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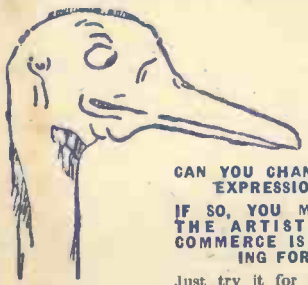

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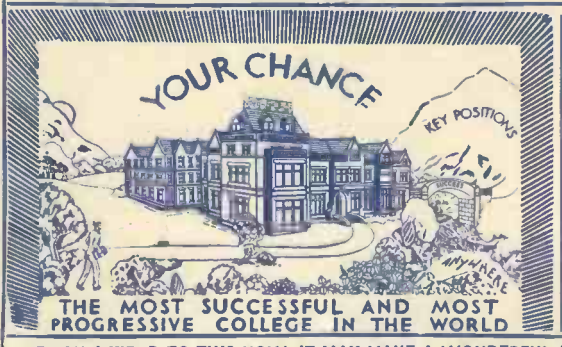

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PRACTICAL MECHANICS

Owing to the paper shortage "The Cyclist" and "Home Movies" are temporarily incorporated

Editor : F. J. CAMM

VOL. IX. DECEMBER, 1941 No. 99

FAIR COMMENT — BY THE EDITOR

The Country Needs Your Waste Paper—Urgent

EVERY reader knows that there is a serious shortage of paper. Wood pulp, which is the chief raw material for paper making came from Scandinavia, which country supplied the larger part of world demand. That supply, owing to the war, has stopped, and ships cannot be spared to bring the material from the other side of the Atlantic. Waste paper is, therefore, urgently wanted for vital national needs. Waste paper is re-manufactured into new paper which is needed for scores of uses directly connected with the war effort—shell containers, shell fuse components, mine assemblies, dust covers for aero engines, cut-out targets, boxes for aero cannon shells, cartridge cases, for radio sets, machine gun belts, and even for wall boards for building Army huts.

I want to enlist your help urgently in a great round-up of all the waste paper hoards in the country. Believe me, there are hundreds of thousands of tons to be obtained in this way if we all put our backs into the job. I want you to do that.

Turn Out Your Old Books

YOU have a hoard of paper at home which you will not need again; it may be in the loft, the garden shed, on your bookshelf, in some cupboard under the stairs. Carefully go through it and throw away those old magazines, newspapers, and bound volumes for which you have no further need. A couple of hours spent in this way will provide a useful supply from your home alone. Do not imagine that your contribution, however small, is not worth worrying about. It is. You have not much to do to collect it and place it neatly stacked by the dustbin. The local authorities or the boy scouts, or the girl guides, will collect it. The Ministry of Supply wants 100,000 tons of waste paper quickly. At present we have to employ 25,000 tons of shipping in order to import from abroad paper for the purposes I have enumerated. If we can collect the waste paper in this country that tonnage can be diverted to the important purpose of carrying munitions to Russia. Every class of waste is needed—back numbers, books bound and unbound, novels and sheet music, old picture postcards, Christmas cards, price lists, catalogues, almanacks and time tables, odd rolls of wall paper, cardboard boxes, cartons, cigarette packets—in fact, anything which is paper or cardboard. There is not one household which cannot contribute its quota, for paper and cardboard exists in every home. Waste paper is now a precious war material, and I want you to respond to my appeal at once.

From Cellar to Attic

IF you cannot conduct the search yourself, get your wife or a relative to do it for you. It will provide you with an opportunity for a glorious purge of useless material occupying valuable home space. Perhaps your wife, your mother, or a relative can be persuaded to have an early spring clean *now*. from cellar to attic, searching every drawer and cupboard, and turning out every scrap of waste. Search the bookshelves; they harbour worthless volumes which will never be read again, but have been perched on the shelves for years. A large tonnage can be obtained from old and unwanted books. There should be a regular and systematic collection of all current waste paper, such as newspapers, periodicals, magazines, and wrapping paper.

All local Councils have been instructed to organise the collection of waste paper. It is in their interests to do so, for it helps the rates, as Councils are paid for the waste paper, and after deducting the collecting and sorting costs, there is a useful balance to go towards the relief of rates. If you are a reader of this journal, and find that your Council is not promptly and effectively making these collections, you should write to me as follows:—F. J. Camm, Practical Mechanics, Tower House, Southampton Street, Strand, W.C.2, marking your envelope "Waste Paper." I will then see that every case is reported to the Ministry of Supply. Unfortunately, in the interests of economy, I cannot acknowledge every letter, but I give you my assurance that every complaint will be taken up in the proper quarter. It is important to remember that waste should not be placed in dustbins where it is likely to become dirty, wet, and useless. Stack it in a dry place, tie it up in bundles to facilitate easier handling, and if you can find the time do a little sorting. Keep the newspapers, the periodicals, and all kinds of white paper separate from cardboard, white paper, brown paper and other paper. This will greatly help the sorting authorities.

When you turn out your correspondence, and your private files, do not fear that your letters will be read. If you have such a fear, tear the correspondence up—the paper mills will not mind. If you do not wish to do this, rest assured that your correspondence will be torn up by those who have no time to read it.

Another point—readers are urged to be thrifty in using paper. I should not be devoting space to this appeal did I not know that the country's need is urgent and vital. I ask you to heed my appeal *now*.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

Index to Volume 8

NOW that technical information on all subjects relating to the war is sought by those in the Services, and those engaged on munitions, it is more than ever important that readers of technical journals should be able to save valuable time by consulting indexes of the periodicals containing the information. This, and our associated technical Journals have performed, and are still performing, valuable war work. It is more convenient to have your volumes bound, but if you do not wish to do this, you should certainly obtain a copy of the index which may be obtained for 9d. from The Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Binding cases and indexes may be obtained for 5s. from the same address.

Lord Mayor's Air Raid Distress Fund

APROPOS the Lord Mayor of London's appeal for funds to enable him to continue his work of providing for those who have suffered as a result of air raids, when sending funds to the Mansion House, London, E.C., envelopes should be marked "Thank Offering." Remember the slogan, "Penny a day for a peaceful night, 2d. a day for a blitz." The money should be stored and sent to the Lord Mayor, say, every quarter.

How Flowmeters Work

The Principle of Operation of Various Types of Meter Manufactured by Elliott Brothers, (London), Ltd., for Steam, Water, Air and Gases

Fig. 1. Indicating float-type flowmeter

MOST readers are acquainted with the ordinary gas meter as installed in a house or factory for recording the amount of gas consumed, but there are many other variations of this type of meter used for recording the flow of steam or water.

For example, in a large steam plant the use of a flowmeter enables every part of the plant to be kept under perfect control. As compared with the pressure gauge, the steam flowmeter enables fluctuating demands to be much more accurately followed by the boiler plant. The use of flowmeters in Gas Works, and in connection with Water schemes, ensures greater reliability of service, and permits of the proper determination of supply charges.

Principle of Operation

The measurement of the flow of liquids or gases in a pipe is now almost universally carried out by what is known as the principle of differential pressures, a practical application of Bernouilli's theorem. This theorem put simply, states that the pressure and the square of the velocity in a given pipe line are related inversely, or in other words, the greater the velocity of the flow, due to a reduction in cross-sectional area, the lower the pressure.

In actual practice, a restricted area is placed in the flow. The difference in pressures at the full diameter of the pipe and the point of maximum velocity (known as the "vena contracta") is then proportional to the square of the rate of flow in the full pipe.

In Fig. 4 it will be seen that the difference between positive and negative pressures is greatest when the downstream pressure is measured at the "vena contracta" which occurs just beyond the orifice or restriction. This pressure difference, shown in the mercury manometer below the pipe, is used for the measurement of flow. It will be observed, also, that the pressure in the pipe rises again after the orifice plate until it is practically the same as before at a point about four pipe diameters beyond. Some small proportion, however, has been permanently lost in the form of heat depending upon the amount of restriction offered to the flow by the orifice. A usual figure for this loss is about 50 per cent. of the pressure difference created by the restriction and used for the measurement of the flow.

Where the initial static pressure is low and does not permit of even this small loss, a Venturi tube is used. This is a length of pipe, so shaped that the fluid is made to pass through a restricted bore without any turbulence, thus preserving stream line flow. The recovery of measuring head or differential pressure may then be as high as 90 per cent. These pipe orifices and tubes are described in detail later.

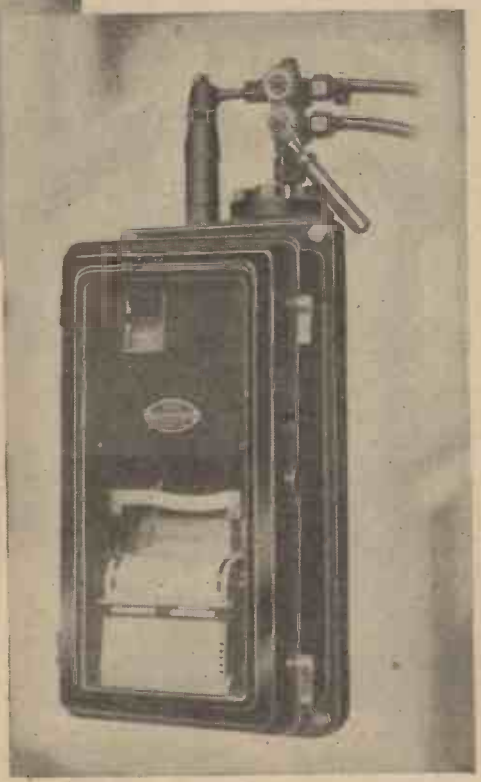


Fig. 2. Recording float-type flowmeter.

Owing to the square law relation between rate of flow and differential head, it is necessary to provide a conversion gear to obtain an evenly divided scale. With instruments of the type described, this is done by means of a suitably shaped cam (F). (See Figs. 3 and 5.)

Float Type Flowmeters

In the Manometer, shown in Fig. 5, the meter body is in effect a U tube made from solid drawn and welded steel parts, containing a quantity of mercury (A). The points (L) and (H) are connected to the pipe line on either side of the orifice— (H) being the high pressure side.

A cast-iron float (B) rests in the mercury in one arm and its rise and fall, according to the corresponding flow, operates a rack and pinion (C) which in turn actuates the indicating pointer (D) or pen arm through a magnetic coupling (E). Special care has been devoted to the accurate construction of the transmission gear, from the inner pressure chamber containing the full working pressure to the external indicator or recorder.

In many other makes of similar meters the movements are transmitted by means of a stuffing box or gland which always gives variable friction losses and impairs the sensitivity of the instrument. With the magnetic coupling in this case the pressure chamber is entirely closed off from the indicator. This arrangement is highly satisfactory and confers on the meter a high sensitivity.

A system of automatic valves is also provided to protect the meter against reverse flow, overloads and sudden fluctuations of an extensive nature (G). In point of fact the greater the overload, the more firmly the valve is kept closed ; on the conditions becoming normal once again, however, the valve opens immediately. The meter is thus most adequately and reliably protected.

Three ranges of differential pressure heads can be supplied as standard, viz., 1.5 metres, 3 metres and 6 metres of water, and these are to a limited extent interchangeable, having removable negative chambers.

The cocks, which are fitted as standard in all these meters, are of robust construction and easy operation. The two cocks, one for each of the pressure pipe connections, are mechanically connected together by a lever. One movement of the lever through 90 degrees closes both valves from the full "on" to full

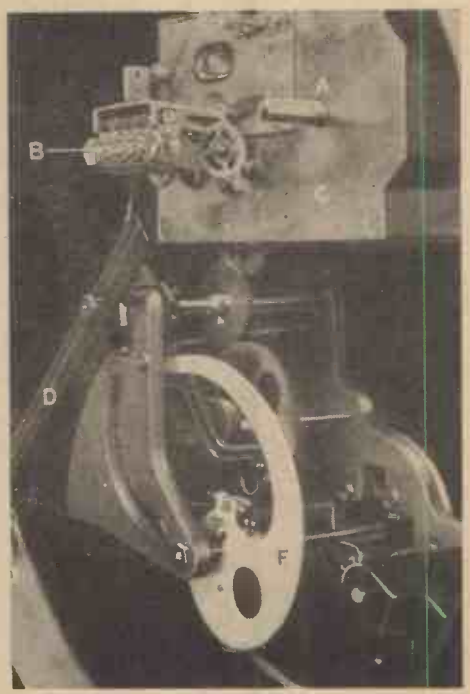


Fig. 3. Interior of indicating float-type meter, showing integrator.

"off" position and at the same time connects the two sides of the manometer together, thereby equalising the pressures in the "off" position and bringing the pointer to zero.

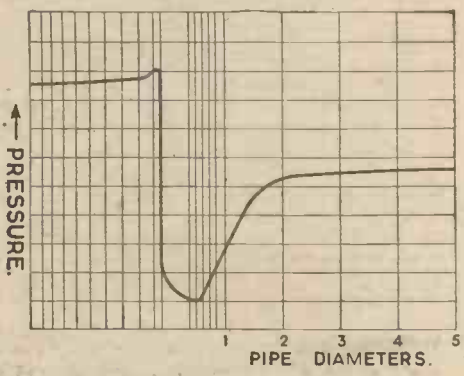
Indicating Meter

The general appearance of this instrument is shown in Fig. 1. The dial is 12 inches in diameter, with a scale angle of 270 degrees and approximately 24 inches in length, the bold marking and clearness of the dial making it very easy to read at a distance. This instrument can be supplied for working pressures up to 1,000 lbs. per sq. inch, and the scale is evenly divided from 1/10 full flow upwards.

The instrument is suitable either for wall mounting or flush panel fixing.

Combined Indicating and Recording Meter

In this meter (see Fig. 2) the recorder is of the continuous chart type, having a pen which enables an unbroken line record to be obtained on the chart. Each chart roll lasts one month at a speed of 1 inch per hour, the useful width of chart being 3¾ inches, and decimally divided for normal supply. Specially calibrated charts, corresponding to the particular instrument with which they are to be used, can be supplied at an extra cost. *The charts have rectangular co-ordinates* and are, therefore, much easier to read than those with curved timing and calibration lines. The standard instrument is fitted with a hand-wound spring-driven 8-day clock, but an electrical synchronous clock can be provided, if desired, at the same price.



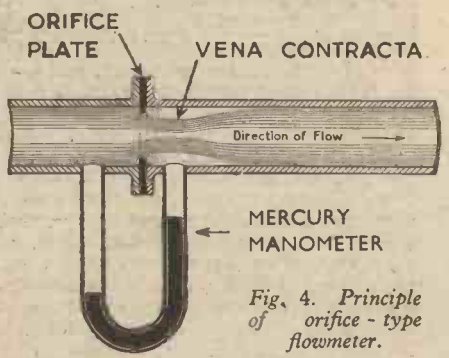


Fig. 4. Principle of orifice-type flowmeter.

An arrangement is also provided, as standard, whereby the speed of the chart can be quickly altered when the instrument is required to record very rapid fluctuations in the flow. In addition to the chart and pen, an indicating scale is provided. The instrument is suitable for flush mounting or for wall fixing.

Integrator

An integrator of the direct-reading cyclometer type can be fitted to either the Indicating or Recording Meter (see Fig. 3). This additional accessory is normally supplied with a hand-wound spring-driven clockwork, but can be arranged with synchronous motor electric drive, if desired, at the same price. In Fig. 3 (C) is the clockwork, (A) the winding square, (E) the stop-start mechanism, and (B) the five-figure counter.

