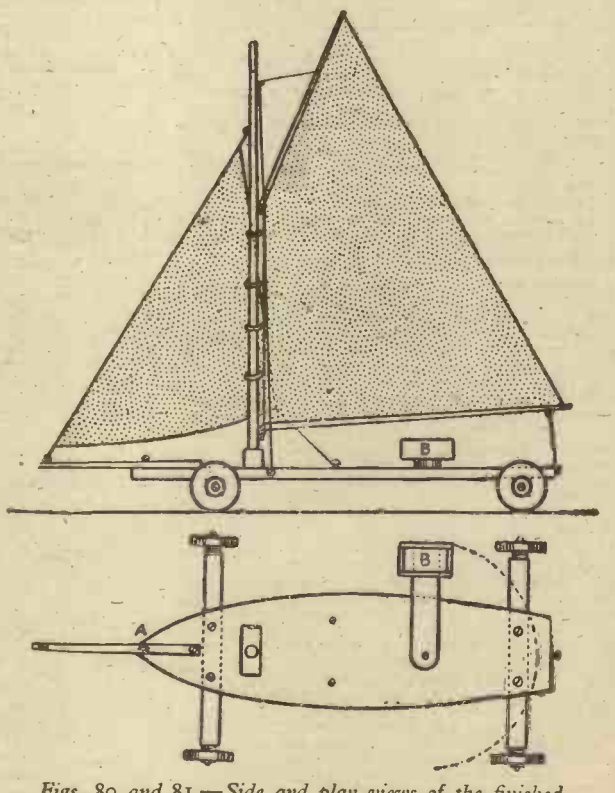


Fig. 78.—The mould for making the lead weight.

adjustment with the sheets will be necessary until the correct balance of sail pressure has been found.

The conditions under which a land yacht sails are entirely different from those obtained when a boat is floating in water. The rudder of a sailing yacht may be set to keep her on her course, but if the wheels of a land yacht are adjusted to the same purpose they only cause a drag and prevent her moving.

(To be continued.)



Figs. 80 and 81.—Side and plan views of the finished model land yacht.

QUERIES and ENQUIRIES

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

Smoke Candles

I SHOULD be obliged if you could give me information regarding the container for a smoke candle mixture and the method of setting it alight. The container would have to be small and could be carried without the contents falling out. The method of fusing the mixture would have to be something simple which could be done in a short time.—H. Hutchison (Kilmarnock).

SMOKE candles and bombs of the type you refer to are best made up in small sheet-iron containers or in similar containers made of medium-heavy sheet cardboard. The containers should be somewhat smaller than a coffee tin. The mixture is readily ignited by means of a length of magnesium ribbon. Alternatively, you may employ a central or an upper "core" of ignition powder consisting of red phosphorus or a mixture of magnesium powder and barium perchlorate. Unfortunately, although these materials are normally readily obtainable from any firm of chemical suppliers (as, for example, Messrs. Griffin & Tatlock, Glasgow), they are now very difficult to secure. However, magnesium ribbon can still be obtained, and we think, after a few experiments, you will find that this material will serve quite well for igniting your smoke-candle powder.

Regulating Resistance for Transformer

I HAVE made a welding transformer from an old core. It has a cross section of 2in. x 2in., i.e. 4 sq. in. The secondary output is 73 volts on open circuit. Can you tell me how to regulate the current without too many volts being lost? When I am using a 16 gauge CXX rod the ammeter reads 40 to 50 amps., and it burns a hole in 1/16in. plate. I have a small resistance in the primary of 2½ ohms. Can you tell me how to cut the current down by half, if possible.—J. R. Batey (Ryton-on-Tyne).

AS your transformer core is 4 sq. in., that is 2in. x 2in., and if you are getting an output of 40 to 50 amperes on the secondary with about 70 volts, it is evident the secondary volts are too high for small welding jobs. You have the option of making a resistance for the secondary side to carry this current and dissipate about half the full voltage, or of adding turns to the primary which will reduce the voltage ratio between primary and secondary. The latter is the more economical method, but as the full load primary current would be in the region of about 14 or 15 amperes the No. 20 S.W.G. you have would not be serviceable, as a No. 14 S.W.G. would be the smallest to use with safety. If you can add about half as many turns again of this gauge to the existing primary coil you will be able to take out two or three tappings at equal intervals, and so obtain a fine voltage regulation on the secondary without the loss entailed by using a series resistance.

Water-retaining Dam

I PROPOSE building a water dam for running a water wheel. Space will allow me to construct a dam 80ft. long, 24ft. wide, 5ft. deep, to hold about 60,500 gallons of water. I have cleared away earth, rock, etc., from inside ACD (see sketch) which leaves natural rock wall D and two half walls A and C. What I want to know is: 1. What thickness must wall B be to withstand pressure of water in dam? 2. Suggested thickness for part walls A and C? 3. The only building materials procurable are lime, sand and stone and 1 ton of cement which I could use for plastering inside of wall B. Cement cannot be had here at present. 4. I want to know formula for mixing lime-sand mortar.—L. Burke (Newtownmountkennedy).

IT is thought that a plentiful supply of water to the dam does not make it essential to construct watertight retaining walls; in fact, to do so will be rather difficult owing to the lack of cement, and probably clay for puddling. However, it appears that the best must be done with lime, sand, stone and a very little cement for rendering the walls. Lime is a very doubtful matrix unless it is hydrated; a poor or non-hydrated lime is apt to be washed away very quickly by the constant percolation of water, particularly as in this case the 5ft. head of water will cause water-pressure.

The main wall B is to be 5ft. high, and has to retain water to this height. The part side walls A and C may be considered as equal to B. It will be advisable in this case to use retaining walls with vertical (not battering) sides, and the formula for water retaining wall is:

T equals HA, where T is thickness mean or average of a plain concrete or brick retaining wall in inches or feet; H is height of wall in same unit as T and A equals constant which varies with class of material, etc., to be retained and is 0.70 for water.

Therefore: T = 60in. x 0.70 = 42in. or 3ft. 6in.

It has been assumed that the wall is of concrete although composed of stone, sand and lime. If the wall is required to be battered, the *mean or average thickness* is computed by the above simple formula, and then such thickness may be reduced by multiplying it by:

0.86 for walls with an external batter of 1 in 12
0.80 for walls with an external batter of 1 in 8
0.74 for walls with an external batter of 1 in 6
0.72 for walls with an external batter of 1 in 5

Therefore if it is required to have a batter of 1 in 6, the above 42in. x 0.74 equals, say, 31in. or 2ft. 7in. average thickness.

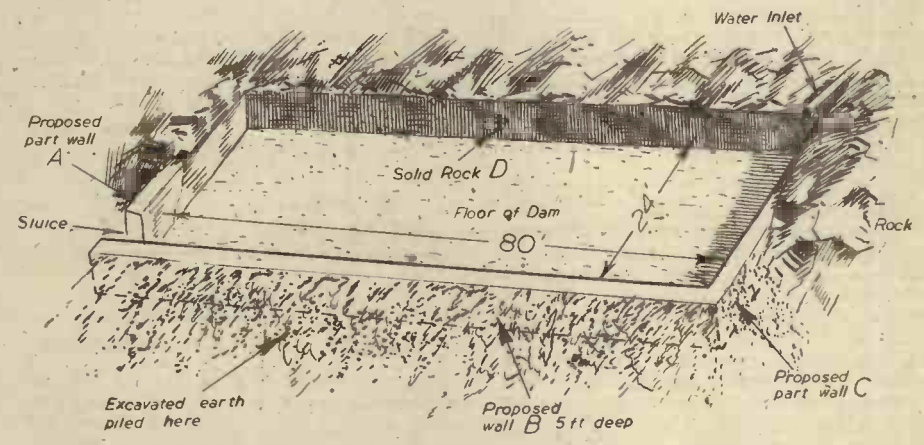
There appears to be approximately 100ft. linear of wall, 5ft. high and, say, 3ft. 6in. thick. This equals about 65yds. cube. Allowing that the voids are 40 per cent. this means that about 26yds. cube of mortar is required to bind together the stone aggregate. The 1 ton of cement will be insufficient to use with lime to make a reasonably strong cement-lime mortar which should in its weakest mix be 1 part cement, 5 parts hydrated lime and 18 parts sand. It will therefore be necessary to use 1 part lime to 3 parts sand. The chest of the next. Keep the pipes large, free from restrictions and sharp bends, and as short as reasonably possible. Use superheat.

3. Yes.
4. Yes, but cut-off is later, say two-thirds stroke.
5. 7/16in. diameter crankshaft.
6. Say 3in. or any suitable size.