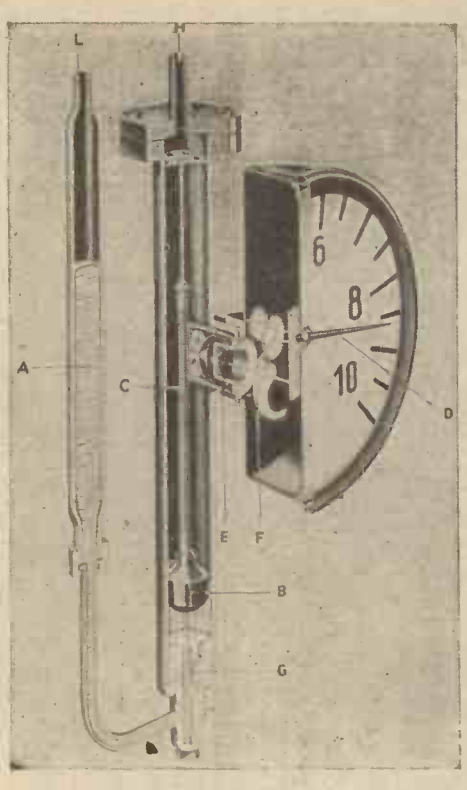


Fig. 5. Section through float-type flowmeter.

Corrections for Temperature and Pressure

In the construction of these steam meters it is assumed that the measurement is only correct if the steam behaves as a perfect gas.

If, when the steam flowed through an orifice or Venturi tube, the pressure, volume and temperature remained constant, then the volume of flow would be obtained from the relation

$$Q = C\sqrt{\frac{H}{\mu}}$$

where Q = Flow in lbs. per hour.
H = Differential pressure head in inches water column.
C = A constant dependent on the ratio of diameters of orifice or Venturi throat to pipe,
and μ = Specific weight of steam in lbs. per cu. ft.

The small adiabatic variation of condition arising from the steam flow through the orifice is taken into account in the calibration of the instrument, and the meter is arranged for a definite steam temperature and pressure which should correspond as nearly as possible to the average working conditions.

If, however, the working temperature or working pressure or both vary, then the value of μ in the equation alters. These variations are relatively small under normal working conditions and can be practically balanced out.

The various mechanical correction gear applied to some varieties of steam meters only complicate the mechanism and thereby lessen the reliability of measurement. For this reason, both mechanical pressure and temperature correction apparatus are considered unsuitable, and are, therefore, superseded in this case by easily read correction charts.

Summary of Types

The various types of instruments may be summarised briefly as follows:—

Indicating Flowmeter.
Combined Indicator and Integrator.
Combined Indicator and Recorder.
Combined Indicator, Recorder and Integrator.

These instruments may be situated up to 75 yards away from the orifice or Venturi tube, the pressure connections being made in small bore copper or steel pipes. For greater distances electrical transmission must be used.

Ring Balance Meters

The measurement of weight by balance is the most sensitive and accurate method known, and Ring Balance Meters, which operate on this principle, are suitable for the measurement of flow of gases or air at very low working pressures.

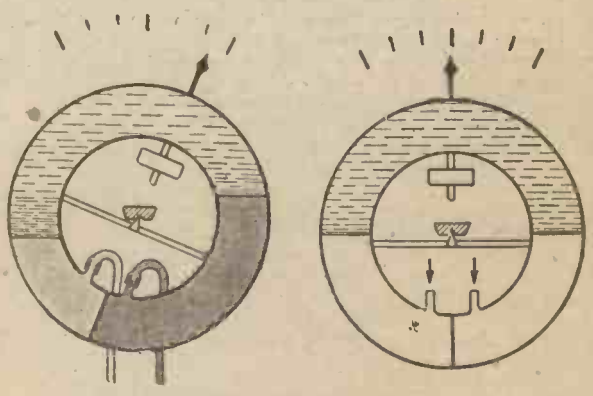
In the case of the Float-Type Meters, previously described, the smallest differential pressure for full scale deflection is 1½ metres of water, but with the Ring Balance the pressure difference may be as low as 36 mm. of water column. This is an immense advantage when the working pressure in the pipe line is small, and where it is undesirable to lose any appreciable pressure due to a relatively large restriction. It also enables an orifice plate to be used where it would be very difficult to arrange for the insertion of a Venturi section.

Construction and Operation

The Ring Balance is a drum, pivoted on knife edges, half-filled with liquid and provided with a counterweight. The space above the surface of the liquid is divided into two by a partition, the pressures to be measured being conveyed to the two spaces by means of flexible tube connections. The drum is therefore, in effect, a U-tube, balanced on knife edges (see Fig. 6).

When the two pressures differ from each other, due to an alteration in draught, or flow through the orifice plate, the liquid is displaced, but the drum rotates until the counterweight in its new position balances the difference between the two pressures. The angle through which the drum has revolved is then a measure of the pressure difference which caused the displacement. The accuracy is not affected by the quantity or specific gravity of the liquid used (see Fig. 7).

(To be concluded)



Figs. 6 and 7. Diagrams of ring balance meter.

Two-Stroke Aero Engines

Their Principle of Operation, and Notes on Supercharging

By S. J. GARRATT

ENGINES working on the two strokes per cycle principle are found among the largest and smallest internal combustion engines. Two-cycle Diesel engines are frequently used on ships in which the power developed runs into many thousands of horse-power, and at the other end of the scale there are auto-cycle engines, also employing the two-stroke principle, with a cylinder volume of less than 100 c.c. Why is it, then, that aero engines always work on the four-stroke cycle?

The answer is undoubtedly that the highest all-round efficiency is required in aero engines, and that an enormous amount of research work has been put into the development of every conceivable detail of the four-stroke engine, with the result that it is in a far more advanced state than the two-stroke. Whether a similar amount of research work on two-strokes would bring them up to the present level of the four-stroke for aero engines is a questionable point.

Auto-cycle Engine

In the case of the tiny auto-cycle engine referred to, simplicity is the ruling consideration, with a view to cheap production, and the engine has only three moving parts, i.e., piston, connecting rod, and crankshaft. It is not important in this case that a considerable proportion of the fuel supplied is wasted, but in aero engines avoidable waste of fuel cannot be tolerated, as it means a reduction in load-carrying capacity, and range of action, or both.

Marine engines run at a comparatively slow speed, and so allow more time for the working charge to get into and out of the cylinder. Weight is not a primary consideration, although of importance, but it is essential that such engines should be economical in fuel consumption. With aero engines, however, both these points are of first importance.

Now the power developed by an internal combustion engine depends upon the amount of air it can consume. Any means which ingenuity can devise to increase the weight of air properly burnt by the engine per unit of time will result in an increase of power. Of course, a proportionate amount of fuel is required to supply heat to this air, but it is the weight of air that is the limiting factor to the power developed, not the quantity of fuel.

Supercharging

An increase in r.p.m. then will result in more air being used, and a consequent increase of power without increase of weight, except inasmuch as it is necessary to strengthen certain parts for mechanical reasons. Furthermore, supercharging crams more air into the cylinder with a similar result, i.e. more power, though in this case there is a definite increase of weight due to the supercharger, and its drive. Hence, in aero engines the highest possible r.p.m. and supercharging are both necessary, the latter, of course, being particularly required at high altitudes.

The above remarks apply equally to four-stroke and two-stroke engines, of course, but in both cases an increase in r.p.m. means that there is less time for the air to get into the cylinder, and it is in this connection that the four-stroke has an advantage. Consider such an engine running at 2,400 r.p.m., i.e. 40 revs. per second. The inlet valve will probably be off its seating for say 220 crankshaft degrees, so that the time available for air to enter the cylinder is $\frac{220}{360 \times 40} = .015$ seconds. In a two-stroke cylinder the duration of opening of the inlet ports would be about half this, i.e. about 110 crankshaft degrees. If the effective port opening were the same in both cases, the two-stroke would require to run at half the speed of the four-stroke to get the same quantity of

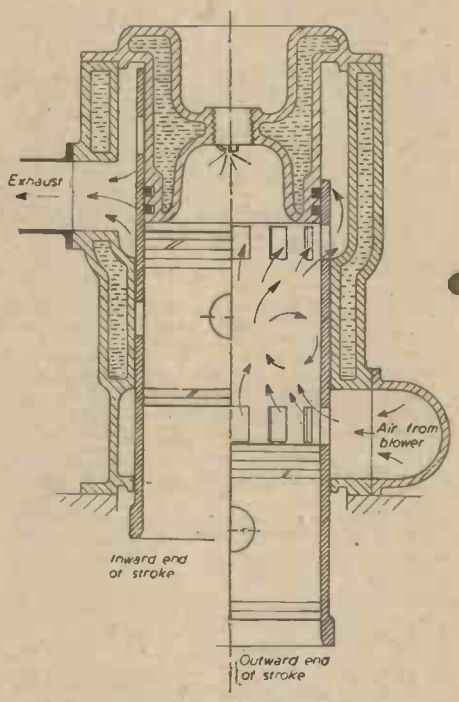


Fig. 1. Sectional diagram indicating cycle of operations in a sleeve-valve engine.

air per stroke into the cylinders, but in cylinders of moderate dimensions (compared for instance with marine engines) the port area per unit of cylinder volume can be greater in the two-stroke. Furthermore, as the two-stroke engine has to be forcibly fed by means of a blower of some sort (the small three-port type of engine uses its crankcase as a charging pump), the mass of air that can be passed through the

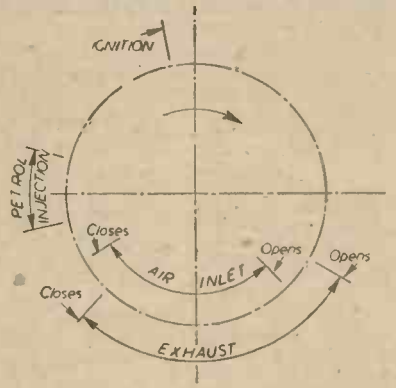


Fig. 2. Timing diagram.

inlet ports can be increased by putting up the blower delivery pressure, so there should be no real difficulty in getting sufficient air into the cylinders, even at high engine speeds.

Power is, of course, required to drive the blower, but all modern four-strokes are fitted with blowers for supercharging, and as the same blower would be required for normal charging, and for supercharging, it would not be a fair comparison to debit the whole of the blower power as an extra for the two-stroke. The exhaust-driven turbo-supercharger would seem to be particularly suited to the two-stroke, because besides maintaining ground level conditions on the inlet side, it does so also on the exhaust side, thus assisting to maintain the density of the new charge in the cylinder. Obviously, this must not be carried to such an extent as to interfere with cylinder scavenging.

Sleeve-valve Engine

A sleeve-valve cylinder which might form the basis of a two-stroke engine design is shown in Fig. 1. The sleeve has a simple reciprocating motion only, there being no need for the combined reciprocating and rotary motion as with a single sleeve four-stroke. The sleeve moves generally in the same direction as the piston, which is an advantage to mechanical efficiency. The exhaust ports are at the top end, and they open and close before the inlet ports, as shown by the timing diagram, Fig. 2.

Air only would be supplied by the blower, and petrol is injected into the cylinder early in the stroke. Ignition would then be electric, though there appears to be no reason why such an engine should not use compression ignition.

The greater heat flow to the cylinder walls in a two-stroke would probably make liquid cooling essential, and this has considerable bearing on the cylinder arrangement. A radial engine does not lend itself very well to liquid cooling, but presents no problems of balance, while a "straight row" or "in line" cylinder arrangement can be jacketed more readily, but introduces problems of balance which do not arise in the usual four-stroke. A 6-cylinder four-stroke engine, for instance, has its pistons moving in pairs, but if a two-stroke engine has its pistons moving in pairs they will both be firing at the same instant. This results in an increase in the $\frac{\text{max.}}{\text{mean}}$ torque ratio necessitating heavier mechanical construction, and a higher weight per horse-power.

Junkers Two-stroke Engine

The German "Junkers" two-stroke engine gets over this balancing problem by employing two pistons per cylinder, one at each end, and no cylinder head. There are two crankshafts geared to a common airscrew shaft, which results in a very heavy engine. This Junkers engine, however, is probably not intended as a serious competitor to the four-stroke, but is more likely an effort to gain experience for further research and development.

Running Cars on Coal Gas

Some of the Problems Connected with the Simple Conversion of Vehicles to Operate on Low-Pressure Town Gas

By E. A. C. Chamberlain, Ph.D., D.I.C.

(*Continued from page 45, November issue*)

The Gas Carburettor

It is, perhaps, unfortunate that the name carburettor should have persisted, since it is not an apparatus for adding carbon to the gas. However, the word has been universally accepted for its petrol counterpart, and the phrase "air gas proportioner" is too clumsy for general use and "mixer" has been found to cause some confusion when dealing with the motor trade. The minimum requirements of a gas carburettor are:—

1. To give a constant air gas ratio over the whole range of operation.
2. To cut off the gas when the engine is stationary.
3. To give immediate response to throttle variations.
4. To provide easy starting, steady idling, and freedom from stalling on disengaging the clutch or after braking.
5. To have a low intrinsic resistance to gas flow in order to permit as large a volume of explosive mixture as possible to be drawn into the engine.

All these requirements must be fulfilled; and while they may not offer a serious problem if the design of the carburettor is considered in conjunction with a particular engine, the problem is complicated by the necessity of producing a carburettor that can be fitted to engines of widely different design and horse-power. For this reason it is essential that the gas carburettor should be capable of adjustment over a wide range of air gas ratios.

Several suitable carburettors are available which fulfil these conditions, and, as an example, Fig. 1 illustrates the G.L.C. No. 2 carburettor, suitable for use on engines developing up to 60 b.h.p. Its method of operation is as follows:—

The suction of the engine moves the piston (1) against the spring (2); air then enters through the adjustable air ports (3) and the corresponding slits (4) in the piston. Gas enters through the annular space between the cone (5) and the piston. The fuel air mixture passes to the engine via the butterfly control (6) or the petrol carburettor adaptor (7).

The fuel air ratio is determined by the angle of the cone: the larger the angle, the richer the mixture. A trimming adjustment for the air-gas mixture is provided by the air shutter. The cone has a short parallel section to enable the mixture to be adjusted for slow-running conditions. Withdrawing the cone enriches the mixture at low engine speeds only, and this adjustment should not be used to increase the gas supply under load conditions, as correct air gas ratio will not then be maintained. It should be remembered that with gas there is no condensation of the fuel in the induction system when starting a cold engine, and that there is, therefore, no need for a choke or other means for obtaining a temporarily rich mixture.

The first gas fuel car in the West Country being filled at the Plymouth city gas works in 1939.

Method of Fixing the Carburettor

Experience with many different types of vehicle, especially those with engines fitted with S.U. petrol carburettors, has shown that the most satisfactory method of fixing the gas carburettor is by means of a tee fitted into the air intake of the petrol carburettor. One limb of the tee carries the gas carburettor with a bush (Fig. 1), and the other limb a release valve which can be tripped in the open position to act as the air inlet when running on petrol. This method of fixing is shown in Fig 2. By this means no alteration is made to the throttle control and the slow-running adjustment of the throttle remains the same for both petrol and gas. In addition it is unnecessary to seal off the gas carburettor when running on petrol.

The alternative method of fixing is to make a connection direct into the induction manifold by means of an elbow using the butterfly fitting (Fig. 1). This method entails fixing alternative throttle controls, and it has been found to increase the probability of air leaks through the petrol carburettor, with consequent difficulty in maintaining correct air gas ratio control. In our opinion this method should only be adopted when the first cannot be used.

Two-stroke and Single-cylinder Four-stroke Engines

Engines of these types do not operate satisfactorily with the standard G.L.C. carburettor, since the suction in the induction manifold is discontinuous and the carburettor slider tends to oscillate with the engine piston. The problem has been solved by fitting the gas carburettor in the petrol carburettor air inlet, as in a normal engine, and operating the gas carburettor slider by a Bowden control fitted in series with the petrol carburettor butterfly throttle. This method has proved very successful on Trojan vans and on single-cylinder portable generating sets.

The Gas Container and Auxiliary Equipment

Before discussing road results after conversion, it is necessary to consider the equipment needed for carrying the gas on the vehicle, since the design and construction of the gas bag and its support have a marked effect on performance. When designing the gas container, the bag and the crate must be considered as an integral unit which must fulfil the following conditions:—

1. The bag must store sufficient gas to give a reasonable mileage between fills.
2. The bag must at all times be under control, so that it collapses regularly and at no time must the material block the gas outlet.
3. The bag and crate must be constructed so that strain due to wind

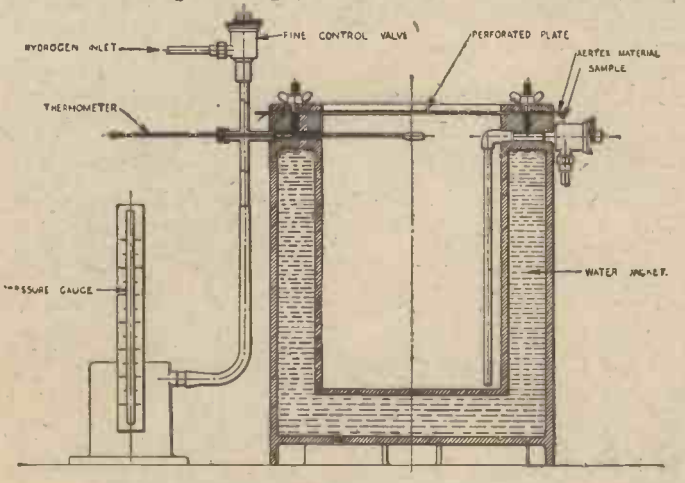


Fig. 8. *Diffusion cell for testing gas-bag fabric.*

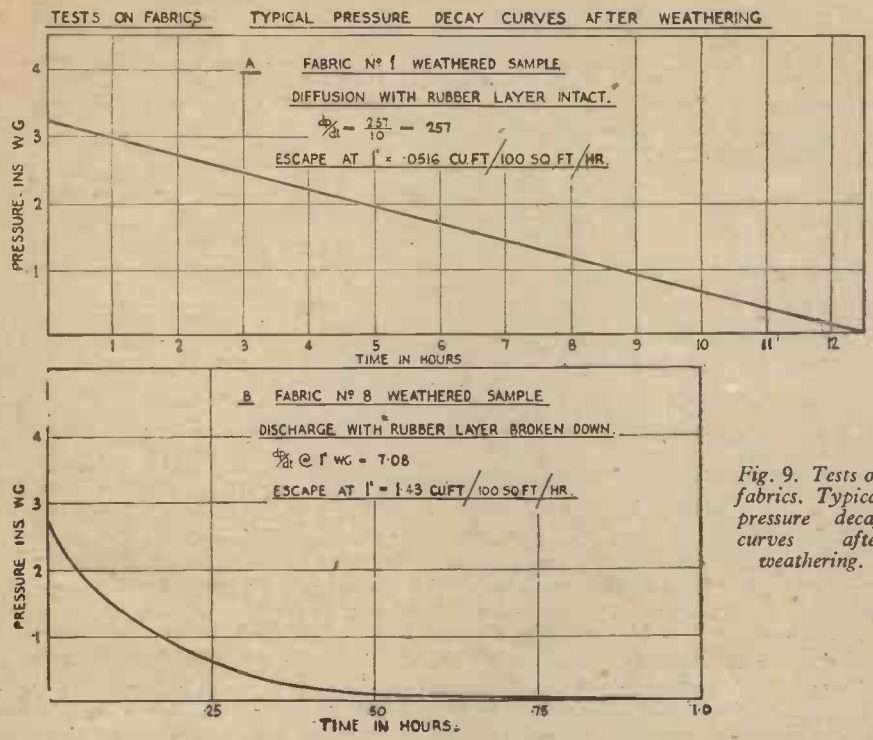


Fig. 9. Tests on fabrics. Typical pressure decay curves after weathering.

currents when the vehicle is in motion is reduced to a minimum.

4. The friction between the bag and crate must be as little as possible, and the bag should be reinforced wherever rubbing cannot be avoided.

Of these conditions, numbers 2 and 4 provide the most difficult problem, particularly as they are largely interdependent. Much experimental work has been done to ensure that the gas bag collapses inside the crate in such a way that the bag can be completely emptied without the gas outlet becoming blocked by the fabric. With the wooden box crate of the type shown in the illustration (Fig. 3) this object is achieved by leaving the front of the box open so that wind pressure acting on the front of the bag forces the gas to the back. The gas connection is then made at the back of the bag, the fabric being supported on the sides of the box in the vicinity of the outlet to prevent it becoming blocked when the bag is nearly empty. If a solid front is fitted to the crate, not only is the wind resistance increased—a point which will be considered later—but eddy effects when the vehicle is in motion produce no regular pressure on the bag which may collapse at any point, a fact which makes the location of the gas outlet difficult. The difficulty may be overcome by fixing perforated tubes along the floor of the bag connected to the gas outlet or by placing a cane basket over the outlet inside rhs bag; but it is far simpler to adopt the system first described.

A considerable number of experiments have been made on retaining devices for the bag. These have included hinged arms along the sides of the box connected by elastic to wooden slats passing through pockets running across the top of the bag. Experience with a fleet of Morris 12/4 vans has shown that none of these methods can be considered satisfactory. The chief fault lies in the fact that when the bag is partially deflated and the elastic becomes slack, the movement of the vehicle tends to set up a wave motion of the transverse wooden slats, and this rapidly increases in intensity; as a result, the bags are found to suffer abnormal abrasion and to tear quickly.

The practical solution of this problem is shown in the sketch (Fig. 4). The crate is about 14 in. high; the floor should be of three-ply or made by fixing battens at about 1 ft. intervals across the crate, passing through pockets in the base of the bag. The bag is fixed at each of the bottom four corners of the floor and elastic retaining ropes are fitted as shown in the illustration. By leaving the front of the crate open and taking the gas connection from the near side rear corner in the manner shown, the bag fabric cannot block the gas outlet.

The Walsh Collapsible Crate

An interesting type of container is that shown in Fig. 5. The action resembles one unit of a concertina. The bag is held between two rigid angle-iron frames which remain in parallel planes relative to each other, irrespective of the quantity of gas in the bag. By this means the bag is completely under control at all times. With a bag of this type the gas outlet can be taken from any point of the base of the bag, but it must be understood that the near rear side corner outlet should be adopted whenever possible, since this offers constructional advantages when making the gas connections and fitting the filling valve. A further advantage of this sytem is that when collapsed, the bag occupies a minimum amount of headroom, and offers practically no wind resistance when in this position.

Gas Bag Capacity

From the figures obtained on the Austin 16/6 engine the ratio of the thermal efficiencies of No. 3 petrol and gas are:—

Thermal efficiency gas/thermal efficiency petrol =

$$\frac{18.5}{19.4} = 0.954$$

The calorific value of No. 3 petrol is given as 1.505 therms per gall. The number of cub. ft. of gas equivalent to a gallon of petrol is, therefore, approximately:

$$\frac{1.505}{0.954} \times 200 = 315 \text{ cub. ft.}$$

In practice it is desirable that at least 20 miles should be covered with one filling, and the following figures indicate what bag capacities are required for various h.p. vehicles to give this mileage:—

H.P.	Approximate M.P.G.	Approximate capacity of bag cub. ft. to give 20 miles.
8	40	150
10	36	175
12	24	260
16	20	300
20	18	350

It should be mentioned that it is the practice not to exceed a pressure of 2-in. water gauge (0.072 lb. per sq. in.) inside the gas bag, and a pressure cut-off should be fitted in the supply pipe at the filling station to shut off the gas when this pressure is reached. This precaution is taken in order to avoid strain on the bag fabric and to prevent the over-enrichment of the air-gas mixture which would occur while the gas was under pressure just after filling.

The following data obtained during tests shows the most convenient size bag that can be fitted to various makes of vehicle and the mileage that can be expected per bag.

Resistance Due to Wind Pressure on the Front of the Bag

The pressure on a flat surface exposed at right-angles to the wind direction is given by the equation;—

$$P = \frac{5GaV^2}{8g}$$

P = pressure in lb. square foot.
Ga = weight of 1 cub. ft. of air at N.T.P. = .0807 lb.
V = velocity in ft. per sec.
g = gravitational constant 32.2.

The total pressure in lb. on a flat surface A sq. ft. in area travelling at S miles per hour in a still atmosphere will therefore be

$$P = A \times .00334 \times S^2$$

Hence the total horse-power required to overcome the wind resistance at S m.p.h. is given by

$$\text{H.P.} = A \times .00334 \times S^2 \times .00267S$$
$$= A \times S^3 \times 8.9 \times 10^{-6}$$

(To be concluded)

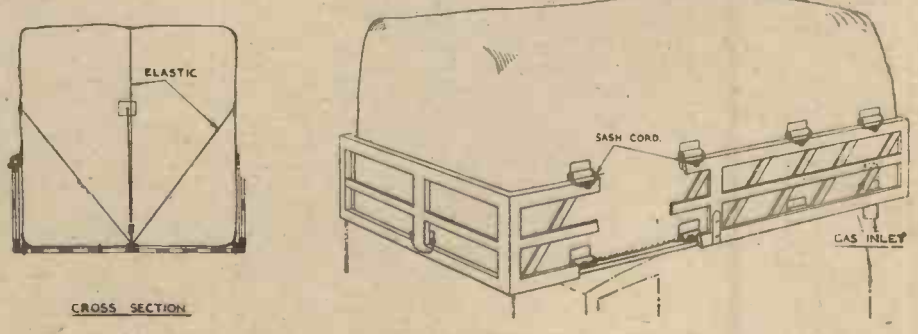


Fig. 10. A new type of crate for holding the gas bag. This is an improvement on the arrangement shown in Fig. 4.

Beaufort Bombers commencing a flight—to attack enemy shipping.

The World of Aviation

World's Largest Flying Boat : A Mahogany Aeroplane : New Aero-Engines : New American Fighters : Aero-Photography : Flying a Halifax Bomber : Target Shooting.

World's Largest Flying Boat

KNOWN as a "Battleship of the Air," the biggest flying boat in the world, weighing 70 tons, will soon make its first flight in the United States. It is known as the XPB2M-1, and its construction was started a little more than a year ago at the Glenn Martin Company's Baltimore works. It has a two-deck hull and a wing span of 200 ft. The four Wright Duplex Cyclone engines develop 2,000 h.p. each. Armament is, of course, secret, but it can be said that the ship carries a number of power-operated turrets. The machine was designed for high altitude operations, and should be able to keep above the effective range of anti-aircraft fire. The 'plane will be able to fly non-stop across the Atlantic and back.

A Mahogany Aeroplane

AN aeroplane made of laminated mahogany, which is stuck together with plastic glue, has been built in New York. It has two tiny 65 h.p. engines, cruises at 125 m.p.h., and carries four people. The cost of operating the machine for an hour is stated to be 10s. The Langly Aviation Corporation will mass produce the plane, and the president of the Corporation, Mr. C. S. Bragg, stated that the wood process was the answer to any metal shortage.

Casting Engine Parts

HENRY FORD hopes to double his output of aero engines by using cast engine parts. He is experimenting on a 12-cylinder, liquid-cooled 1,800 h.p. engine with cylinders and crankcase cast in a single block, using cast pistons and cast cylinder liners.

Gliders to Fuel Bombers

THE British Air Commission has asked American glider makers for specifications of a "flying gas tank" for fuelling bombers after the take-off. According to American Aviation, the plan is for a glider carrying 500 gallons or more fuel to be attached to a heavily laden bomber about to take off. As the bomber gains speed with its fuel wagon in tow, the glider will soar above it and transfer its load of fuel, afterwards cutting loose and returning to the starting point.

Tail-less Fighter

THE United States is now building fighter planes which have no tails and no fuselage. The aircraft is known as the "Northrop Flying Wing," and has its engines built into the wings. The cabin is in the nose of the plane, two gun turrets are built into the top of the wing, and movable tips on either side of the wings serve as rudder and ailerons. The inventor, John Northrop, is a leading aircraft designer and head of the Northrop Aviation Company of California. It is claimed by the manufacturers that they are the first to build such a plane, and they expect it will attain greater speeds than ordinary planes, and that it will be easier to manoeuvre.

Latest American Fighter

IT is claimed that the latest American fighter is the fastest and most formidable in the world. The Vought-Sikorsky Thunderbolt P-47 single seater is powered by a new Pratt-Whitney 2,000 h.p. air-cooled engine, and carries a heavy armament. Performance figures are secret, but an American test pilot estimates its speed to be in the region of 400 miles per hour.

A "Bergy Bit"

HOW big is an iceberg? Very few people, probably, could answer that question, but that is just one of the curious pieces of knowledge that pilots of the R.A.F. Coastal Command have to possess. Some of their flights take them far into the Arctic Circle, and they must send back reports on what is happening to the ice up there. So that these reports may be strictly accurate, the pilots and navigators have learned the traditional ice terms current for centuries among the fishermen of the far north. The answer to the question about the size of an iceberg is that it is "a mass of floating glacier ice rising more than 15 feet above sea level." If it is lower than that, it is not an iceberg, but a "bergy bit." A bergy bit, the pilots are told, is usually about the size of a cottage. There are numerous other technical ice terms. "Brash," for instance, is broken ice in small fragments through which a ship can be forced. "Field ice" is a large area of unnavigable ice whose limits may not be visible from the masthead of a ship. "Growlers" are detached pieces of icebergs or pack ice, almost awash. "Pancake ice," is newly frozen ice, in pieces 1½ to 10 feet in diameter and 2 to 4 inches thick, with slightly upturned edges. The general term for all kinds of soft ice which cannot carry a man, or a seal, is "sludge ice," whereas "slush" is a thin layer of ice crystals covering the sea, so that the ripples disappear and it becomes greyish in colour.

R.A.F. Combat Films for U.S.A.

AUTHENTIC combat films—pictures on 16 m.m. film taken by R.A.F. fighter pilots during actual combat with the enemy—have just been flown out to the United States where they are to be used in American news reels. Their arrival coincides with the first screening in New York of "Target for Tonight"—the epic film of R.A.F. Bomber Command.

The films show the latest type Hurricane fighter—the Mark II, armed with 4 cannons or 12 machine guns—in action against German Flak ships, E-boats and other surface craft. Some of these shots have been included in a Movietone News Reel recently shown in Britain. They give a "pilot's eye" view of

what happens to Nazi shipping when the firing button is pressed, and reveal in dramatic fashion the devastating effect of the Hurricane's new armament. Through bursts of "ack-ack" one sees the whip lash of the fighters' shells and bullets cutting into the vessels, often to leave them "in sinking condition."

Aerial Photography

MANY square miles of territory can be photographed with one click of the shutter by means of aero cameras now in use. It is also possible to show a floating mine from several thousand feet up, and from other pictures it is possible to calculate the height of a ten storey building to within six feet. Camouflage can be pierced and even wilting grass less than an hour old is revealed by air photos with modern cameras.

Fighters Protect Ships

ACCORDING to a recent official announcement, new methods of protection for shipping have been put into operation. Catapults have been fitted to certain ships and fighter aircraft provided to deal with enemy aircraft shadowing or attempting to attack. After being catapulted from the ship, and either shooting down or driving off the enemy, the pilot has to land at a shore base if one is near enough, if not he lands on the sea as close to the ship as possible to be picked up. This new method of attack has already proved successful.

Soviet Radiolocation

SPEAKING recently at Shiregreen Working Men's Club, Sheffield, Professor J. B. S. Haldane said that Soviet scientists had developed radiolocation some years ago to help ships in the Arctic Ocean. That was why Moscow air raids had been beaten off. Dealing with wages in the Soviet Union he said that they varied, but no one received an income of £5,000 a year. The average skilled worker received £15 to £20 a month. A man might have his own house built, said Professor Haldane, but he could not let it and make rent.