Low-voltage Motor

I WISH to construct a series type of electric motor to work off 6 volts and develop 1/3 h.p. The source of current is a large capacity accumulator, and the top speed would never exceed 1,200 r.p.m. when in service. Please give main dimensions of armature and field laminations, and also the gauges of wire for winding. I understand the motor will take about 60 amps. Also, I require the size and weight to be cut to a minimum, and especially do I want the diameter of the motor to be as small as possible.—G. V. Down (Hove).

YOU cannot hope for an output of 1/3 h.p. from a 6-volt D.C. motor with an input of less than 83 to 85 amperes, and this will lead to great difficulty in your design in dealing with such a heavy current and windings, especially as you state weight is to be reduced to the minimum. It will entail a special design of field and armature stampings, a very heavy section of commutator bars and brushes, and windings



Proposed water-retaining dam. (*See reply to query—L. Burke*).

1 ton of cement may be used with 2½ or 3yds. cube clean sand to render the inside of wall about 1in. thick.

It is advisable not to rely too much on any counterbalancing effect of the earth piled against wall B. Water exerts a much greater overturning force than the earth, and the latter if relied upon would have to be very well rammed, and any water which percolates through the wall might affect it.

Triple Expansion Marine Engine

IT is my intention to get out the drawings for a model triple expansion marine engine, prior to constructing same. Would you enlighten me on the following points:

1. The proportions of the three cylinders to give 1 h.p.

2. The general principle of passing on the steam pressure to each cylinder.

3. Can I use a crankshaft with throws at 120 deg.?

4. Is the ordinary slide valve used, as in the "double-acting" cylinder?

5.—Safe diameters of crankshaft and pins.

6. Diameter of flywheel—"Marine Engine" (Birmingham).

THE size of your engine will depend upon the r.p.m. required and the boiler pressure available. 150lb. per sq. in. is about the minimum for a triple expansion engine. An engine as follows should give 1 h.p. at about 1,000 r.p.m.

1. ¾in.—1¾in.—2¼in. by 1½in. stroke.
2. Pass the exhaust from one cylinder to the steam

of stranded copper, in order to be a manageable proposition. As there are stringent restrictions to the purchase of any of these materials at the moment it would be purposeless in drafting out a design and winding specification unless you are in possession of the necessary purchase permit from the Board of Trade or Ministry of Supply.

Bleaching Leather

CAN you inform me how I might whiten a quantity of leather so that it may be dyed various colours? The leather is at present light fawn.—J. E. Castell (Middlesbrough).

IT is not necessary to bleach a leather completely before it can be dyed to any required shade of colour. The light fawn leather which you mention can be dyed quite brilliant colours by the ordinary procedure of leather dyeing. If, however, you deem it essential to bleach the leather, this can best be effected by exposing the moistened leather to the action of the fumes of burning sulphur for some hours. Afterwards the leather must be well washed.

Another method of bleaching consists in immersing the leather in a fairly strong solution of potassium permanganate until it becomes dark all over. The leather is then rinsed and immersed in a 20 per cent. solution of sodium sulphite (not sulphate) which has been acidified with a little dilute hydrochloric acid. Finally, the leather is well washed and dried slowly.

Bleaching treatments for leather should be avoided whenever possible, since they tend to weaken the fibre

of the material. At all events, after a leather has been bleached, washed and slowly dried, it should be treated with a little neatsfoot oil in order to render it supple.

If you have further trouble in this direction, perhaps the British Leather Manufacturers' Research Association would be willing to give you skilled advice. The address of this association is 18-20, St. Thomas Street, London, S.E.1.

Making Grease and Oil : Printing Inks

COULD you inform me how grease is made and how oil is obtained from seeds, vegetables, fish and nuts? Also, how are printing inks manufactured?—M. Rodoysky (Bridgend).

THERE are countless different varieties of "grease." For this reason we are unable to tell you how they are all made. Mineral greases, such as Vaseline or petroleum jelly, are obtained from the refining of petroleum distillates, the crude grease remaining after the lighter oils have been distilled from them. Animal greases are merely fats, saponified or unsaponified, from various animal bodies, whilst vegetable greases follow the same lines. In heavy engineering circles "grease" is frequently the term applied to a mixture of tallow and crude oil.

Oil is obtained from seeds and vegetables in several ways. In the first place, it may be expressed or squeezed out of the seeds, as in the case of linseed oil. Alternatively, it may be dissolved out of the seeds or vegetable parts by solvents such as naphtha; or, again, the seeds, nuts, etc., may be distilled in a current of steam, which latter will suffice to remove the volatile oil from the seeds and cause it to collect in a cooled receiver. Fish oils, such as cod-liver oil, are usually obtained by direct expression from the livers of the cod family of fish. The crude fish oils are then refined by chemical treatment and by distillation.

Printing inks are made by grinding suitable colouring matters or "pigments" with a "vehicle" consisting of a combination of oils, varnishes, together with relatively small amounts of "driers," waxes and grease compounds.

The ingredients are first mixed in a "charge can" or a kneading machine, after which they are ground by steel roller mills. The exact nature of the "vehicle" (i.e., the oily, greasy part of the ink) is governed by the exact purpose for which the ink is required, its drying properties, hardness, etc.

Printing-ink manufacture is a highly specialised and skilled industry which it is hardly possible to imitate on the small scale.

Small Synchronous Motors

I AM contemplating the construction of a small synchronous motor for an electric clock to be worked off A.C. 230 volts 50 cycles. Could you please inform me if it is possible to predetermine the speed of the motor by the number of segments on the rotor or starter, or both, and, if so, how can this be calculated, and by what formula? I am aiming at a speed of 60 r.p.m. if possible.—E. Daniel (Knutsford).

IT is essential in these motors to make the angular spacing of both teeth and slots equal in the rotor and stator, no matter whether the stator completely embraces the rotor or not. Each alternation of current carries the rotor forward by one tooth, and on a 50-cycle circuit, that is, with current alternating 50 cycles in each second, the rotor will have travelled forward by 50 teeth. In one minute of 60 seconds it would have travelled 3,000 teeth, therefore, if an actual rotor speed of 60 r.p.m. is aimed at the rotor will need 3,000 divided by 60=50 teeth.

Calculating a Watch Train

WOULD you please give me an explanation of how to fit a hairspring on to the balance staff of a watch?

Also, how to calculate the train of a watch?—W. Paul (Glasgow).

IT is quite impossible to tell you in a letter how to respring a watch. Information on this subject, however, is given in "Watches: Adjustment and Repair" (price 6s. 6d. by post from this office).

To calculate a lever watch train: The fourth wheel turning 60 times for one turn of the centre wheel, the numbers of teeth in centre and third wheels multiplied together must be 60 times the product obtained by multiplying together the teeth of third and fourth pinions. For example, to take the seconds train most in use for lever watches having third and fourth pinions of 8, we should have $8\times8=64$, and $64\times60=3,840$. Any two numbers which when multiplied together make 3,840, would be suitable for the centre and third wheels. But, unless some special numbers are desired, the calculation need not be carried farther, because it is evident the two numbers we already have (64 and 60) will answer the condition. The escape wheel, having 15 teeth turns once for every 30 vibrations of the balance, in the train of 16,200, which is the most usual for English watches, we have $16,200\div30=540$ turns per hour for the escape pinion. As the fourth wheel turns 60 times an hour, the numbers for fourth wheel and escape pinion must be in the same ratio as 540 and 60, that is $(540-60=9)$ as 9 to 1. And, if we decide on 7 for the escape pinion, we have $7\times9=63$ for the fourth wheel.

Volumetric Process for Steel Analysis

IN the course of my work as a steelworks chemist I use the potassium cyanide volumetric process for a speedy determination of nickel in the steel.

In the back titration with N/10 $AgNO_3$, using KI and $(NH_4)_2SO_4$ as indicators, the end-point is a slight opalescence, which should be stable.

I have been troubled recently with a fading end-point, so much so that there is as much as 1cc. difference between the first hint of the opalescence and the final end-point (stable).

Could you please tell me what causes this, and when it does happen whether the correct back titration is to the first end-point, or to the final stable one?—R. A. Dewar (Uddingston).

IT is extremely difficult to assign a cause for the fading end-point in the titration which you describe. Normally, with this type of reaction, you should get quite a clear-cut, decisive end-point which, in good light, is unmistakable. In your case we can only suggest that some impurity in the reagents used is at the root of the trouble. Alternatively, such impurity may have been picked up from the vessels or bottles used for containing the solutions.

We presume that you use distilled water for making up your solutions, and that the purity of the ammonium sulphate which you use is above suspicion. If this is contaminated with ammonium chloride an ineffective end-point to the titration might, thereby, readily be set up. Also, if there is a trace of absorbed ammonia in the water used for making the solutions, a fading end-point might also result.