How to Fly a Halifax

EVEN the most experienced pilots on two-motor type bombers find there is a lot to learn before they can take over the new four-motor giants now reinforcing the bomber fleets of the R.A.F. Here is how one pilot—a Flight Lieutenant with the D.F.C., who has been on a dozen raids over Germany in the new Handley-Page Halifax—described his sensations on his first Halifax flight:

"I can tell you I was startled when I first looked inside the control cabin. There were more than fifty instruments—it seemed as though there were four of everything. I noticed ten petrol gauges, then the airscrew feathering knobs which adjust the blades, bringing them into line with the direction of the aircraft so that there is the minimum drag, and four extra motors to control these adjustments.

"Before crews take over the new bombers they join what are called "conversion flights." These are courses of training in which they are "converted" to flying Halifaxes—in more senses than one.

"After the change over from two-engined bombers, a crew usually does quite a few hours' practice flying in the Halifax before going on operations. In that time they find that, once the complications of the new bomber have been mastered, it is an easy aircraft to fly." This pilot was enthusiastic about the fire power and armour plating of the Halifax. As for its bomb load—very much greater than that of any of the older two-motor bombers—he said, "they are as unpopular with the Germans as they are popular with their crews."

Two U.S. Dive Bombers

THE R.A.F. Fleet Air Arm will soon have two new types of U.S. dive bombers in operation, which are described as revolutionary. They are the Brewster Bermuda, a two-seater, said to have a high speed and to carry a heavy bomb load, and the Vultee Vengeance, also a two-seater, incorporating features which are the direct result of tactical experience gained by the R.A.F.

Powerful Aero Engine

THE WRIGHT Corporation of New Jersey is now producing in quantity an engine which yields no less than 2,200 h.p. It is the most powerful motor so far built in the United States, and has 18 air-cooled cylinders, and through having a highly advanced form of super-charger, is specially suited for bombers and fighters intended for sub-stratosphere flying.

Loading up a Stirling bomber preparatory to a raid on Germany

R.A.F. Regroup the Stars

THE R.A.F. have made a clean sweep among the tars. Those haphazard collections of stars, the constellations, in which the ancient Greeks could see legendary figures, were not good enough for the R.A.F. The navigators of our bombers, taking altitudes of the stars from the astrodome, and so finding their own position within a few miles at any moment of a thousand mile journey, wanted something better than Heavenly Twins whom even their own mother would not recognise. Therefore, the authorities have simplified the constellations for the navigator into regular and orderly groups of stars which take the bomber straight to Berlin. Even the man in the street has come to recognise certain groups like the Plough or Orion. The R.A.F. have chosen seven simple groups like these, and have found it possible to hang upon them all the stars employed by air navigators all over the world; so that a child can learn the important stars as easily as he learns his rivers, capes and bays.

By means of new charts of the heavens, the air navigators are taught to ignore the great multitude of stars and concentrate on 24, a few of which can always be found in a second, either because they are very bright or because they form part of an easily recognised pattern. So the air navigator now looks out on a rationalised and unromantic sky; there is only one reminder of the mystery which once surrounded the stars, a constellation in the shape of a question mark.

Bomber's Shooting Gallery

THE air-gunner's target may well be Messerschmitt fighter, but sometimes it consists of certain innocent targets, named "drogues." The drogue is simply a twin of the cone-shaped "wind-sock" which flaunts above every aerodrome, in peace time or war. It is white, two to four yards in length and, when filled by the wind, some two or three feet in diameter at its widest end. This object is towed some thousand feet in the rear of another aircraft, whose pilot's main cares are that the towing cable should not catch him by the tail, thereby hurling him into the sea, and that some over-impetuous gunner should not look on *him* as the target. As a precaution he has ready a handsome variety of coloured fireworks to let fly at appropriate moments. White means "Carry on firing." Green "Wait," Red "Cease Fire," and so on. "All ready to go? Right, we're taking off now," calls the captain of the first bomber detailed for the shooting gallery. His aircraft soars into the sky, circles the station and sets off straight across country. Ten minutes later it sweeps a wide arc round an aerodrome where three single-engined aircraft are lined up ready and waiting. The big bomber continues to circle until its captain sees one of the towing-planes taxi and take off below him. Then he sets off for the sea.

In the turrets the gunners are ready, sights set, guns loaded to fire. The bomber sets a course down the bay, parellel with the coast, with the towing aircraft flying level, a little ahead and some three hundred yards away, seawards. The drogue streams behind the small aircraft, surprisingly tiny and far. A white star sails up. "Open fire." their captain's voice tells the gunner.

Rut-tut, rut-tut-tut! go the guns. Dots of gold tracer sail across from turret to target, lag a little behind, then settle well into the target's forward half as the bomber puts on full "boost," and surges ahead past the towing-plane. "Cease fire!" calls the captain, anticipating by seconds a frantic red Verey signal.

The Katzmayr Effect

Notes on Experiments on Dynamic Soaring

By R. H. WARRING

DURING many years spent in the study of aerodynamics and aircraft design, the author has come upon many interesting, but otherwise obscure, phenomena which, after a momentary prominence, are quickly forgotten. Not the least of these is the series of experiments carried out by Von. R. Katzmayr in the early 1920's on dynamic soaring which led to the astonishing conclusion that an aerofoil could experience *negative* drag !

Dynamic Soaring

Dynamic soaring means the process whereby a glider or engineless 'plane may utilise the energy of the wind in order to soar even when there is no definite upward velocity component due to the wind, e.g. gusty weather. That this was possible was known many years ago, and Lanchester propounded a mathematical solution in 1905, but the practical results of Katzmayr considerably clarify the general problem.

He found that if an aerofoil was placed in an airstream, which, instead of being a steady flow, was given an oscillatory motion so that it assumed a wave form then the lift and drag values obtained differed greatly from those obtained in steady flow. In his experiments, the incoming air passed through pivoted slats across the opening of the tunnel. The angle of these slats (relative to the undisturbed air) could be varied at will, and they were so arranged that they twisted up and down about an axis perpendicular to the undisturbed air, giving it a deflection first one way, positive, and then the other, negative. Thus, the airflow in the tunnel itself consisted of a continuous series of waves.

It was found that, in general, there was a slight reduction in the lift of the aerofoil and a great reduction in drag, with a corresponding increase in the lift/drag ratio. The drag was even negative at times. This effect was enhanced by increasing the amplitude of the waves, but the *frequency* had no effect over quite a wide range.

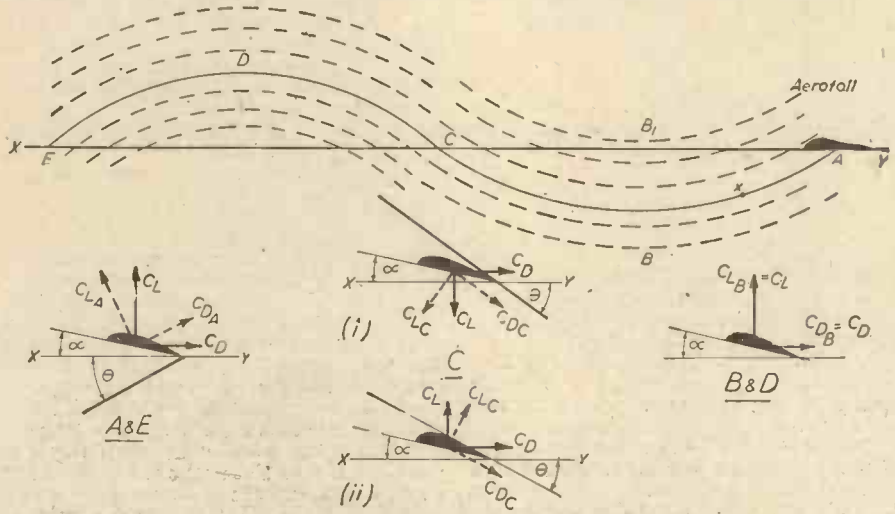


Fig. 1. Details of the oscillatory airflow.

Angle of Attack

Obviously, the angle of attack of the aerofoil is changing continuously, and so it would seem that if we kept the airflow steady and made the aerofoil itself oscillate so that its angle of incidence, and thus angle of attack, was continually changing, we should get the same effect. This was, in fact, another of Katzmayr's experiments, and gave a seeming paradox, for both lift *and* drag were decreased so that the lift/drag ratio also decreased.

To understand the difference between these two conditions we must consider what happens in detail to the aerofoil in each case. Take the oscillatory airflow first (Fig. 1), in which ABCDE is a complete wave of the airstream which flows past the aerofoil. The angle of incidence of the aerofoil is taken with reference to the mean wind direction, i.e. XY, which corresponds to the direction of normal straight flow. This angle is denoted by α.

The angle of attack, being the angle between the aerofoil and the direction of the relative wind is thus seen to be $\alpha + \theta$ at A, or, if we use the notation shown in the small diagram, in which all angles below the horizontal line are reckoned negative, and all above positive, the angle of attack at A is $\alpha - \theta$, θ itself being negative, the algebraic sum is still $\alpha + \theta$

Now the whole of the airstream consists of an infinite number of such waves ABCDE, so that conditions at B_1 are the same as at B. Thus, when the airstream progresses one-quarter of its wavelength, the aerofoil is subject to a relative wind in the direction of flow at B, i.e. horizontal, and thus its angle of attack is α, θ being equal to zero.

When C reaches the aerofoil, the wind direction has changed from negative to positive. The angle of attack is $\alpha - \theta$ and, if this is a greater negative angle than the angle of attack of zero lift of the aerofoil, then the lift is directed downwards, i.e. negative, as in the first case. If $\alpha - \theta$ is less (negatively) than the angle of attack of zero lift, then there is still a positive lift component as in the second case.

The angle of attack is once again equal to α when D reaches the aerofoil for θ is again zero and finally, to complete the passage of the wave, conditions are the same as at A when E reaches the aerofoil and the whole cycle is repeated by the next wave.

We have seen that the *frequency* of the oscillations does not affect the result. Thus, we can find the forces acting on the aerofoil at different points along the wave, assuming that the frequency is small so that there are no interference effects to consider. From these results we can find the *average* condition prevailing over one complete cycle.

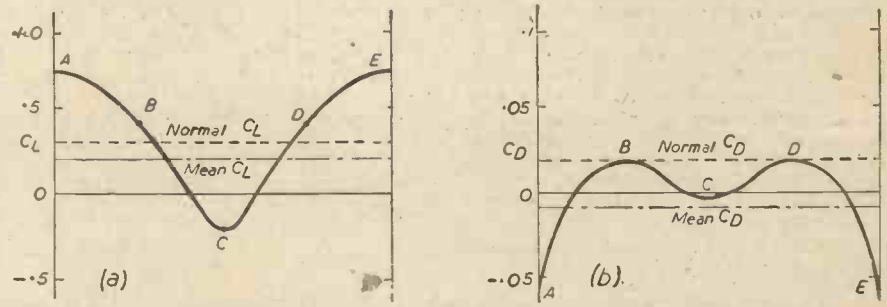


Fig. 2. Showing graphically the calculated values of C_L corresponding to points ABCDE on Fig. 1.

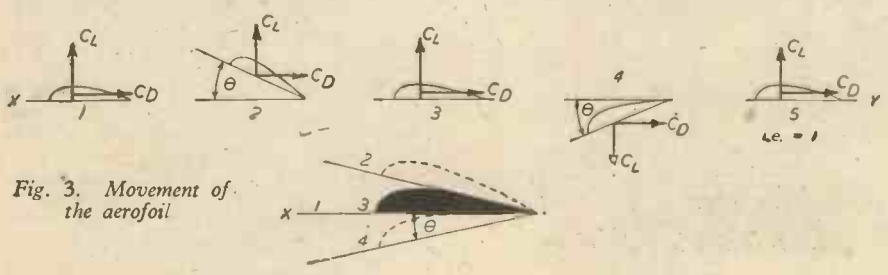


Fig. 3. Movement of the aerofoil

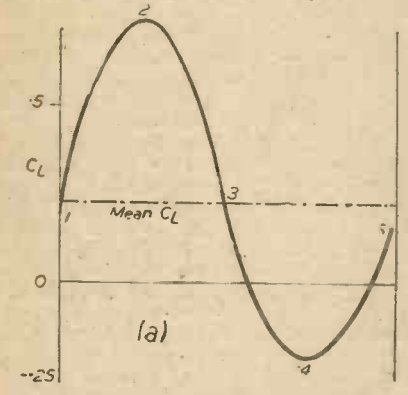
Lift and Drag

Now the lift and drag of an aerofoil is always measured perpendicular and parallel respectively to the *direction of the* relative wind, and in order to compare our results with standard conditions, i.e. steady airflow, we must resolve all our forces perpendicular and parallel to the line XY.

Consider point A, then. Since $L = C_L q S$ and $D = C_D q S$, we can use C_L and C_D (the lift and drag coefficients respectively) as pro-

portional to lift and drag as this is somewhat easier. The lift generated by the aerofoil is perpendicular to the relative wind direction, and thus lies at an angle θ forwards from the perpendicular XY. Similarly C_D is inclined upwards at an angle θ to the direction of the true C_D taken as parallel to XY.

Thus to get our true lift coefficient C_L, we must resolve forces vertically, and for true C_D forces are resolved horizontally. To get a



general equation, consider the conditions at any point x on the wave. Let the corresponding value of θ at this point be θ_X and the lift and drag coefficients perpendicular and parallel to the relative wind at X be C_{LX} and C_{DX} respectively.

Then $C_L = C_{LX} \cos \theta_X + C_{DX} \sin \theta_X$

Similarly for drag

$$C_D = C_{DX} \cos \theta_X - C_{LX} \sin \theta_X.$$

Particular attention must be paid to the *direction* of these component forces as, for example, we get at C, case (1) C_{LC} and C_{DC} both have a negative component in the direction $-C_L$, but in case (2) C_{LC} and C_{DC} are opposed in direction when resolved along C_L and it is important that the direction of each force should be clearly understood. A sketch of the conditions should help in this respect.

Calculated values of C_L corresponding to points ABCDE of Fig. 1 are shown graphically in Fig. 2 for a particular wing section and maximum value of $\theta = 10°$. During the cycle it changes from a high positive value, A, to negative at C, and back again to positive at E. The greater part of the curve is above the alscissa, and so the resulting mean lift coefficient over the whole cycle is positive, and its value can be found by integration or by graphical methods. The mean value is marked on the curve as is also the left coefficient corresponding to normal, straight airflow, and the slight reduction is seen.

The drag coefficient has a greater variation, as shown in Fig. 3, its mean value being found as above. If the area enclosed by the curve and the axes is greater below the alscissa than above, the mean value is negative, and, if less, positive. Hence, it is possible to get a negative drag for the aerofoil over each cycle. That this is quite feasible can be deduced from Fig. 1, especially at high values of θ for the value of C_L is much greater than that of C_D over a fair range of angles of attack, and thus $C_{LX} \sin \theta$ may exceed $C_{DX} \cos \theta$ when the true drag is negative. This is further supported by experimental proof that the reduction (and ultimately change of sign) of drag increases with increase of θ.

Consider now the case of the aerofoil in a steady airflow, only this time the incidence of the aerofoil is varied periodically. As before, consider the frequency as small so that we may consider positions along each cycle of operation separately. In other words, the effect being independent of frequency, the vertical velocity of the aerfoil itself as it changes incidence can be ignored. The problem then reduces to this.

The aerofoil moves as shown in Fig. 3, from position 1 to 2, 2 to 3, 3 to 4, 4 to 1, completing one cycle. The resulting aerodynamic force on the aerofoil in each position is shown resolved into its lift and drag components in the usual way, but note that since the direction of the relative wind is always *horizontal*, and thus there can be no *forward* component which opposes or even overcomes the drag as in the previous case.