It seems, therefore, that you will have to seek out the presence of some contaminating and undesirable impurity in your reagents, and/or solutions, and, having eradicated such impurity, we think the trouble will vanish. In any case, in the circumstances which you describe, we are of the opinion that you should take the first definite end-point as constituting the end of the titration, and not the stable end-point obtained subsequently.

Copper Oxide Rectifiers

I WISH to know how to make copper oxide from pure copper such as that used in all-metal rectifiers. How can I make the selenium type?—C. W. Ridley (Preston).

THE copper oxide coating which is present on metal rectifiers is applied by means of a secret, or, at least, an unpublished process, the surface film of copper oxide being obtained in micro-crystalline form.

In your case, however, you may adopt one of two methods, viz.:

Method A.—Pass the rectifier strips for a few seconds through a non-luminous gas flame until they acquire a bluish-black coloration.

Method B.—Heat the strips in molten saltpetre, and afterwards wash them well in hot water in order to remove all traces of the saltpetre.

Copper oxide rectifiers are much more efficient than those of the selenium type, and we would, therefore, advise you to confine your experiments to the above.

Treatment of Gypsum

ANY suggestions on the following queries will be greatly valued. I wish to develop a gypsum seam which is not large enough to open up along normal lines. The gypsum is in stratas from 1in. to 4in. thick; it is a fibrous variety, i.e., satin spar, and is 99.9 per cent. pure.

Plaster of paris is likely to be a useful outlet, although output would be limited due to the hand working of the deposit; however, could you give me the names of firms who might be able to supply me with a small grinder (experimental), and could you suggest a calcining layout to deal with, say, a few pounds at a time?—J. W. Sharpe (Retford).

AT the present time, you may have great difficulty in obtaining any small grinding plant, new or second-hand. We would, however, suggest that you make inquiries of any of the following firms, which are all manufacturers of crushing and grinding plants: International Crushing & Grinding Equipment, Ltd., 34, Victoria Street, London, S.W.1; Nordberg Manufacturing Co., Ltd., Bush House, Aldwych, London, W.C.2; Messrs. Carter, Ltd., Engineering Works, Dunstable; Miracle Mills, Ltd., Loudwater, Bucks.

The procedure in the modern treatment of gypsum is as follows:

The material from the quarry or mine is dried in a rotating cylinder heated by a paraffin or gas flame. The material is then rough-ground in a crusher and screened by passing through a coarse mesh. It is then roasted or calcined, and finally it is re-ground and screened. For experimental use, your calciner may comprise a shallow tray made of sheet metal and heated by a coke fire underneath. The tray should be provided with a removable cover in order to conserve the heat.

Good quality gypsum has many uses besides plaster of paris manufacture. Among its uses, we may enumerate the following:

An inert "filler" in the asphalt industry.

An "extender" in the paint trade.

A "retarder" for the setting of Portland cement.

As a "filler" in the paper-making industry

In the textile trades (cotton and lace making), as a "filler" for the production of certain types of finishes.

In the manufacture of sulphuric acid.

As a source of sulphur.

In the commercial production of small statues and other moulded objects.

In the rubber industry, as a "filler."

As a refractory material, in view of its capacity to resist heat.

From the above list, you will thus realise that gypsum is a highly useful material which may be put to many different uses. In order to investigate any of the above possibilities, you should get into touch with any of the large firms in the respective industries.

Material Specifications

CAN you enlighten me on the following:

Engineering materials are manufactured under certain specifications such as Directorate of Technical Development or British Standard Specification; please explain their meaning and origin. Does a D.T.D. material ever become a B.S.S. meaning after the metal has passed through its experimental stages?

I am under the impression that manufacturers of a D.T.D. material can only guarantee it within limits of the specification, but a B.S.S. material is strict to specification and does not differ by any manufacturers, hence the meaning British Standard Specification.—H. A. Taylor (Hendon)

A MATERIAL specification is drawn up by a committee or an organisation to meet certain requirements or to cover a combination of requirements. The British Standard Specifications were developed by a committee representing engineering industry in general and cover the vast majority of normal requirements. Other organisations such as D.T.D. do similar work in respect of their own particular requirements, and hence draw up their own list of specifications. There is inevitably much overlapping, and the total number of steels described in all such specifications is far greater than can really be justified. The existence of so many specifications cannot be entirely explained on technical grounds. It is apparently easy and natural for an organisation to develop a dignity that forbids it to accept material specifications brought out for general use.

Much time and labour has been expended on tables showing British Standard materials and the approximate equivalents in other classifications, and this perhaps tends to heighten the impression that there is a need for the many slight variations between the hundreds of material specifications.

Pharmaceutical Examinations

WILL you give me a syllabus of the examinations for which a student of pharmacy has to enter (from the Matriculation to the Qualifying Examination of the Pharmaceutical Society, and also tell me whether pharmaceutical work is based on the organic branch of chemistry?—W. E. Savidge (Blackpool).

IT would not be possible for us to give you here details of the somewhat lengthy syllabus of study which is, under present-day regulations, laid down for the student of pharmacy. You can, however, obtain such a syllabus, together with all necessary details concerning pharmacy studentship, by writing to the Secretary, The Pharmaceutical Society of Great Britain, 17, Bloomsbury Square, London, W.C.1.

Pharmaceutical work is based upon chemical principles and upon a knowledge of both inorganic and organic chemistry, although the chemical knowledge required for pharmacy examinations is not of the profound order of that required for the more specialised examinations of, say, the Institute of Chemistry.

Membership of the Pharmaceutical Society (which is the legal qualification permitting an individual to practise as a pharmacist) necessitates the providing of evidence of a good general education (Matriculation, Higher School Certificate, or some equivalent), apprenticeship to a practising pharmacist, and attendance upon a prescribed course of instruction at a technical college or similar approved institution We are not sure whether the Blackpool Technical College provides courses for pharmacy students, but the Technical College associated with the Harris Institute at Preston certainly does. We would advise you to get into touch with the Principal of this latter college after you have formulated your plans for proceeding with your pharmacy studies.

Detector Apparatus

CAN you tell me if there is some simple apparatus, either electrical or magnetic, that can detect metal within a short distance—say 12 inches? To make myself more clear, when a piece of iron or steel is brought near the apparatus it registers it either on a meter or some way or other. An example of what I mean is the mine detector used by the Army for finding mines hidden in the earth.—C. Tandy (West Bromwich).

IT is believed that an exploring coil consisting of a solenoid without any iron core, and energised by high-frequency current, can be used to detect the presence of metallic ores in the ground and has been used with some degree of success, but no statistics appear to be available, and it is obviously a matter needing extensive experimental development. It is suggested that you consult the records of the Electro Technical Society, which may be done by arrangement with the secretary of the Iron and Steel Institute, 28, Victoria Street, London, S.W.1.

THE Cyclist
Editor: F. J. CAMM

VOL. XI MAY, 1943 No. 255

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

Comments of the Month

By F. J. C.

Hire Purchase

As from March 1st last, the New Board of Trade Order which bans the hire-purchase of price-controlled goods became operative. This Order includes bicycles. The reason behind this Order apparently is to prevent unnecessary expenditure on luxuries, and release money for War Savings. To consider a bicycle as a luxury is, of course, absurd. The very limited supply of bicycles finds such a ready market that they can be sold for spot cash. And so the object of the Order as far as this is concerned is defeated at the start. People who buy bicycles to-day have them as necessities, because other transport facilities are denied to them. The trade itself has been anxious to reduce the demand because they cannot supply it, and the control of the supply of raw materials has itself so limited the supply that the Order as it applies to bicycles was quite unnecessary. The Order will not, of course, affect hire-purchase agreements which were in effect prior to March 1st.

Treasure In Your Cycle Shed

THOSE who see some magic in the phrase "synthetic rubber" and are relying on it to help us out of our serious rubber shortage are living in the land of wishful thinking. Government speakers recently have stated that for a long time the synthetic rubber which is being made in America would arrive in this country only in experimental amounts; that even then we would need to learn the technique of using it; and that, in any case, natural rubber would be needed to mix with the synthetic product. A modern mechanised army "marches" on wheels, and military operations might be brought to a standstill if the rubber essential for tyres proved insufficient.

Motorists, drivers of transport and public service vehicles, motor-cyclists and cyclists can all help the nation to conserve its rubber supplies by taking the utmost care of their tyres.

Meanwhile the need for waste rubber for reclaiming is urgent. How much is there now lying idle in cycle-sheds that could be given up for salvage? With the coming of longer days, with greater opportunities for being awheel, cyclists will be more often opening the doors of their cycle-sheds than in the dark days of winter. Behind those doors may be material which would be very treasure-trove to the war factories. Old, worn-out tyres, inner tubes, brake-blocks, pedal rubbers, and so on, are all wanted. Perhaps, too, the cycle-shed contains other materials not directly connected with cycling or motor-cycling. Possibly there is a length of worn-out garden-hose, old, never-to-be-worn-again Wellingtons, rubber soles, worn cricket-bat grips and racquet grips. Even dilapidated rubber kneeling mats, rubber washers, or door-stops and many other articles of rubber which have long since ceased to be of use, may have found their way into the shed.

Every scrap of waste rubber should be put out, separate from other salvage, ready for the local council's salvage collector when he calls.

Enormous quantities of rubber are required for the production of munitions and equipment for the Fighting Services; from six pounds to equip a Commando to miles of insulation in a battleship. Bombers and fighter 'planes, tanks and guns, radio equipment and R.A.F. dinghies, oxygen masks and gas masks, barrage balloons and anti-gas clothing, are only a few of the many items demanding rubber, and Japan now holds 90 per cent. of the world's natural resources.

February Road Accidents

ROAD deaths in February totalled 511, or one more than in February, 1942. This is the first month for a year and a half which has failed to show an improvement on the same month of the previous year.

Compared with February of last year, the number of adult pedestrians killed has fallen by 57, but the number of child pedestrians killed has risen by 28—an average of exactly one more every day.

The total for the month of 93 child deaths, including those of five cyclists, is the highest for any February since separate records of child casualties were started in August, 1938.

Accidents are most frequent amongst children between the ages of three and seven, and in many cases the accidents are the sequel to a sudden dart into the road, often from behind a stationary vehicle. Drivers should be prepared to cope with emergencies of this kind.

Increases are also shown in the road deaths among motor-cyclists and adult pedal cyclists.

Glass on the Roads

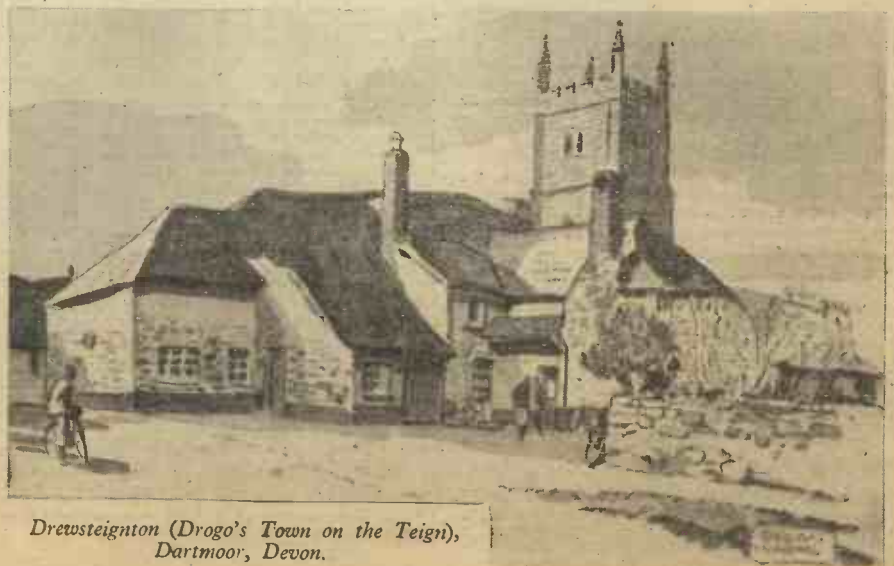
THE National Committee on Cycling has circulated the following notice to the press:

"Since the National Committee protested against the disappearance of 75,000,000 milk bottles a year an order has been issued making the wilful destruction of these bottles an offence.

"May we now point out that bottles which have contained other refreshments are, according to reports reaching us, almost an equal menace to the life of tyres? Members of local authorities will forgive us if we remind them that, under section 72 of the Highways Act, 1935, they have already been given power to deal with the bottle smashers."

The Change-over to "Limited"

WE have been asked by a number of members associated with one of the cycling clubs the position when a resolution is passed that the club be formed into one of limited liability. The old rules provide that the club shall hold its annual general meeting in a particular month this year. This has not been done in view of the intention to alter the constitution, and the point at issue is: Does the club exist between the date when they should have held their annual general meeting and the holding of the first meeting under the new constitution? We have inspected the old rule, which quite clearly states that the officers automatically resign each year, but they may, of course, offer themselves for re-election. Our answer is that the club does not exist, it has gone out of existence, and will not come into existence again until the club has been formed into a company. Therefore, any arrangements made for the holding of opens are invalid, and the R.T.T.C. cannot recognise the results, since it will be necessary for the company when it is formed to reapply for affiliation to all of the national bodies. Thus, a hiatus has been created, and although the rules of national bodies are seldom rigidly enforced and seem to be broken more often than they are observed, in this case a most difficult situation has been created by the unnecessary haste with which the decision to make the change was brought about.



Drewsteignton (Drogo's Town on the Teign), Dartmoor, Devon.

Paragrams

The ruins of Girnigo Castle, Caithness, Scotland.

N.C.U. Membership Increase

MEMBERSHIP of the National Cyclists' Union is steadily increasing, latest available figure showing a substantial gain over the corresponding period last year.

Jack Shilson Wounded

POPULAR member of Plymouth Corinthian C.C., Jack Shilson is in an African hospital suffering from severe wounds.

N.C.U. Benefits

THE National Cyclists' Union reports that figures to date indicate that in 1942 over £6,067 was recovered for members.

Herne Hill Track's Surface

HERNE Hill track will be resurfaced this year either with bitumen or cement. The track management committee are negotiating with the appropriate authority for the essential permit to commence work at the earliest possible date.

Congratulations

THE National Cyclists' Union is now in its 66th year.

National Clarion Meet

THE National Clarion Cycling Club will hold its 48th annual Easter meet at York.

Hardly Adequate

MRS. IDA GLOVER, of Eastbourne, left in her will the sum of £8 for the purchase of *two* cycles.

East Anglian C.C.

ALTHOUGH it has several keen members, and is remaining affiliated to national and local associations, there is not much chance of the East Anglian C.C. resuming activities this year.

Southgate C.C. President

CLUB champion in 1894 and in 1905, Mr. R. E. Watkin, who joined the club in 1885, has been elected president of the Southgate C.C. for the second consecutive year.

A Splendid Record

DURING 1942 mid-Yorkshire District Association of the Cyclists' Touring Club carried out over 400 club fixtures. Over 263 maps were borrowed by members from the association's library.

Encouraging Youth

BRADFORD Racing Cycling Club has instituted a special section for junior members up to the age of 17, and at a reduced subscription of 3s. 6d. per annum.

A Wise Move

ON the grounds that the privilege had been abused by riders other than those for whom it was intended, and that certain clubs were alleged to have accepted entries while an event was in progress, South Wales District Council of the R.T.T.C. have agreed not to accept entries for events on the morning.

Carlyle C.C. Jubilee

AMONG the clubs celebrating their jubilee this year is the Carlyle C.C.

Finsbury Park Precedent

NOW celebrating its 60th consecutive year, Finsbury Park C.C. has created a precedent by electing two presidents. Mr. A. C. Crane, founder member and first hon. secretary, enjoys the distinction with founder member Mr. Ernest Allen.

Southgate Cyclist in R.A.A.F.

FRANK WILSON BARNES, member of Southgate C.C., who went to Australia just before the war, is now a pilot officer in the Royal Australian Air Force. He is stationed in the Middle East.

Medway Wheelers Juniors

MEDWAY WHEELERS are encouraging young blood by reducing minimum age for membership to 15 years.

"Ad Astral"

A CYCLING club attached to a R.A.F. station has chosen the appropriate title of "Ad Astral." Frank Sugden, Bradford C.C., is the secretary.

Full Midland Programme

TWENTY-EIGHT open road time trials are to be held this year by clubs affiliated to North Midlands District Council of the R.T.T.C.

Yorkshire Road Club

OVER 30 members of the Yorkshire Road Club have resigned, including their star rider Ron. Kitching. The majority disagree with the club's policy of excluding from membership anyone who takes part in British League activities. Kitching has joined the North Road C.C.

Newcastle Road Club's Loss

BOB CLARKSON, former official of the Newcastle Road Club, has been killed on active service. He lost his life during a bombing raid, and was buried in a small British cemetery on the North African frontier.

Southern Roads Record Holder Missing

JOINT holder with J. Leigh of the S.R.R.A. Worthing and back tandem record and of the Association's 12-hour tandem record with L. H. White, popular "Bill" Hawkins has been posted as missing, presumed killed.

New Name for Liverpool Combine

THAT go-ahead combination of clubs, formerly known as the Liverpool Combine, has decided to change its name to the Merseyside Combine, and has planned a series of open events for this season.