Thus, the variation in C_L and C_D throughout the cycle is as shown in Fig. 4 (*a*) and (*b*) respectively, where it is noticed that the drag never reaches a negative value. Its lowest

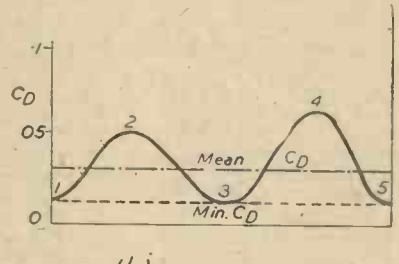


Fig. 4. Variation of C_L and C_D

value is when the aerofoil is at such an attitude during its oscillation that the angle of attack corresponds to that of minimum drag for that particular section, and at any other part of the cycle it is greater than this.

Mean values of C_L and C_D are found as before, when the lift/drag ratio, using the same data as before, is seen to compare poorly with the normal value and even more so with the true Katzmayr effect.

A further series of experiments were also carried out with the aerofoil remaining at a fixed incidence, but oscillating up and down in a steady airflow, to see if this would more nearly approach the first conditions. In this case it was found that the characteristics of the aerofoil were slightly lowered, and this may be explained by imagining this flexing movement as a combination of the two previous examples in which the second one predominates.

Thus, although the true Katzmayr effect may be produced to some extent, the gains are more than overwhelmed by the second condition, which results in characteristics of a slightly lower value than normal.

The true Katzmayr effect is probably felt to a certain extent in natural flight, for air seldom flows in steady lines. It becomes turbulent, forming eddies and waves, especially near the earth's surface where it is retarded by friction and succeeding layers rolling over those being slowed up. Thus, it is possible to draw energy from the wind, in the form of negative drag, and certain types of sea birds have been observed to utilise this effect. Gliding or swooping down towards the surface of the water they are able to soar, even though there are no definite up-currents, and, by continuing this process, may cover great distances without flapping their wings.

To summarise we may state that :—(*a*) An aerofoil having a translational (i.e. forward) velocity through an oscillating airstream has its characteristics favourably improved, even to the extent of a reversal of the drag force. The extent of this charge is dependant upon :—

(i) The amplitude of the oscillation. According to Shatswell Ober, the reduction in the drag coefficient varies approximately as the square of the amplitude.

(ii) The aerofoil characteristics themselves, particularly at angles of attack above the stalling point and below zero lift. Generally, the drag reduction for a thick aerofoil is proportionally greater than that for a thin one.

The frequency of the oscillations does not appear to have any effect on the result, but it should be noted that all mathematical treatment assumes that the *wavelength* is long compared with the chord of the aerofoil. If the wavelength is so short that it approaches the chord length, the above treatment is invalid. In this case the effect on the *camber* of the aerofoil section must be considered.

(*b*) An aerofoil oscillating about an axis perpendicular to a steady airstream suffers a detrimental change in its characteristics.

(*c*) An aerofoil flexinglaterally, i.e. oscillating perpendicular, to a steady airstream suffers a slight loss of its favourable characteristics and its motion may be considered to be made up of (*a*) and (*b*).

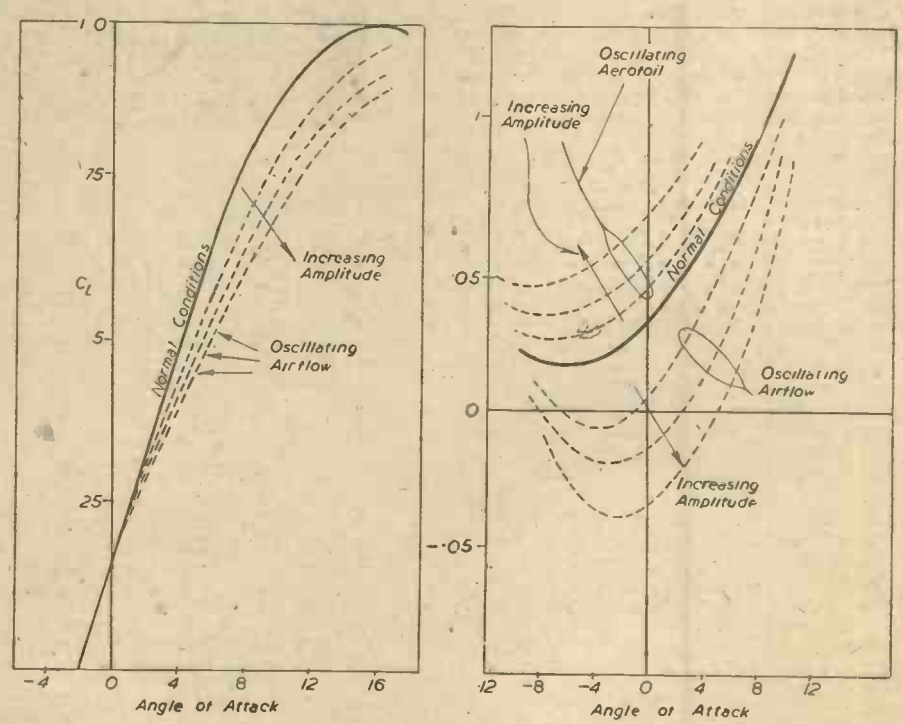


Fig. 5. Diagrammatic representation of aerofoil characteristics showing changes due to oscillating airflow and aerofoil

PHOTOGRAPHY

Picture Making by Enlarging

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

Notes on Composition, and the Preparation of Negatives

I THINK it would be advisable at this stage, before giving any more hints on this most interesting of photographic processes, if we tried to get a true or, at any rate a reasonably true, conception of what a picture really is. We may all have some idea in our minds, but when it comes to turning out a "picture" it will be found that it is a vastly different and harder job than criticising the work of some other person.

At this point I would like to pass on to you a definition of a picture that was given to me many years ago by one of the leading photographic artists of his day; he contended that a picture was "A representation of a scene, figure or object carefully reproduced by painting, drawing or photography, so as to have a permanent record of something which had pleased the eye," he then added this remark: "The reproduction should be of such a character that it could be framed and hung on the walls of the living room, and if it was found to give you pleasure every time you looked at it, and would stand this test for a few months, then it was a picture, but if there happened to be something about it which caused you annoyance after a few weeks, then it was not standing up to the test, and should be removed from the wall."

I think it is the most useful piece of advice I ever had, and one which I have found most helpful in making my enlargements. If you consider it you will find that it embodies so much that you will quickly be able to judge your own results and, what is of great value, you will find that you are actually making use of the advice when you are taking your pictures, and thus getting a bigger average of successful negatives.

Composition

Personal opinion must, of course, play an important part in the choice and selection, and also in the criticism of a picture, but there are certain rules which are general to all, and therefore must be followed as far as is possible with the limited means which we users of the camera have at our disposal. I will briefly sum up these rules under the headings of Composition, Balance, and Harmony.

I have already advised you to take an opportunity to visit a photographic exhibition, but when doing so, do not rush round it; go with the idea in your mind of learning something. Study one of the winning pictures, and with Composition, Balance and Harmony in mind, you will soon begin to realise why that particular picture caught the judge's eye and received an award.

Composition is far too vast a subject to be dealt with in the limited space at our disposal here; whole books have been written on it, and there are probably several in your local library, but, for a start, it will help you to note that the composition of a picture takes the form of "lines" such as triangular, serpentine, or oval, and can sometimes comprise two of these. Balance as the name implies means evenness of equality; there must not be any part that is overpowering all the remainder, neither must one side dominate the other. Harmony, to put it simply, means that there is a linking up of all parts, and no one part attracts the eye without leading it to other parts, and so the eye will eventually take in the whole picture as one.

Just for a few moments take your thoughts away from the pictures in a gallery, and let your mind recall some of our beautiful buildings such as old abbeys and cathedrals. Why do people visit and spend hours looking at St. Paul's, Westminster, York, Canterbury, Wells, Gloucester and the ruins of Fountains, Tintern and others of equal historic interest which this country is so proud to possess; it is not only because of their old age and history, but because they are beautiful to look at; there is grace, charm, symmetry and architectural perfection, and all these attractions can be summed up in those three headings of Composition, Balance and Harmony.

Picture Making

Thus we begin to understand what we have to aim at in the making of our pictures, and I expect many of you may ask—how is it possible to do all this by simply making enlargments from our negatives? The answer is that it is not possible to make "pictures" from all your negatives, because not every negative is a pictorial one; there are millions of films exposed which at their best can only be considered as records, and are not worth a large sheet of bromide paper. It should be borne in mind, however, that if you are the fortunate owner of an enlarger, you will take a great deal more care in the selection of the subjects you intend to photograph, in the exposure and the development of the films.

Assuming that you have got some negatives which you think are worth while, and that you would like to try your hand at enlarging, you will want to know about some of the devices used by exhibitionists for obtaining such good results. Some of these devices are quite elementary, and can be done by everyone, but others are for the advanced worker, and can only be accomplished by long experience coupled with a good knowledge of art and skilful handwork on both the negative and print. It is only possible here to touch on the former group.

An example of fairly good composition in a landscape. There is balance, and also harmony of tones, and the eye takes in the whole of the view without being unduly attracted to any single object.

Removing Blemishes

It will be obvious that any blemish on a negative, such as stains, fogging, pinholes or scratches, finger markings or dust, must be removed before attempting to make an enlargment. If there happens to be a tiny pinhole in the negative, this will naturally appear as a large black spot on the enlargment.

Stains can occur as the result of chemicals settling on the film, through using stale or overworked developer, or through insufficient fixation. There are some chemical stains which cannot be removed, and it is a waste of time to attempt it; some will disappear if the negative is treated to a strong acid-fixing bath for a few minutes, and then very thoroughly washed. A film that has been insufficiently fixed will have some grey patches, but if the negative is an old one, these may have changed to a brown colour, and the only treatment is to soak the negative in clean water until it is thoroughly softened, then place it for several minutes in a fresh acid-hypo solution and hope for the best. It may clear, but it sometimes happens that the film has been so long exposed that it is impossible to remove the free silver. With regard to fogging, there are two types of this, chemical and light; the former should be treated in the manner suggested for chemical stains, but if this is not effective then the following can be tried, which is also a remedy suggested for light fog. The film should be soaked in water, then passed to a ferricyanide reducer for a few seconds and then washed; if the fog has not been removed, give a second dose, but as this reducing bath works very rapidly, care must be taken to prevent too much reduction, otherwise you will find that the image is also being attacked. Some workers have found that the fog, if only slight, can be got rid of by the use of the redevelop method of intensification, which is the process whereby the image is first bleached in a chromium bath, and then redeveloped

back again by the use of a clean working developer, such as a fresh solution of Metol-Quinol; but here is an essential point which must be noted—as soon as the image has blackened, remove it from the developer, and plunge it into a bath of running water. It must not remain in the developer longer for you will be intensifying the negative and thereby increasing the density of the fogging.

A definite line of fog on the film caused through light getting into the camera is a ticklish proposition and requires skill. If the negative is a valuable one and you want to try to do something to it, you can with a sharp scalpel or retouching knife cut some of the dark streak out. This is done by a continuous scratching of the part with the knife. Another method, also adopted by the advanced worker, is to make a transparency of the negative and then retouch with the pencil until the fogged part is blackened to the depth of its surroundings. In both these treatments it is most important not to "cut" or retouch over the borders of the fogged section.

Pin-holes and Scratches

If you have a steady hand these do not offer any great difficulty. I have found that with a very fine sable brush and a bottle of Johnson's Spotting Medium—and a little practice—it is quite easy to fill the hole. Beginners must realise that they have to match the density of the surround and this, more often than not, means that they must use the spotting medium of the desired tone; a spot of water, and the tiniest touch of the black on the tip of the brush will give the first application, and then this can be built up, if necessary, with further applications. In the case of a scratch, do not attempt to draw the brush along the length of the scratch but fill it up with a series of dots, and then further dots in between the first ones, and try to match up exactly the tone of the surrounding parts.

To eliminate finger markings, which are the result of handling the film, and in consequence are grease markings, lay the film in a bath of methylated spirit with the film surface upwards, and swab it carefully with a wad of cotton wool; be sure to keep the film under the solution the whole time.

If the markings are dirty ones then it may be possible to remove them by soaking the film in water and swabbing it as suggested with cotton wool.

Dust on the film, which cannot be removed by soaking and carefully spraying the surface, or gently skimming a point of wet cotton wool across it, should be left on the film, and the spotting medium used on your print.

This Ersatz

Notes on Some of the Various Artificial Products in use at the Present Time

By PROF. A. M. LOW

THE war has already brought a host of new words to our everyday vocabulary, not a few of them, I think, because of their interesting sound. German words, in moderation, have the fascination of novelty to British ears tuned to different phonetic responses. Blitzkreig has a world of meaning that is missing in "lightning war," to speak of the Luftwaffe (even if the pronunciation is doubtful) shows superiority over those who merely call it the German air force (I have even heard thoughtless people speak of the German *R.A.F.*!), and *ersatz* sounds so much more interesting than substitute or synthetic. Writers of fiction well appreciate the value of peppering their narrative with a selection of foreign words to give atmosphere.

Ersatz, as we now use it in general conversation, has all kinds of meanings, and illustrates the danger of technical words becoming part of our everyday vocabulary. The scientist, of course, is constantly attempting to make our language more precise. The man-in-the-street will tell you that water is H_2O, but the chemist knows there is a difference between ordinary water and hydrogen "oxide." The fact that we use the descriptions sodium carbonate and washing soda is not accidental, but illustrates the difference between common usage and the precise language of science. Washing soda may be one of a hundred different materials, the great bulk of each of which is sodium carbonate. But sodium bi-carbonate is—well, just sodium bi-carbonate, or as completely without impurities as the chemist can make it when time is no object.

Chemical Purity!

In spite of the saying that to the pure all things are pure, the fact is that to the purist *nothing* is pure. In the laboratory a chemical may be prepared which is 99.999 per cent. pure. It may be made so carefully that even the most up-to-date analytical methods can detect no impurity. But the chemist would not claim or admit that it was perfectly pure. For perfect purity—in the chemical and not the Buchman sense—is, of course, like infinity, unattainable.

But to return to ersatz, the word seems to be used to cover at least three different kinds of materials. It is used in describing what we have for years called synthetic products, large or complicated molecules built up artificially from a more simple kind. The greatest producer of ersatz products in this sense is Nature. Goering's factories do not compare in a year with the output of Nature in a week, for Nature has available sources of heat and pressure almost infinitely greater than any which the R.A.F. have bombed. But it must be admitted that Nature is—from the point of view of men in a hurry for petrol for their cars—rather slow. Much synthesis is simply doing what Nature does, but doing it more quickly.

There are many synthetic substances made by the chemist which are not produced by

Pieces of black carbon obtained from gas works, and which are used for the manufacture of synthetic diamonds.

Nature, or produced only in such small quantities that they have not yet been found in the natural state. This includes a huge number of drugs and dyes. But in the first class of ersatz goods, I put those that are man-made copies of natural products. . . . . and note that they are usually exact copies. The chemist can make cane sugar in various ways in his laboratory. It is physically and chemically exactly the same as the cane sugar obtained from beet or sugar cane; the difference, if any, would be in the nature of the 0.01 per cent. impurities. Sugar is amongst the purest substances in common use.

Rayon

There is another group of ersatz or synthetic products, the best known of which is rayon, sometimes called artificial silk—but it is not silk at all. Chemically it bears no resemblance to the silk of the silkworm. Physically, it resembles it fairly closely, and since it is for its physical qualities that we use silk, and not its chemical nature, rayon is very useful for many purposes for which silk was formerly required or, more important, greatly increases the number of consumers of this material. Silk stockings could never have become a popular fashion but for rayon—there would not have been enough silk in the world to go round so many millions of lovely legs!

There are ersatz products we use because they have the same taste, the same smell or the same appearance as natural ones. Most of our "fruit" flavourings bear no chemical resemblance to the flavouring matter of the fruit they "imitate." Synthetic indigo is not at all the same thing as real indigo, although it produces the same effect on the eye. No one has yet managed to find what is the substance in certain flowers that makes their scent—but the chemist has made a very good imitation of its effect.