Swiss Wheelfolk

IT is estimated that as a result of the war there are more cyclists than ever in Switzerland, and one of every two inhabitants is a cyclist.

Hostel by Volunteers

SPEAKING in Edinburgh to youth hostel members, Sir John Sutherland said that they should consider a scheme to erect a youth hostel to members who fall in the war.

Cotton Tyres

BICYCLE covers made from cotton are now being tried. They have been used under ordinary cycling conditions and found satisfactory, although not as good as rubber covers.

Back to London

THE Y.H.A., London Regional Group, has moved back to its London address, 23, Taviton Street, W.C.1, for all business purposes, from evacuation quarters at Kemsing.

South African Rubber Substitute

THE Russian dandelion which forms the basis of a rubber substitute has a rival in a South African shrub from which it is said that four times as much substitute can be secured.

Synthetic Rubber

AMERICAN production of rubber from a species of dandelion has grown in recent months, and in Minnesota a yield of 8,000lb. per acre has been achieved.

More Hostels

STEPS are being taken to open or reopen youth hostels at Godshill, Marlborough, Corris, Ludlow, Linton (Wharfedale), Ilam Hall, Bardon Hill, and Cwm (Flintshire).

Scottish Dates List

THE official list of Scottish open events is out earlier this season, and may be obtained from the S.A.C.A. secretary, Stanley Telford, 26, Bouverie Street, Port Glasgow, Renfrewshire.

Death of Trader's Son

SERGT. JACK S. ALEXANDER, who died in action in North Africa while serving with the Royal Armoured Corps, was a member of the well-known firm of Scottish cycle distributors, Alexander's, Ltd.

Another Pedal Car

A GLASGOW man has made a pedal-propelled family car to seat four, and claims that it will do 20 m.p.h. It cost £30, and has two sets of pedals and three gears. The total weight is 90 lbs.

Death of Tourist

A. G. BRADLEY, who has died at Rye at the age of 92, was a guide-book writer who used a bicycle on his expeditions. He wrote many guides, his most famous being those about the west and north of England.

Hostel Changes in Scotland

AT the annual council meeting of the Scottish Y.H.A., held in Edinburgh, it was decided to close the hostels during the day, as in England, and to increase the overnight charge from 1s. to 1s. 3d.

Bicycles in Floods

DURING the winter flooding at Hull, when some parts of the "old town" were submerged to a depth of over two feet, bicycles played a great part in transport when other vehicles and pedestrians were held up.

"Rest" Improved

THE new road up the east side of the "Rest and Be Thankful," in Argyllshire, has been completed, except for the top dressing. The road is not yet suitable for traffic, and no date of opening can be given.

"Rustling" of Ponies

THE wild ponies of the New Forest, a district familiar to touring cyclists, are being "rustled" regularly by thieves. A reward of £100 has been offered to anyone able to give information leading to the arrest of those responsible.

James Alexander (right), former Scottish track star, and now head of the firm of Alexander's, Ltd., cycle distributors, and James Dyas, of Penrith, on a coupled machine. These coupled mounts were once popular among a section of the cycling fraternity—note the period moustaches adopted as part of the make-up. The machines are actually modern tandems linked with couplings once sold for the purpose.

Around the Wheelworld

By ICARUS

Bath Road Club Resignations

I AM asked to state on behalf of C. A. (Bath Road) Smith, that he has tendered his resignation to the Bath Road Club because he disapproves of the actions of the Committee, and the conduct of the Bath Road Club. He has asked for the return of the first Bath Road Club Cup which he won outright in the 'nineties, and which he re-presented to the Club. This request has been granted. Bath Road Smith was the first and only Hon. Life member of the Club, and it is unusual for an Hon. Life member to resign.

Other members of the Bath Road Club who ask me to announce their resignations for similar reasons are J. Dudley Daymond, who has been a member for nearly 40 years, and has had a continuous connection with the club as one of its executives; J. E. Rawlinson, A. H. Bentley, E. Coles-Webb, and J. L. Callway, all old members; whilst I understand that the sole surviving Founder Member, W. G. James, has also tendered his resignation. I hear that many other resignations are pending.

New Roadfarers

NEW members of the Roadfarers Club include Freddie Grisewood (of the B.B.C.), Ransom Morford, Capt. Morphy, E. J. Mitchell, Andrew Robertson, Sir Arrol Moir and J. M. G. Rees. Although this Club was only founded in 1942, it already has a most powerful and influential membership. It is, of course, a national institution, and membership is by invitation of the Council.

Rex Coley

FOR the first time in its history a by-election for a seat on the Council of the C.T.C. has resulted in a tie, both Rex Coley ("Ragged Staff," the well-known tourist) and C. V. Glenn Smith receiving 95 votes. Mr. Coley, who has been the Councillor for the Division (East Midlands) during the previous two years, only allowed his name to go forward again as an alternative to the seat becoming vacant, as he has always held strongly to the opinion that C.T.C. Councillors should be, whenever possible, permanently resident in the areas they hope to represent. On being notified of the result of this contest, Mr. Coley immediately withdrew his claim to be considered the successful candidate, and warmly endorsed the election of Mr. Glenn Smith.

Loiterers' Country Dinner

THE ninth dinner of the Loiterers' Section of the London C.T.C. was held at Broxbourne, Herts, in March, and was attended by a company of close on sixty members, who rode to the venue on bicycles. "Ragged Staff" (Rex Coley of the Midland C. and A.C.) was invited to take the chair, and in his speech to the assembly urged the young members to come forward as nominees for the C.T.C. Council, "as the present constitution badly needs a generous influx of youthful cyclists with a vigorous programme."

Thousands of Bicycles

BRITISH cycle makers propose to make during 1943 about 800,000 bicycles, of which, it is estimated, more than a quarter of a million will go to the Services.

The total is much the same as was achieved in 1942, when particular provision was made for women munition workers and nearly 300,000 women's machines were distributed.

One result of the war has been the progressive reduction in the United Kingdom bicycle export trade and only a limited number was supplied in 1942 to the British Commonwealth of Nations, the Colonies and certain Allied territories outside the Western Hemisphere. Care, however, is being taken to meet the wants of countries served by the Middle East Supply Centre.

Dunlop Tyres

A NUMBER of Dunlop cycle covers have been issued in Cruiser, Invader and Champion patterns without being branded "War Grade." These covers are of War Grade quality and from February 1st, 1943, have been invoiced as such to traders, who in turn, should resell at the appropriate War Grade prices.

All Dunlop cycle tyres issued from this date, and until further notice, whether branded or not, are to be regarded as War Grade.

Three Tyre Talks a Day

THREE talks a day on tyre economy and maintenance have been given between the months of March and April at the Berkeley Court Exhibition by technical experts supplied by the Tyre Manufacturers' Conference. They are Mr. C. J. Bulmer (Dunlop); Mr. N. V. Clarke (Goodyear); Mr. E. B. Morgan (Firestone); Mr. C. H. Schmidt (Avon); and Mr. R. G. Walker (Michelin). Each of the speakers dealt in his own way with the forms of abuse; how to recognise it; what it does to the tyre; and how to correct it. A film illustrated the points made.

Timekeepers Wanted

The London Section of the B.L.R.C. requires the services of some qualified handicappers and timekeepers. Will interested timekeepers (not essentially R.T.T.C.) write to the Secretary, P. Hare, 244, Ardgowan Road, Catford, S.E.6.

Some of the members of the Roadfarers Club at a recent luncheon at which was debated street and vehicle lighting.

Cyclorama

By H. W. ELEY

Falling Foss (Force), Little Beck. A few miles from Robin Hood's Bay, Yorkshire.

The "Prettiest" Village!

EVERY now and then, correspondence crops up in the press as to which is the prettiest village in England. It is, maybe, an unprofitable subject for discussion, but nevertheless an intriguing one. . . . I suppose that most of us, from time to time, compare our notes and, out of the memories of our tours, claim some one village as being the ideal. Often have I listened to this subject being discussed in some friendly inn. And strong and vigorous claims have been made for Long Melford, in quiet Suffolk. But just as someone sung the praises of this beautiful village, someone else would chime in with a claim on behalf of Bibury, in the grey Cotswolds. Then, out of the blue haze of tobacco smoke in the little bar, would emerge the claims of some hamlet in Wiltshire or Dorset. And so it would go on, until some wise old man would tell the company that there was no "prettiest"—and that England was so full of lovely places that it was futile to try and award the palm to any single one. With that view, I heartily agree. And in the inn, back we would get to our talks of sports records, old-time cycles, champions of the long ago . . . until a tired and ruddy-faced landlord called "Time, Gentlemen, Please." A little argument outside the inn, then . . . a moonlight ride home, with the countryside quietly sleeping, and an owl hooting occasionally from the spinney. Good times!

The Shy "Brock"

CYCLING around the borders of Staffordshire and Warwickshire recently, I fell in with a genuine nature-lover, with a passion for observing the habits of the wild creatures of the English countryside. We talked of voles, and harvest-mice, and stoats and weasels . . . and badgers. And when it came to "Brock" we both agreed that he was the shyest and most elusive fellow of our land. Usually only appearing at night, it takes an observant and very patient "watcher" to see much of him. And how strong he is! Those long claws can dig deep into the hard earth, and many a rabbit "stop" has been found, dug out, and the baby bunnies killed by friend Brock. His teeth are amazingly strong and he must have been a tough customer for the dogs to tackle in the "bad old days" when badger-baiting was a popular British sport . . . and that is not so very long ago!

Rubber Shortage

THE authorities who deal with questions of rubber shortage and salvage have been active lately, and nearly everyone must have been impressed by those big "sixteen-sheet" posters which have appeared on the hoardings, telling us that "Rubber is Scarce." The information is coupled with a timely reminder to take extra care of our tyres . . . and the advice is not intended only for the motorist! The cyclist has his or her part to play, and because the wheeling fraternity has always been patriotic, I feel certain that the advice will be heeded, and that cyclists will do those little things which will make tyres last longer, and so help the war effort.

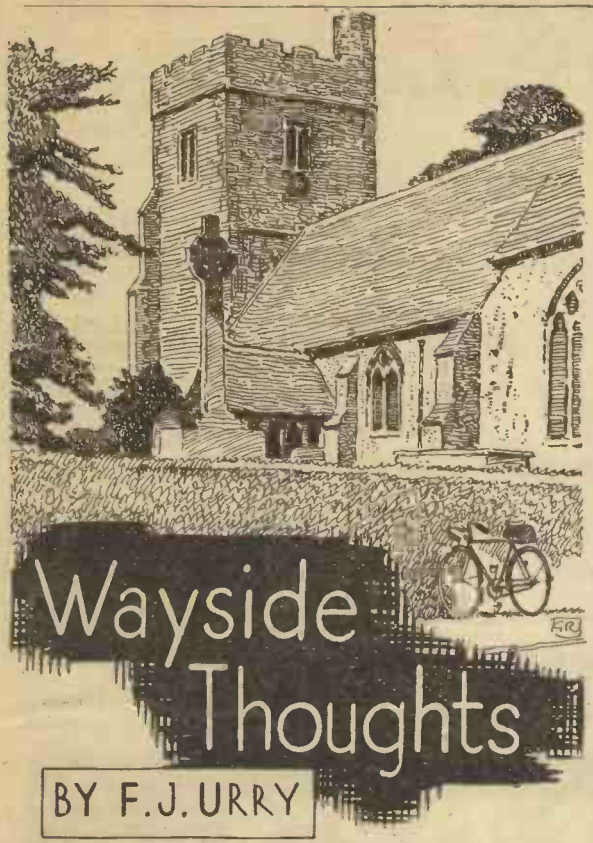
Blue-bell Time

THE wonderful run of fine weather, with its joyous week-ends, has brought cyclists out in their hundreds, and it has been good to see the young and the old setting off to seek the peace and beauty of the countryside. Happy family parties . . . with "Dad" and "Mom" keeping up well with the youngsters, and showing them that they have not forgotten how to sit a bike correctly, and pedal in the proper way. As yet, the hedges are bare, and it is too early to taste all the delights of spring . . . but that green princess is on her way, and soon it will be May-time, with fields starred with golden buttercups, and the hawthorn hedges all foamy with blossom. And, by the way, when that time comes, and there are bluebells in the woods, I do make an appeal that those who gather them do not pull them up by the roots! It is a disheartening sight to see great bruised bunches of bluebells tied on to cycles . . . roots torn out of the woodland glade. Think of others, and leave the roots so that those carpets of blue may delight again and again.

Badges of War Leaders

BECAUSE this is a "total" war, I suppose that there have been no available supplies of the necessary materials to manufacture buttons featuring our leading generals and war "chiefs." I am reminded of this because the other day (also in an inn), I saw a faded old picture of the leading generals of the South African war of 1899-1902. There they all were, as I remembered them as a boy! General Kelly-Kenny; Sir Redvers Buller; Sir George White; "Fighting Mac"—the renowned Sir Hector MacDonald; and Sir John French, long afterwards to lead our Expeditionary Force in France in 1914. And I recalled how every boy of the period used to "sport" coloured badges, showing these leaders. We used to collect the badges, and ardent enthusiasts would possess "complete sets." Ah well! those days are long ago, and we have "progressed" in matters of warfare, and I suppose that the entire casualties of that far-off campaign would appear trivial in these days of fantastic figures and holocausts of slaughter.

A wartime picture of the car park at the Wembley Stadium, taken during the recent football match England v. Wales. This parking place is usually filled with high-power cars, but now the humble bike holds pride of place.



Wayside Thoughts

BY F. J. URRY

Let's Get Down To It

MY plea for a conference of road users—as opposed to a conference of road interests—for the purpose of exchanging views on the future of road travel, seems to have fallen upon deaf ears up to the moment of writing. It may be that because it came from a cyclist its import was thereby restricted; but I would like to remind all folk that cyclists still constitute more than a fifth of the population, and their point of view must be heard and considered. If there are people who say such a conference would achieve nothing but talk, I would remind them that only as a result of talking does action follow, and on one score alone action seems necessary, with nearly 7,000 killed on British roads in 1942 (to say nothing of the injured), and this in a period when motor traffic has been reduced by two-thirds its pre-war total. We must face these facts, and they are deplorable; but the saying of that and agreement with it does not get us anywhere. There is, of course, a remedy, but apparently no one wants to face the facts or compromise their pet theories on the possibilities of curing this slaughter, and still retaining those road rights which, it seems to me, must always remain public property in a democratic country. And it is on that assumption that I think a conference of road users is essential if the folk who really knew the conditions are to escape the bureaucracy of Government departments swayed by commercial interests at the expense of the common people. What the final answer will be to the problems of the road it is not possible to say; but I do feel in my bones that unless we road farers of all travel denominations make known our thoughts and feelings on this most important matter, we shall find ourselves the victims of over-riding financial interests, the Cinderellas of the road without a hope of finding the magic slipper.

[*The Roadfarers' Club provides such opportunities. The total membership of national bodies is less than* 100,000.—ED.]

In the U.S.A.

I HAVE heard it said that we should copy the road system of U.S.A., and I can understand that the man in a hurry would like to see such a development, even in our small land, where distances, in comparison with U.S., are negligible. But listen to this: It is an extract from a letter received from an American friend with a big cycle manufacturing business in Chicago, and a country house 80 miles away. "You say you would like to do some cycling here, and I am fearful this might be a bit disappointing. I wish I could adequately describe our highways. Perhaps my own use of these highways may give you some idea. In peace-time I usually drive the 80 miles to that country place on Friday evening and back again on Monday morning. I use the less frequented roads and drive heavy cars. The first 20 miles out of the city are a bit slow; they take about 40 minutes. The remaining 60 miles I usually cover in an hour. There are no speed laws and my average driving speed is 70 to 75 m.p.h. This may sound a bit wild to you, but then you must consider our roads, generally speaking, are fairly straight, and the curves so engineered that the worst can be taken with a fair degree of safety at a mile a minute. Most of the curves can be negotiated with safety at 70–80 m.p.h. You rarely see cars on those going less than 50, and generally 60–65 seems to be the average speed. The highways are nearly all of concrete 20 to 30ft. wide, and on the verges is a shoulder of packed earth, 6 to 10ft. wide, rough, of course, and covered with grass and weed growth. You will understand that in such circumstances cycling would be a bit hazardous. Of course, there are side roads on which traffic isn't very heavy. Some of these are concrete, but most of them are surfaced with crushed stone or asphalted; but even on these roads we have the occasional wild man driving at high rates of speed, and the cyclist is always an annoyance to him.

Do You Want This?