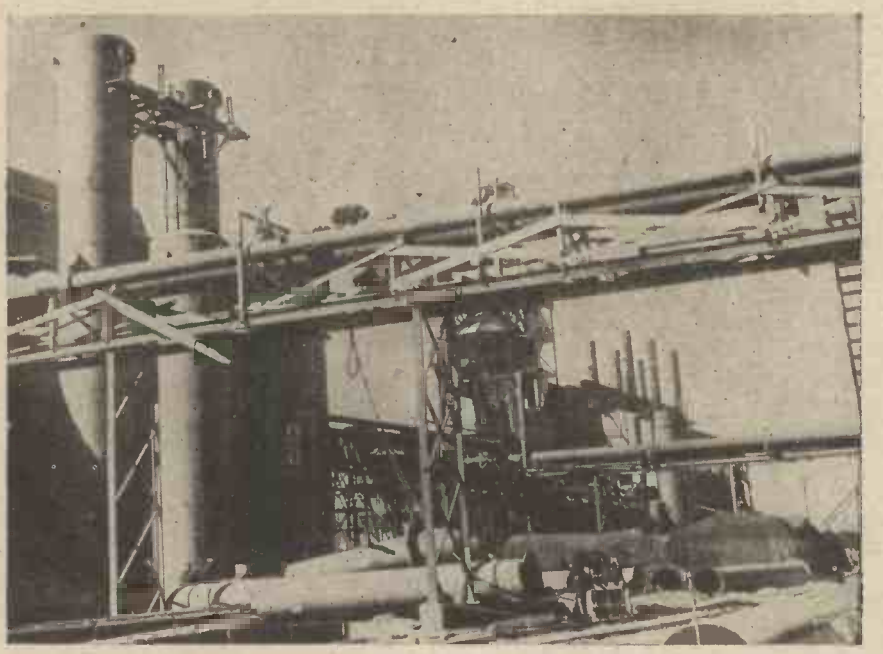
Ersatz "Coffee"

In these two classes of ersatz products, Britain is at least as skilful as Germany. Why, then, do we associate ersatz so particularly with Germany, and use the German word? Because the Germans have produced a third kind of substitute for which sham would be a more correct description. Ersatz coffee would be quite all right provided it had the flavour, aroma—and perhaps the colouring of real coffee. But the one point on which every consumer of ersatz coffee seems agreed is that it bears no very great resemblance to coffee at all. It may or may not be a good drink. If it *is*, why not give it a new name? It is the sham of calling it coffee to cover the economic and political difficulties or adventures that brought it into being that is the "fake" which brings a slightly unpleasant association to the word ersatz.

The only justification for synthetic articles at all is that they are better than the original (synthetic drugs are often purer than natural extracts, and therefore can be administered more exactly), or that they are cheaper than the original and, therefore, can be more widely distributed. I am instinctively shy of the ersatz product which is really a poor imitation. To call it by the name of the original, even with a subtly inserted "art." (or the German equivalent) before it, smacks of deception.

THE MONTH IN THE WORLD OF

Science and Invention



A large plant under construction in Canada for the manufacture of chemicals and explosives

Four Miles Under Sea Bore

WITH the completion of the pilot tunnel for the Moji-Shimonoseki railway tunnel, what is claimed to be the biggest under-sea bore was opened recently. The tunnel which will be nearly four miles long, links Shimonoseki in the Yamaguchi prefecture in Honshu, to Moji in Kyushu Island.

Peanut-Shell Fire Extinguisher

AN oil fire in a Sydney peanut butter factory was recently put out by chemists with foam-powder extracted from peanut shells in a test.

Rubber Polishing Wheels

HIGHLY polished effects on metal surfaces can now be produced by rubber polishing wheels having polishing compounds impregnated in a special binder. Scratches and grinding marks can be removed from metals before polishing them, by means of the wheels, but they are not suitable for plated work.

Fiberglas

FIBERGLAS is a new material consisting of glass cloth woven from continuous fibre soda-free yarn, impregnated with heat-resisting insulating varnishes. It is supplied in various thicknesses coated with black or yellow insulating varnishes, and is particularly suited to electrical insulation requirements. It is also made in standard tape widths and standard roll lengths. Electrical apparatus insulated with Fiberglas is claimed to have greater overload capacity, can be made smaller in size and lighter in weight, and will outlast equipment protected with ordinary insulating materials. Fiberglas is made by the Irvington Company, of New Jersey, U.S.A.

Plastic Bearings

A GOOD deal of attention is now being given to the possibility of using plastic materials for engineering bearings, and also of bearings made of plastic impregnated with Nylon, an artificial silk produced in the United States. The latter have already been introduced and these bearings, it is stated, can carry heavy loads and require no lubrication. They are being used for electric motors. In this country bakelite impregnated bearings have already been used, and a solid polymer produced from ethylene gas has been moulded into bearings.

Catalin

STANDARD rods, sheets, tubes, shapes, and special castings, similar to metal ones, are now available in a cast phenolic resin known as Catalin. The product is not moulded, but is supplied in solid form in a wide range of basic colours, transparent, translucent and opaque. It has a specific gravity of 1.30 and a tensile strength up to 4,000 lb. per square inch. Catalin can be turned, sawn, milled, threaded, formed (but not drawn), engraved, ground and polished without special precautions. The material is used for a variety of purposes such as electrical insulating parts, control knobs, tool handles, clock mounts, furniture handles, knife handles, tap wheels, and ornamentally turned articles.

Self-Compensating Spring

THE All-Weather Springs concern, of New York City, is manufacturing a new self-compensating spring which uses 36 per cent. nickel steel, and can be combined with other springs or elastic elements such as bellows, and diaphragms, to produce instruments whose accuracy is said to be virtually unaffected by ordinary temperature changes. They are being used in spring scales, aeronautical instruments, and other spring actuated instruments.

Longest Conveyor Belt

THE conveyor belt which furnishes the aggregate for the Shasta Dam, California, is 9.6 miles long, and is claimed to be the longest in the world. It is stated that this conveyor will handle 10,000,000 tons of aggregate during the next four years, at a speed of 550 ft. per minute. It is illuminated for its entire length, and is only covered in the rainy seasons.

Aircraft Skins

ACCORDING to the Dow Chemical Co., magnesium alloys are quite suitable for use as skin material in view of their low specific gravity. Very smooth surfaces are required in order to improve the aerodynamic refinement of an aeroplane. In dives, great demands are placed on the buckling strength of the aircraft skin. Satisfactorily smooth surfaces can be obtained by means of flush riveting, spot welding, and other methods. The strength of thin-gauge skins is not sufficient to maintain the surface smoothness also under great loads, as a result of which increasingly heavy skins will be required in monocoque construction. The loads placed on the skin by the local formation of compressibility shock, resulting from the velocity of sound being exceeded locally, can grow to such an extent that heavier sheet than previously must be employed.

Talking Postcards

THE Russians have done better than our film letters to the troops in the Middle East. Russian soldiers get spoken messages from home on a postcard. At Moscow planetarium a sound-recording studio has been opened, and people may have their voices recorded on to a celluloid record which is pasted on a postcard and sent through the post. The men can listen to the talking postcards as every Russian unit carries its gramophone.

A Rocket Gun

ACCORDING to a Berlin report, Russia's latest secret weapon is a rocket gun which fires up to 60 shells simultaneously. It is reported to have been used in considerable numbers on the Ukraine sector, but no details of the new weapon have been given.

All-welded Ships

IT was revealed recently by Mr. W. A. Woodeson, president of the North-East Coast Institution of Engineers and Shipbuilders, that more than twenty-six merchant ships, all of the express-freighter type, are now being built in an American shipyard on the all-welded principle. The institution is affiliated to the Society of Naval Architects and Marine Engineers (U.S.A.). Under the affiliation scheme the best brains in British and American shipbuilding exchange ideas. Mr. Woodeson said: "The survey of the effect of welding on the fighting qualities of ships will be one of the most interesting post-war considerations of naval architects, especially in view of the mixed performance of the German capital ships, whose construction so largely depended on electric arc welding. The American shipbuilding concern has laid down a yard and shops specially equipped to produce nothing but all-welded vessels. In June this yard launched an all-welded steamship of 17,000 tons, which is claimed to be the first all-welded passenger ship in the world."

New Bullet-Proof Steel

IT was revealed recently in Sydney that a new bullet-proof steel had been discovered which is cheaper to make than any now produced by Britain or the U.S.A.

The new Hurricane in its latest form—as a fighter bomber

Crater Formation in Welding

WHEN the welding arc is broken suddenly, the molten metal at a weld loses its heat quickly, and fails to get rid of slag and gases, so resulting in a crater. When a variable resistance of sufficient capacity is introduced into the excitation field of the generator on the welding machine, it is possible to reduce the current density gradually in the excitation field, by manual control, without altering the input current to the generator. Employing this principle, the Wilson Welder and Metals Co., New York, have developed a "Strocoo" electric arc crater eliminator. The welding operator can cut in and out of the field by means of a switch, the whole equipment being attached to the body of the generator.

Invention Speeds Shell Production

A MACHINE for forging shells at a rate hitherto unknown, has been invented by a Scottish engineer. In revealing this recently, Mr. Arthur Woodburn, M.P., Parliamentary Secretary to the Secretary of State for Scotland, said that for some time past the engineer had been advising the Ministry of Supply on shell production. Shells were being turned out in as many minutes as it took hours in the last war.

Hydraulic Steering

AN interesting innovation in the way of finger-tip control is illustrated by the adoption of a hydraulic booster on the steering system of the newest caterpillar tractors. Oil pressure cylinders are fitted to the steering arms, which are actuated by a twin valve assembly. The tractor is steered in the normal way, but the wheel is linked with the valve referred to above. When the wheel is turned, it operates a valve so that oil under pressure is admitted to the small hydraulic ram or cylinders fitted on the steering arms themselves. The direction in which the driver turns his wheel determines whether the oil enters the ram at the base or the top. In effect, the manual operation is an adjustment of the hydraulic steering system, and consequently, finger-tip control only is required on the steering wheel. The whole is so arranged that if the hydraulic pressure fails, the steering reverts automatically to the mechanical type.

X-rays for Boiler Plant

THE Combustion Engineering Co. of New York are installing a million volt X-ray apparatus for the radiographic observation of welded seams in boilers and high-pressure vessels. Drum walls up to 5 in. thickness can be examined, the X-ray plate requiring for this a five-minute exposure, at 48 in. focal length. It is explained that this high voltage will give sharper definition of the photograph, while a penetration up to 8 in. can be obtained in steel. As one might expect, equipment of this kind will require careful housing, to prevent danger to the operators, and the building in which the tube rests has walls of concrete 18 in. thickness. The equipment comprises resonant transformer, the X-ray generator itself being mounted co-axially in the transformer, the whole being surrounded with compressed Freon gas, and enclosed in an earthed steel tank.

A New Fatigue Test

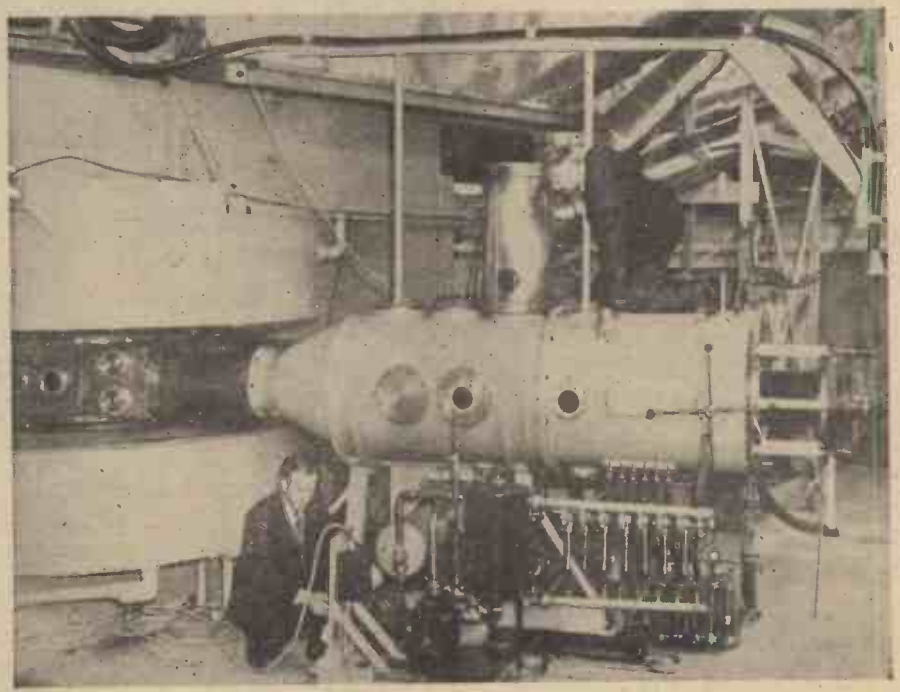
BY using a frequency of twice the mains value of 60 c.p.s., Welch and Wilson have designed a fatigue testing machine, which not only represents a big step forward, but enables an accurate assessment of fatigue to be made up to 1,000 deg. F. The specimen being tested is deflected by electro-magnetic means, at twice the mains frequency, and by designing the machine so that its natural frequency is resonant with the mains, a saving in power consumed is made possible. The amplitude of deflection is controlled by means of two contacts, which control the feed to an iron-cored coil, the latter, in turn, controlling the feed to the electro-magnet, which deflects the specimen. When the latter requires a fatigue crack, its frequency departs from the resonant beat, and this causes the contacts to "miss." A few of these "misses" in succession operate a relay, which then cuts out the power to the machine and stops a clock. The machine might be said to be self-registering, and has the advantage that the specimen need not be accurately balanced, and can be of simple shape. The heating of the specimen is carried out by means of an electric heater which is dropped over the specimen.

Canadian Chemical Plant

SINCE the start of the war large scale chemical developments have been brought about in Canada at a cost of many millions of dollars. Huge plants have been erected to produce large tonnage of chemicals, including those essential to the production of explosives, gas respirators, and those used in the laying of smoke screens, important in naval and aerial strategy. See illustration on the preceding page.

Honeymoon Bridge

NIAGARA'S new "Honeymoon Bridge," replacing the one which collapsed in 1938, will soon be in use. Costing £940,000, the bridge which links the U.S. with Canada, is described as the world's largest fixed-end, steel-arch span.



The 225 ton "Cyclotron," the world's largest atom smasher. In preliminary tests this machine emitted a 19 million volt beam of deutrons for producing radioactive substances of great medical value

MASTERS OF MECHANICS

No. 71. The Hornblowers, and The Invention of the Compound Steam Engine

THE steam engine owes its earlier development not, as is generally asserted, to the inventions of James Watt, but, on the contrary, to the genius of a handful of English inventors, more obscure by far than Watt was, but nevertheless of considerably more importance and value in the furtherance of engineering science than the over-lauded Scot.

Much of the steam engine development which occurred in the eighteenth century took place in Cornwall, the " Cradle of Steam Power.' The Cornish tin mines—the famous " Wheals " —had applied steam power for pumping purposes from its very earliest inception. Hence it was that steam engine development was particularly active in the Duchy of Cornwall, since almost every engineer of note was, in those days, to be found among the tin mines of Britain.

Closely associated with the development of the steam engine in Cornwall was the family of Hornblower, an enterprising and virile band of individuals who, springing originally from the Midlands, settled in Cornwall, and played a tremendous role in the introduction of steam power in England.

Of these Hornblowers, the one which concerns us the most is Jonathan Hornblower the younger, an individual who, as the original inventor of the Compound Steam Engine, is deserving of lasting engineering fame. Yet the story of Jonathan Hornblower has, for a variety of reasons, been suppressed in England for a century or more. Few textbooks of engineering history treat of Hornblower in anything like the detail with which they deal with James Watt. For the story of Jonathan Hornblower the younger is, in one respect, the story of James Watt's villainy, and of his remorseless persecution of an individual whom Nature had appointed to be the intellectual and inventive superior of himself.