"ON our city streets cycling is practically out of the question. While speed is supposed to be held down to 25 m.p.h, in the outlying and less congested parts it approximates to 30–35 m.p.h.; but in the denser areas traffic is very heavy. So you see in order to enjoy cycling it is necessary to select some spot in the country where traffic is comparatively light. This accounts for what we call 'cycle trains,' where groups of 25 to 200 riders take their machines on the train, and disembark at some picturesque spot where they can ride without being hounded off the road by the ever-present motor-car. There are many such places, but the road to them from the big industrial centres is a difficult traverse for the cyclist." There speaks a cycle manufacturer whose interests obviously are to sell bicycles and make the game as popular in America as here. And what chance has he got to accomplish this? I would ask the maker here to con the contents of this quotation from a private letter, and then put to him the question whether he feels a genuine interest in making our British highways uncontrolled speed tracks for a minimum number of users, or keeping them open for the use of the folk who own them, and in the main pay for their upkeep. It seems to me that if we are to save our roads for the common service of the common people a stricter control is necessary, and a greater vigilance together with heavier penalties for trespassers against the law, if the roll of death and destruction is to be challenged and subdued. In my opinion this island is too small to accommodate great motor roads, and its diminutive size must challenge the minority desire for excessive speed, and the scarification of its limited acres by such grandiose schemes.

Showing Signs

TALKING of roads reminds me that my route to work is becoming very patchy after standing up to the throb of the traffic for so long without showing any inordinate disintegration. Tram-lines, where they still exist, are a nightmare in the real sense of the term, for on my journey home a week or so ago when the night was of Egyptian darkness, I struck a patch where the setts had sunk three or four inches below the rails, and did a violent left-hand skid without actually falling. When I examined the spot it seemed to me rather remarkable that the violent wrench had not unshipped the tyre. I reported the matter to the local authorities and they sent a couple of men to dump a gritty tar mixture in the hole, which certainly does remove the danger for the moment, but the patch will not last long. Actually I expected the road surfaces to deteriorate much more rapidly than has been the case, and insofar as that is concerned we have been fortunate; but now the time has arrived when there are signs in most places that repair and renovation is urgent. No doubt a lot of patching will take place during the next few months as far as the labour conditions will allow; but we must realise the difficulties surveyors are facing and not expect miracles to happen. Those of us old enough to recollect the state of our roads in 1918, after four years of war transport, will not grumble over-much of the shattered surfaces over which we are riding now, for they are race paths compared to the sea-shore tracks we struggled over five and twenty years ago.

Bad Policy

IT annoys me to see some of our wartime bicycles I am not complaining of their similarity, or finish or weight, or any of the things that ordinarily strike the eye of the observer, but of their gears, perhaps the most important thing of all concerned with easy running and comfort. There are no change-speed gears made to-day, so perforce the buyer of a bicycle is confined to one ratio, and nine out of ten wartime machines are geared too high. Why? Because manufacturers have certain size chain wheels in stock, free-wheels have been standardised at 18 teeth, and the rider has to accept the combination giving gears over 66in. and up to 71in. It is absurd, either for the utility rider, or the individual, mainly middle-aged, who has taken to cycling. The ideal gears for a single-speed machine are between 60in. and 63in., and more especially is this the case with the wartime bicycle with its greater weight and less resilient tyres. Does the manufacturer know these things, and if so, why does he insist on making cycling hard work? For that is what it amounts to. I know that statement to be a fact because I have been instrumental in lowering the gears on several wartime models in service among my acquaintances, and following the change of ratio their reaction to the pastime has been, and is, entirely different to their previous "hard work" bogey. I suppose the fact is the cyclist with but slight knowledge of the make-up of his machine is the victim of folk, on the manufacturing side, who are equally ignorant of the genuine importance of gear ratio in relationship to easy cycling.

A Game for All Ages

THERE appears to be a tendency in the cycling press these days to pour scorn on the "old codger" who rides a bicycle and likes it, because he has had the temerity to suggest that every notion backed by the younger generation may not prove altogether useful to the cycling community. Furthermore, because some "ancient rider" prefers to undertake his touring with the fullest possible comfort, he is written down as a snob, scarcely fit to associate with the youngster just starting on the "long littleness of life." Now that sort of thing is just nonsense and it is almost time somebody said so. Cycling is a game for all kinds and conditions of people, but very naturally it possesses the greatest attraction for the younger folk because of its cheapness and sporting quality; but that fact does not make it any less enjoyable for the middle-aged or elderly. Even our young enthusiasts will grow old in due course, and possibly the severest critics among them to-day will then have conveniently forgotten their diatribes of the moment, and probably cycling as well. Do those people want cycling to be confined and governed wholly by the younger folk? If so they are automatically condemning the years ahead of them and doing the pastime a great dis-service, for I submit that the complete enjoyment of cycling only comes to us when we have fully trained our observance and our sense of beauty, and has nothing whatever to do with where we stay, how much we spend, or what total mileage decorates our annual chart. I believe the old cyclist, the individual who rides whenever the opportunity presents itself, possesses the spirit of the pastime in a greater degree than the young enthusiast, because the genuine love of the game is in him, otherwise he wouldn't be an old cyclist. Do not let us make the mistake of thinking cycling is only a game fit for the young, because it isn't true, but if enough people keep on saying so, it may be in great danger of becoming true.

Club Notes

Jubilee 50 for Manchester

MANCHESTER WHEELERS are to hold a Jubilee invitation 50 to celebrate their diamond jubilee.

Support for R.T.T.C.

THE West Bradford C.C. has decided to uphold the N.C.U. and R.T.T.C. decisions on massed-start events on the road.

Ivory Killed

JACK IVORY, Southend and City Wheelers, has been killed in action. He was former Essex grass track champion.

Star in Scotland

YOUNG Douglas C.C. road star J. Griffiths, winner of last year's West of Scotland T.T.A. Novice 25, is serving with the Navy in Scotland.

Sheffield Revival

FOLLOWING a period of inactivity, the Sheffield Central C.C. has been revived.

Scottish Official in Forces

WELL known as a West of Scotland cycling official, Gordon Anderson, Ivy C.C., has joined the Forces

Clubman an Airman

JOHN NICHOLSON, lanky member of the Dundee Thistle Road Club, has just gone to the R.A.F.

List of Scots Opens

THE 1943 Scottish dates list was available at the end of March this year, some months before its 1942 appearance. The list gives details of all Scottish opens this season, and may be had from the secretary of the Scottish Amateur C.A., Stanley Telford, at 3½d. post free.

South Scotland "Hundred"

FOR the first time within recent years, an open 100 is being promoted this summer by the Ayrshire and Dumfriesshire C.A.

Brinkins at Work

JIMMIE BRINKINS, the Scottish speed star, is now in training at an R.A.F. camp in the North of England, where he is trying to found a cycling club for personnel.

Novel Scots Opener

FIRST open event of the Scottish season was the Clarion Tour de Trossachs, run off over a course of 26½ miles, which included several sections of 1-in-12. The winner was Alex. Gilchrist, Royal Albert C.C., who clocked 1hr. 16 mins. 54 secs., while winner of the special prize for fastest man up the Duke's Pass was Alex. Hendry, Glasgow Wheelers, with a time of 10 mins. 55 secs.

My Point of View

BY "WAYFARER"

Insurance Against Cycle Thefts

THE daily press announcements of an insurance company offering cover against the depredations of cycle thieves proclaim that "the best means of getting about nowadays is on a bicycle." Yes! nowadays—and always! In peace as well as in war, the bicycle is the handiest, healthiest, and cheapest—and therefore best—mode of locomotion.

"A Hair of the Dog"

THIS may have been said previously, but it is worth repeating; on the morning after the night before (on a cycle tour, for example), when you wake up feeling stiff, the best cure is "a hair of the dog that bit you." However sluggish—however disinclined for cycling—you may feel, it is cycling that will put you right. A spot of fast pedalling will speedily remove yesterday's stiffness, and make a new man—or woman—of you. Try it for yourself; don't imagine that you are too tired to ride.

Incongruous

WITH pleasant musical hum caused by hard tyres hitting a good road, the last word in bicycles overtook me the other Sunday afternoon. There were two of them—new, highly coloured (one bright red and the other equally bright yellow), and mudguardless. A pleasing sight—until you noticed that both the riders were wearing trousers. That feature, too, was the last word—and seemed hopelessly incongruous. In any event, trousers are always out of place in connection with cycling, except as regards riding to and from business. [*Why? Because an artist always depicts cyclists in plus fours?*—ED.]

For Consideration

IT appears to me that we who are fond of rough-stuff cycling should review our ideas at the present moment, having regard to the rubber position. The fact of the matter is that we can hardly afford to impose on our tyres the extra wear and tear that accrues from some of the churned-up "surfaces" over which, normally, we like to frolic. When tyres were plentiful and cheap, we could bash 'em about to our heart's content, but now that "the case is altered," as the inn sign says, we ought to "gang warily."

A Near Thing

MY heart recently missed a beat at the sight of a cyclist who decided, quite legitimately, that he could safely cross the road in front of an oncoming tramcar. As he spurted to do so, his chain very inconsiderately broke, and he was left "in the air," so to speak. Fortunately, both parties realised the need for prompt action, the tram-driver piling on his brakes, and the cyclist scrambling off his machine, which he quickly removed (complete with trailing chain) out of the way of danger. It was a near thing. I suppose that we all—again, quite legitimately—[*Unreasonably.*—ED.]—risk dashing across the front of traffic, although, as a rule, it is better to wait. The incident related emphasises the latter point. "Arguments" with much bigger units of traffic are certainly to be deprecated!

Timely Warning

THIS leads me to say that newcomers to the pastime may like to be told—as returners to cycling may appreciate being reminded—that the speed and silence of the modern motor car are factors which we cyclists should always keep before us. In negotiating cross-roads, for instance. It is worth while pausing for a moment or two in order to study the traffic. This car approaching from the left is so far away that surely there is time for us to cross the road-junction in perfect safety. It may be so. But just wait and count up to ten, representing the time required to get over, and note the position of the car when "8" is reached. "Of course," you say, "the motorist will reduce his speed when he sees us crossing." He may—and he may not. At best, you have had a close call, which really is not worth while. So let us submit to these slight delays, in the interests of safety . . . and our health.

"Rat-traps" Defended

MY wife came home t'other day carrying in one hand the wreckage of my cheque-book and leading with the other hand a natty little bicycle, brand new. It is not proposed to say anything in this place about the machine, except that I was mildly surprised to note that rat-trap pedals were fitted—a rather unusual feature in a lady's bicycle. Then I remembered that "there's a war on," which accounts for many strange happenings. The opportunity may be used, however, to repudiate the commonly expressed idea that rat-trap pedals "wear out the shoes." It is not the case. How can they? I have used this type of pedal exclusively—or almost exclusively—for many years, and I am not conscious of the slightest speeding-up in the wear of my shoes. Rat-trap pedals certainly make a series of indentations in the soles, but the shoes are not sent to the repair-shop one minute earlier than would otherwise be the case. Of that I am sure. [*Rat-trap pedals do wear out shoes. Why wear toe-clips?*—ED.]

Lone Furrow

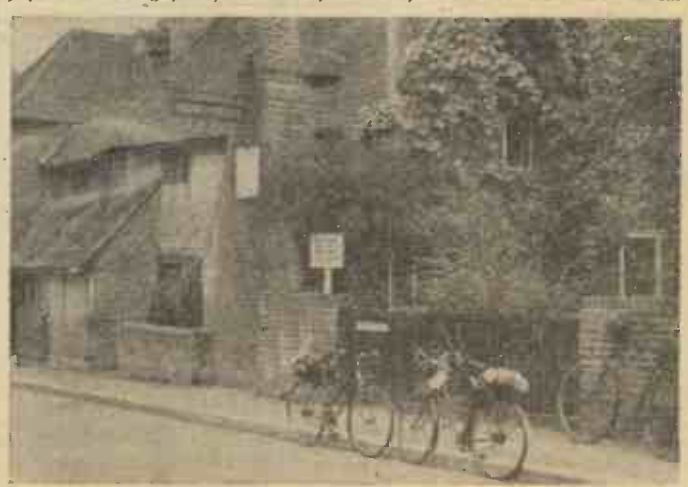
THE boy—young enough to be my son—said that he would come my way for two or three miles, preparatory to slipping off into the lanes and returning to his "digs" at a local farm. We had had tea together, and now, in the cool of the evening, we paid the score, gathered our bicycles together, and hit the trail. He did most of the talking, and I, as a good listener, let him. When the two or three miles of his promise had been doubled, he said: "Well, I'll go up this next turning . . . Cheerio!" Giving him goodbye, I settled down to one of the pleasantest tasks imaginable, for I was on a week-end jaunt. At our next encounter the boy spoke of his thoughts after we had parted, and the fanciful picture he created was quite good. It appears that, on diving into the side road, he at once turned in his tracks, dismounted, and stood there, with envy in his heart, watching me pedalling away until a bend in the road carried me out of sight. Then he saw me in imagination pressing onward, sitting, as he put it, like a statue, now passing the time of day with some other cyclist, now indulging in a bit of back-chat with a pedestrian; now pedalling swiftly down a sharp hill and now coming out of the saddle to walk the uplift that followed. He saw me with his mind's eye fasten my jacket, turn down my sleeves, and put on my gloves. He witnessed the glory of the evening melt into the solemnity of dusk and darkness, and imagined me, at the proper time (or thereabouts, he added, with a twinkle in his eye), switch on my front lamp, and, at the next dismount—with another eye-twinkle—he fancied he saw me twist the cap of my rear lamp. "Then," he concluded, "just as the church clock was striking nine, I saw you ride into the village street and go to the house of your choice, and there I heard you ask for accommodation for the night. How I wished I could be with you!" It was quite a good picture of the lone furrow which I had chosen to traverse—but there was no loneliness.

Notes of a Highwayman

By LEONARD ELLIS

Bucks and the Poets

FEW counties have a greater claim to connection with the poets than Buckinghamshire, no fewer than five of the famous poets being associated with it. In some way or another Milton, Shelley, Gray, Cowper and Waller can be regarded as part of the county's stock-in-trade. I suppose, in view of all the circumstances, Milton must be regarded as the "lion." He came to Chalfont St. Giles in July, 1665, in the hope of escaping the great plague that was then ravaging the country. His friend and one-time pupil, Thomas Ellwood, obtained the cottage for him and he describes it as a "pretty box." Milton's cottage can still be seen and inspected by cyclists in Chalfont St. Giles, and some of the rooms have been laid out as a museum. The cottage is still a very pleasant-looking place, although it has undergone much restoration and improvement. Milton stayed in Chalfont until the March of 1666. Although John Milton sought sanctuary from the plague in the village, Chalfont did not entirely escape the scourge, as several cases were noted in the parish registers. Milton lived for nearly six years—1632-8—at Horton, a village near Colnbrook. This is also in Bucks, but in the extreme little southerly tip that seems to belong to the county only because the Thames chose to make a wide detour to the south.



Milton's cottage, Chalfont St. Giles.

Gray and Stoke Poges

THE next in order is Thomas Gray, of immortal memory. Gray is for ever associated with the Elegy, written in a churchyard. Some say that he had Upton Church, near Slough, in his mind when he wrote the poem, but the fact that he is buried at Stoke seems to have settled the argument and to have given that village an unfair advantage. Gray's tomb is simple and contains his body and that of his mother. An inscription on a monument to his memory recalls that he lies under the stone "on which he piously and pathetically recorded the interment of his aunt and lamented mother." Because Stoke Poges churchyard is such a Mecca for pilgrims from all over the world, it is kept in spotless condition, and as a consequence it sometimes seems quite out of place in that quiet corner of rural Bucks. Stoke Court, nearby, was the home of Gray. In the church itself there is a curious stained glass window, particularly interesting to cyclists. There appears to be a perfect picture of a cherub riding a very fair imitation of a bicycle, but the window is obviously many years older than the earliest bicycle, and the design must be sheer coincidence.

Marlow and the Shelleys

IN West Street, Marlow, will be found the house in which Percy Bysshe Shelley and his wife lived for a year in 1817. It was here that he wrote several works and his wife wrote that weird and fantastic work entitled "Frankenstein," a word that is now often used to denote anything invented by man that eventually engulfs or destroys its inventor. The house now bears a plate stating that Shelley lived here and was here visited by Lord Byron—another feather in Bucks' poetical cap, even though the fact is strenuously denied. Almost as far to the north as Horton is to the south, we come to Olney, where William Cowper lived. His house is still to be seen, but the town and the scenes he described have changed considerably since his day. Edmund Waller was born at Coleshill, near Amersham. An old oak tree near the Manor House is still called Waller's Oak, and by a strange coincidence there was a Milton's Elm at Chalfont; there is a tree intimately associated with Gray in Stoke Poges churchyard, and north of Olney there is the Yardley Oak, immortalised by Cowper in a poem of that name.

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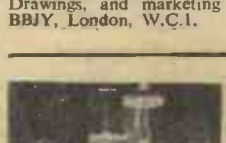

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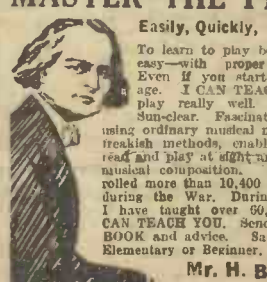

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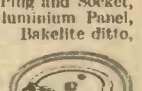

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Published about the 30th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and Printe in England by The Newnes and Pearson Printing Co., Ltd., Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand—Gordon & Gotc Ltd. Sole agents for South Africa—Central News Agency, Ltd. Subscription Rates (including postage), Inland 10s. 6d. per annum. Abroad, 10s. p annum. Canada, 10s. per annum. Registered at the G.P.O. for transmission by Canadian Magazine Post.