The first of the engineering Hornblowers was old Joseph Hornblower, a mechanic, who arrived in Cornwall from the Midlands in 1725. He erected Newcomen engines at Wheal Rose, near Scorrier, and also at Wheal Busy and at Polgooth. Afterwards he returned to the Midlands and we hear of him no more.

The next Hornblowers to make their presence felt in Cornwall were Joseph Hornblower's two sons, Jonathan and Josiah. This Jonathan Hornblower (the elder), in common with his younger brother, Josiah, evidently inherited his father's mechanical abilities, for, after his first visit to Cornwall in 1745, he settled permanently in the Duchy, and became one of its leading engineers.

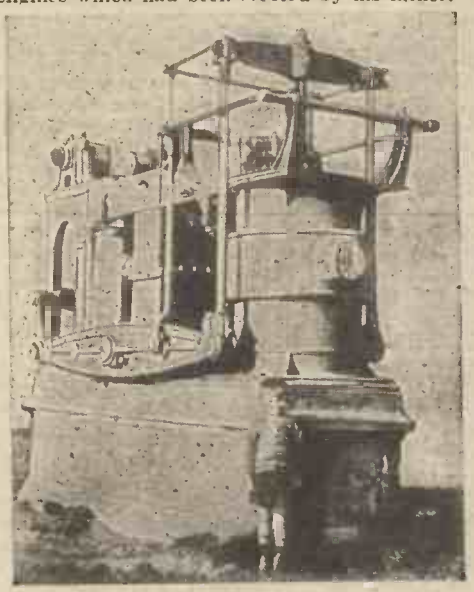
Josiah Hornblower, brother of Jonathan Hornblower the elder, after eight years stay in Cornwall, sailed from Falmouth to America in 1753, there to make engineering history as the first man to erect a steam engine on the American continent.

Jonathan Hornblower

Jonathan Hornblower the elder had a numerous family. Three of his sons, Jabez Carter, Jethro and Jonathan, subsequently became celebrated as engineers and engine builders. It was, however, this latter Jonathan —Jonathan Hornblower the younger—who, by his invention of the principle of the compound steam engine, effected one of the greatest improvements in the entire history of the steam engine.

Jonathan Hornblower the younger was born near Scorrier, in Cornwall, in 1753. His father, Jonathan, was then attaining celebrity as a steam-engine erector and, concurrently, some degree of prosperity. Consequently, the younger Jonathan was sent to the Grammar School at Truro to be educated.

The younger Jonathan was not cut out for any academic career, however. After his schooling was over, we find that he was apprenticed to the trade of a pewterer (plumber?) and brazier, in which trade he settled down at Penryn with his first wife, Rose. Although he was officially a plumber, he was nevertheless possessed of much engineering knowledge and ability which he had acquired bit by bit from the other members of his family. In the neighbourhood of Penryn were several pumping engines which had been erected by his father.



An early marine engine developed out of the Hornblower principle. It is now preserved at Dumbarton

and, doubtless the younger Jonathan had lent a willing hand in the assembly of these heavy and slow-working Newcomen engines.

Of all the Hornblowers, the younger Jonathan was the most experimentally inclined. From his youth he had made attempts at constructing improved steam engines, but it was in 1776, during his Penryn days, that he first hit upon his basic idea of the " compound " steam engine.

Origin of the Compound Engine

The story of the " compound's " origin is most succinctly narrated in the younger Jonathan's own words:—

" In the year 1776 I determined to make a small steam engine for my own amusement, but wished to perform something new.

Accordingly, the first idea of consequence that occurred to me was a possibility of causing the steam to perform more than one operation instead of destroying it in the manner peculiar to all other steam engines.

I made a small model which succeeded so well that I recommended it to my father as a matter of great consequence, whose judgment from long experience as an engineer was sufficient at that time of my life to bias me either to continue my pursuit or to relinquish it. He was of opinion that as I proposed a lid to the steam vessels and a rod of iron to move through a collar of tow in the lid there would be more friction than could be dispensed with; and also that as the pistons would require frequent repair, the cylinder lids must be unscrewed as often as that was done. I therefore had no other thought at that time about it than to amuse some of my friends by a working model. . . ."

The younger Jonathan's working model did more than amuse his few friends. It promised great success, so much so that Jonathan proceeded to build another model on a larger scale and, afterwards, to apply his compound principle at a mine in the vicinity.

He was the first to practise the expansive principle in the steam engine. The Newcomen engines, it will be remembered, were operated by the downwards pressure of the atmosphere, steam being merely used to create a vacuum under the piston. Jonathan Hornblower not only used steam pressure to force a piston downwards, but, by means of an arrangement of two cylinders, he made the steam do work twice before being allowed to escape to the external atmosphere.

Unfortunately, Jonathan, like the rest of his famous family, was an engineer before being a business man. In view of the lack of encouragement which he received for his " compound " principle, he does not seem to have pursued the subject to its logical end. Instead, he dallied, and did not patent his principle until 1781—some five years subsequent to its invention.

James Watt—Swindler

In 1777, the traditionally famous (but actually infamous) James Watt descended upon Cornwall complete with his business-like schemes for erecting his " improved " engine (which he had patented in 1769) throughout the Duchy. Watt's "improved " engine, for which he had obtained that which proved to be a monopoly patent covering all steam engines, was simply nothing more nor less than Newcomen's engine plus a separate chamber for condensing the steam. Through his own rascality, and through the astuteness of his business partner, Mathew Boulton, of Soho, Birmingham, Watt, over a long period, was able to maintain a stranglehold upon steam engine progress in this country.

When, in 1777, James Watt first introduced himself to Cornwall as the first prophet of the steam engine, he naturally made the acquaintance of Hornblower. At first relationships were good, the younger Jonathan merely regarding Watt as a competitor. Before long, however, Jonathan Hornblower began to see things in a different light. Watt was not only erecting his engines up and down Cornwall, but he was also seeking to suppress the erection of any other types of engines in the Duchy.

It was not long before Watt and Hornblower ranged themselves in deadly opposition. Jonathan Hornblower (the younger) put forward his " compound " engine as a new principle. Watt denounced it, saying it was useless and even dangerous, since it employed what Watt termed " high-pressure " steam. A competitive trial between the Hornblower and the Watt " improved " engines was carried out. Hornblower's engine proved to be at least 60 per cent. superior to Watt's Newcomen-type engine.

Legal Action

Foiled in his designs in this respect, Watt next took up his greatest cudgel, that of legal action. A long law-suit took place between Watt and the Hornblowers, the latter being accused of infringing Watt's patents. The Hornblowers claimed that the principle of using steam to press down a piston in a cylinder had been known and practised long

before the date of Watt's patent. Watt maintained that his patent gave him the monopoly of *all* steam engine construction of whatsoever kind and type.

The Watt-Boulton faction was able to command the best, and certainly the wiliest legal ability. The story of Watt's grinding-down of the Hornblowers with his "legal pursuits" is a revolting and a discreditable one. However, the Watt faction had money and legal favour on its side, and, after a lengthy law-suit, it won the day. Hornblower, being financially ruined, was unable to meet the legal costs which he was saddled with, and being unable to pay these damages and costs, he was sent to prison.

Trials and Difficulties

The Watt monopoly lasted until 1800. One would suppose that after the removal of this incubus, Jonathan Hornblower would have reverted to his former plans and have returned to the construction and application of his compound engines. But, somehow or other, the pioneering spirit had now gone out of Jonathan. His life had been one of trials and difficulties. He had lost two wives, had been rendered penniless, and had undergone imprisonment and, additionally, he had experienced the bitterness of seeing his invention metaphorically trampled on the ground.

We can well understand his unwillingness to proceed further with his inventions during the remaining years of his life, during which he seems to have contented himself in erecting engines in Cornwall on the orthodox lines, and to recovering a certain proportion of his lost financial resources.

When he died in 1815, Jonathan Hornblower the younger was by no means a destitute individual. He had recovered a certain competence and had added one or two minor patents to his name. But the compound engine he had dropped entirely as if, strangely enough, it had become anathema to him.

Hornblower's "compound" principle was taken up and successfully applied for the first time by an engineer named Woolf, who erected a pumping engine utilising this principle at Wheal Abraham Mine, Cornwall, in 1814, the year before Jonathan Hornblower died.

Woolf's Engine

Woolf used higher steam pressures than Jonathan Hornblower had ever dared employ in the earlier days of his invention, and, precisely on account of this fact, Woolf's engine scored a considerable degree of success. James Watt, in his heyday, had endeavoured might and main to prohibit the use of high-pressure steam, Watt's own idea of a working steam pressure being of the order of 3 lbs. per square inch. But the Watt monopoly, like all evil things, had worked itself out, and steam engine development was now proceeding apace.

Based upon Jonathan Hornblower's "compound" principle, the system of multiple expansion, as utilised in the marine engine, arose, and by making ocean-going steamships possible, revolutionised sea transport. The principle has since been applied in other ways, but unfortunately Jonathan Hornblower's name has seldom been coupled with it.

For more than a century, the name of Jonathan Hornblower the younger had been a forgotten one in the annals of engineering. Nowadays, however, thanks to the renaissance which is taking place in the study of engineering history, old facts, long hidden, are being brought back to light. Traditional untruths, and long-repeated inaccuracies are being cast aside. The history of invention in England has numerous tragic chapters in it, but few, indeed, evince so great an atmosphere of injustice as does the one which relates the sad story of Jonathan Hornblower the younger, and his unsuccessful struggle with one of the greatest hypocrites which the record of industry and invention contains.

A Contour Projector

Constructional Details of a Useful Piece of Apparatus

By S. J. GARRATT.

FOR examining the contour of small metal or other articles, use is frequently made of a device which projects an enlarged image on to a screen. For instance, to measure the angle of a small screw thread an image of perhaps 40 times actual size is shown on the screen by means of an optical apparatus. This image can be examined as it actually appears on the screen, or the outline can be traced with pencil on a sheet of paper and examined more thoroughly.

A piece of apparatus suitable for the purpose can be made quite simply if a suitable lens is available. The lens should have a focal length of, say, 2 to 3 inches, and should be of good make for accurate results, although almost any lens will do if the possibility of slight distortion is not objectionable. The focus of the lens may be anything within reason, the chief difference caused by a longer focus being an increase in the distance between the lens and the screen.

A cinema projector lens, or the lens from a miniature camera would be quite suitable. No harm will result to the lens and no alteration is required; it should merely be detached from the camera, and put into an adaptor on the projection apparatus. After use it can be returned unharmed for its original purpose.

Constructional Details

One suitable arrangement of simple construction is shown in the accompanying illustration which is almost self-explanatory. The dimensions will, of course, depend upon the size of the article to be examined, and also upon the lens focus, but with a 2 in. lens and small articles, the box can be about 12 in. long, 6 in. wide, and 6 in. deep, with the opal glass partition half-way along the length. If opal glass is not available, ordinary ground glass will do.

Doors should be arranged for access to both compartments, and they may conveniently be arranged to slide, which is probably more convenient than hinging them. Paint the lamp compartment white inside and, the inside of the lens compartment being dull, black.

Holding the Object

For holding the object to be examined in position, a lead weight of suitable size is useful. It should have one or two rubber bands round it, and the object can be just slipped under a rubber band, though if all the things to be examined are alike, it would probably be more satisfactory to devise a special holder.

No focussing arrangement need be provided, as focussing can be done by moving the object (still fixed to the weight) nearer to or further from the lens.

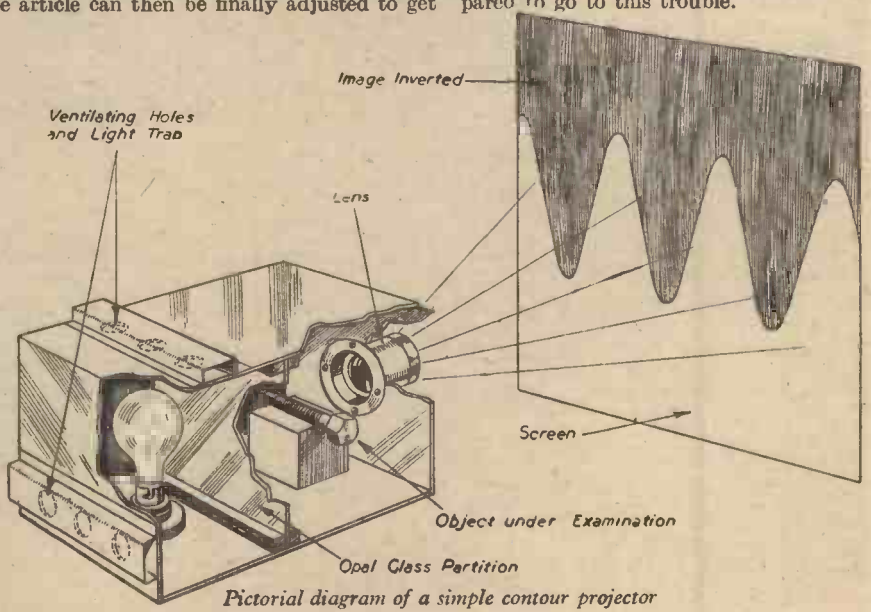
If the lens is of 2 in. focus, the object will require to be slightly more than 2 in. from the lens, and the distance away for the screen will depend upon the degree of enlargement. If the image is to be enlarged to forty times actual size, the screen should be 40 by 2 in., i.e., 80 in. from the lens. The lead block with the article can then be finally adjusted to get the image sharp, and central on the screen. The image will be upside down, but this is not usually an important matter.

Illuminant

The electric lamp should be sufficiently powerful to give a bright image; the enlargement ratio, too, has an important bearing on the amount of light required, a larger image requiring much more light.

If the operator is a photographer, it will be obvious that a photographic enlargement can be made by pinning a piece of bromide paper to the screen and exposing and developing in the usual manner.

It will also be obvious that the projector described is a very simple form. Various refinements such as screw adjustment to the focussing can be made if the reader is prepared to go to this trouble.



Pictorial diagram of a simple contour projector

Our Busy Inventors

By "Dynamo"

To Extinguish Fire-Bombs

WHAT is termed an Incendiary Bomb Controller and Extinguisher is the subject of an application for a patent in this country. It consists of a container having a compartment for holding sand, into which the bomb is hastily deposited. And there is also means for dropping both the bomb and the sand into a lower compartment, so that, during the descent, the sand flows over the bomb. Enemy arson will thus be thwarted.

Rest For The Weary

A BED-MAKER (I use the term in a manufacturing sense) has set himself the task of forming a mattress suitable for air-raid shelters, camps or other places where a convenient portable couch is a thing to be desired. His device comprises a number of bars of a yielding nature. These are placed between sheets of fabric and are so arranged that they may either be turned up on edge or caused to lie flat to decrease the bulk of the mattress. The chief virtue of this bed is that it may easily be rolled up when not required and, therefore, occupies very little room and can readily be moved. In addition, it is asserted that it affords an exceedingly comfortable reclining surface.

In Case Of Water

THE latest raft to be invented has a slight resemblance to a chicken crate, having spars spaced apart. It may be made of wood or pressed steel. The leading characteristic is the fact that it will float either way up. Whichever way the structure floats, one end will be overhung to constitute the bow; the other will face at an angle upwardly to form the stern. Therefore, in the event of shipwreck, it is always ready for use.

Loose Tiles

THE blast of the blitz has no respect for roofs, for if it does not blow the house down, it at least rips off the tiles of roofs in the neighbourhood of the exploding bomb. An inventor has borne this fact in mind while devising an improved means for securing tiles to roofs. He points out that in the majority of cases the tiles are simply laid in position with the nibs on the upper edges engaging with battens fixed to the rafters. And the tiles of each row are kept in place solely by the weight of the row above. Consequently, when a stormy blast or that caused by the blitz gets under them they are doffed with ease.

Sometimes tiles are nailed to the battens; but, after a roof has been finished, it is not possible to discover whether they are secured by nails. Even if the tiles are fastened in this way it is difficult to replace broken ones.

The inventor's idea, which has been submitted to the British Patent Office, is a resilient U-shaped clip designed to fasten the tile to a batten. And it is so arranged that there will not be many a slip 'twixt the tile and the clip.

A Music-Leaf Turner

A NOVEL music-leaf turner is the subject of a recent application to the British Patent Office. It is claimed for the device that its construction is simple and that it is adapted readily to be affixed to the usual music stand on a piano. And it does not require any unsightly fitting apparatus.

There are a bracket support and a number of pivoted fingers designed to be interleaved between the pages of the music. In addition, there is an oscillating arm. The actuating force is furnished by means of a foot pedal placed between the ordinary pedals of a piano.

C. A. Nickle, consulting engineer to the General Electric Company, of Schenectady, and one of the most resourceful experimenters in America, is here seen in the cellar laboratory of his home, with his home-made high frequency furnace for producing diamonds for abrasive purposes.

Weed Shooting

AMONG the ill weeds which grow apace is that tall coarse herb called the dock. To remove this foe of fertility it appears to be the practice to grub up and burn the wanton weed—a slow and laborious process.

Thanks to an invention conceived by a Warwickshire man this field pest may now be destroyed in a rapid and effective manner.

The method of destruction consists in shooting the unwanted plant. The implement for this purpose resembles a gun or walking stick. At the end of the weapon is a circular container which holds the powder. The ammunition is sodium chloride which is the chemical name for salt. Affixed to the handle is a trigger which, when pulled, releases by means of a connecting rod a measured quantity of powder.

If the requisite amount of salt is procurable at this juncture in our country's history, this dock destroyer should assist the agricultural output of our land.

For Spare Wheels

AN improved spare wheel carrier for cars and lorries has been devised. This invention will enable very heavy spare wheels to be detached easily and quickly. It will also make it possible to replace them with equal facility and expedition.

In the case of some vehicles, the spare wheel complete with tyre and inner tube may weigh as much as from 2 to 3 cwts. But, thanks to this invention, even heavier spare wheels may readily be handled.

The carrier in question includes a cradle or other support for the wheel. It also comprises hydraulic means, carried by the vehicle, for raising or lowering the cradle; and means for securing the wheel to the cradle when in its lowered or conveniently accessible position.

Eyelash Brush

THOSE curling eyelashes which are a feature of the film star I understand require artificial treatment. A special brush for this purpose is the subject of an application accepted by the British Patent Office.

The aim of the deviser has been to furnish an improved brush by which a gentle brushing action may be performed. It is claimed that by its means also a preparation can conveniently be applied without waste and without smudging the skin.

Wrist Torch

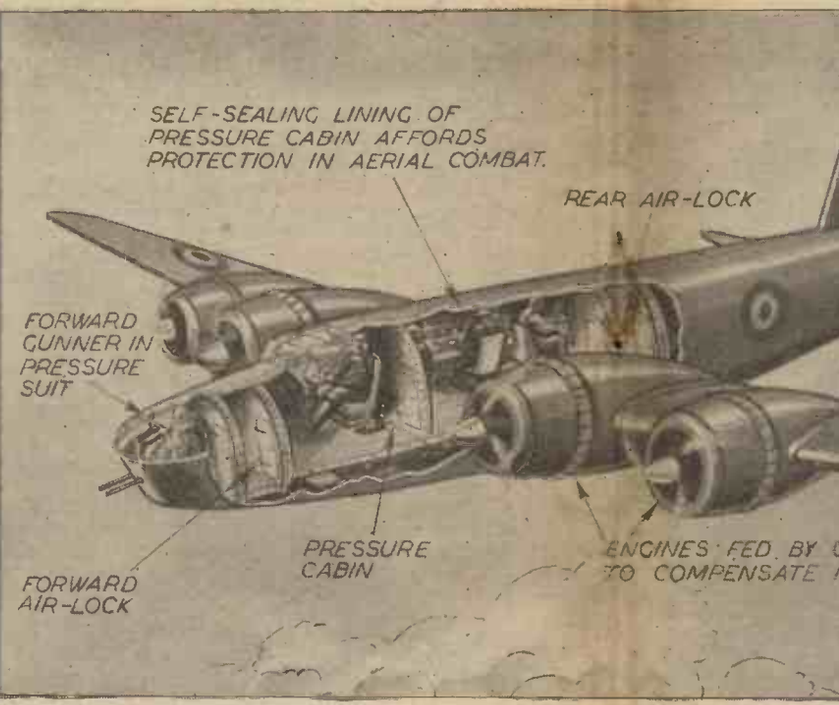
YET another novel torch device which will prove useful in the blackout. This device comprises a wrist strap, a holder for an electric light bulb and terminals for electrical connection to the bulb, to which flexible leads can be attached. These leads are threaded through the sleeve of the jacket and connected to the terminals, and to a battery which may be carried in the waistcoat pocket.

By manipulating the wrist, the circuit can be closed and interrupted quickly, as desired, without it being necessary constantly to move the switch arm.

Radiant Heat

AN application for an improved method of heating rooms has been accepted by the British Patent Office. In this system of heating a large area, such as the ceiling of a room, is made to radiate low temperature heat rays. The occupants of a room are warmed not by air but by direct adsorption of the rays. And reasonable air movement for ventilation can be obtained without loss of heat.

This new method of constructing a ceiling or wall for radiating electrically generated warmth in a building, comprises a layer of plaster board to form a base. Conductor elements interposed between insulating material are applied to the base to form a heating panel. Filling material is applied to the remaining portion of the base to produce an even, overall surface. And a final layer of plaster board is applied to the whole surface.



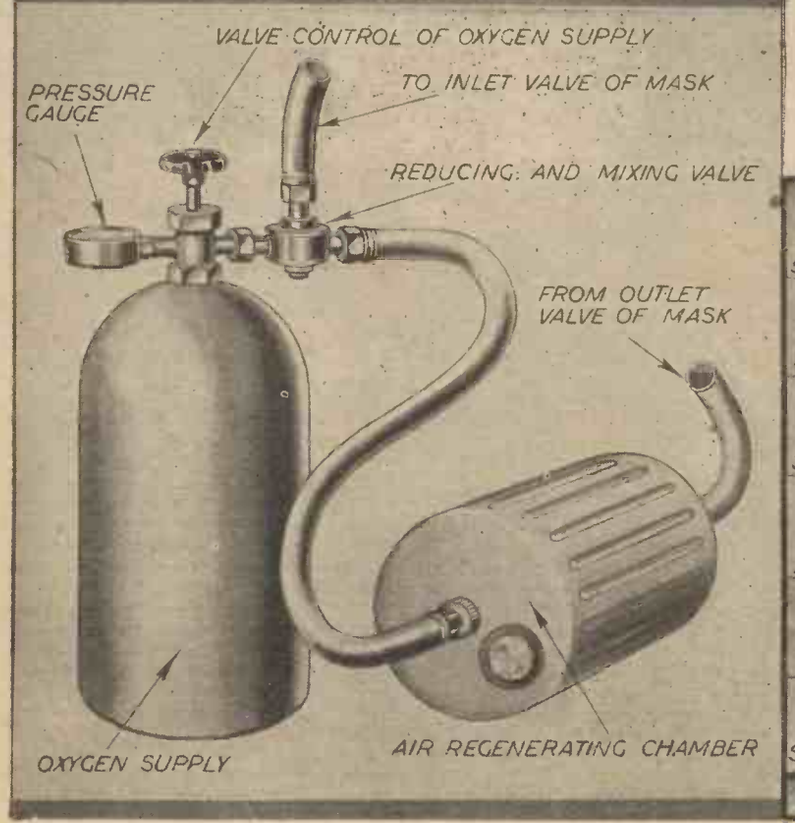
FLYING IN THE STRATOS

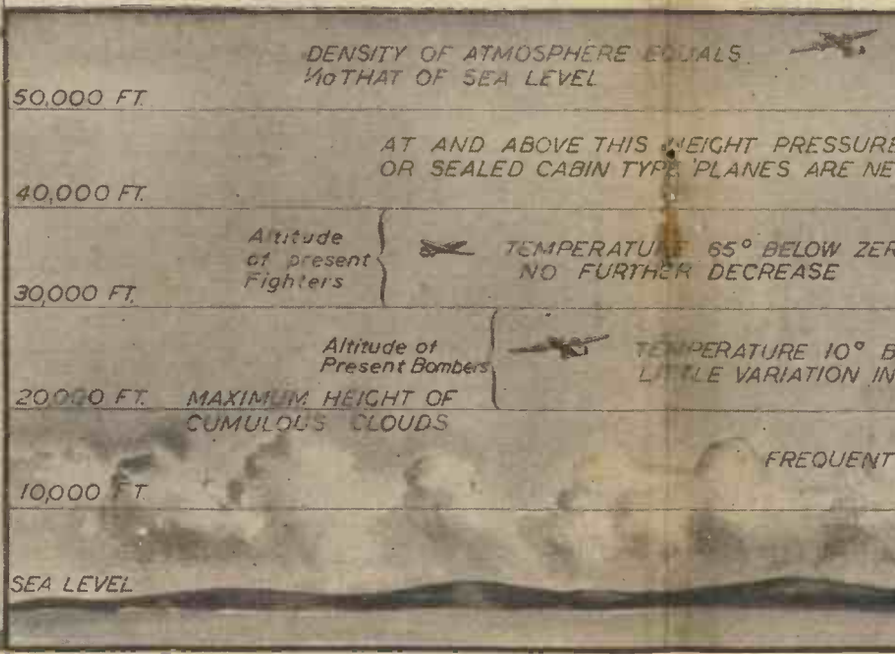
THE problem of flying at heights exceeding 40,000 ft. has been mastered, and to-day bomber aircraft conduct their operations at this great altitude. Owing to the rarefied atmosphere encountered specially constructed aircraft have to be used, as shown in the above illustration. Separate pressure cabins are provided for the crew, who are also fitted with pressure suits. The air in the cabins is warmed and maintained at ground pressure.

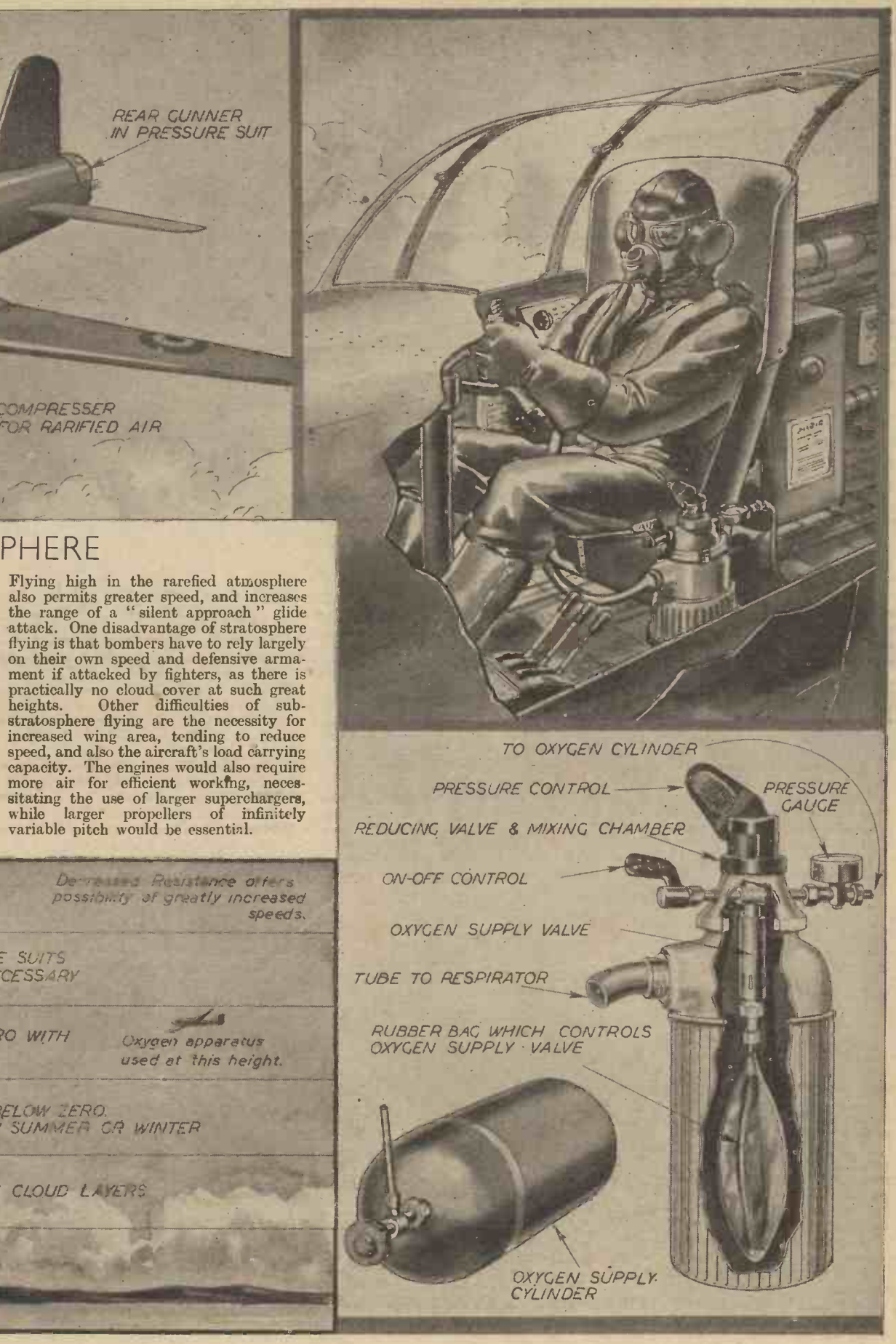
The illustration on the left shows the type of pressure suit an airman has to wear at heights above 40,000 ft. In this suit the air is used over and over again, thus economising in the use of oxygen. Below this illustration details are given of the oxygen supply apparatus.

For sub-stratosphere flying below 40,000 ft. a special "lung operated" type of breathing apparatus, as shown in the illustration on the right, is used. Details of the special type of oxygen apparatus used with this outfit are given in the illustration in the bottom right-hand corner. The illustration below indicates the atmospheric conditions at various altitudes up to 50,000 ft.

One of the advantages of flying at great heights is that it increases the time taken for fighters to climb to the attack, and also gives the pilots a better chance of avoiding searchlight and anti-aircraft fire.







PHERE

Flying high in the rarefied atmosphere also permits greater speed, and increases the range of a "silent approach" glide attack. One disadvantage of stratosphere flying is that bombers have to rely largely on their own speed and defensive armament if attacked by fighters, as there is practically no cloud cover at such great heights. Other difficulties of sub-stratosphere flying are the necessity for increased wing area, tending to reduce speed, and also the aircraft's load carrying capacity. The engines would also require more air for efficient working, necessitating the use of larger superchargers, while larger propellers of infinitely variable pitch would be essential.

The Story of Chemical Discovery

No. 10. The Origin of Organic Chemistry

IT may have been noticed by the reader that all the chemical substances which we have dealt with up to now have been those of a mineral nature. The chemical salts of metals, for instance, nitric, sulphuric and hydrochloric acids, the various sodas, the well-known chemical gases—these and many other similar materials are all derived from mineral or metallic products. Their sources have all been inanimate or non-living ones, and, relatively speaking, all these compounds are of simple and straightforward composition.

But what of the many thousands of materials which derive themselves from living sources? What of the well-known products of fermentation, such as alcohol and acetic acid, the many natural colouring-matters, the vegetable extracts, the products formed in the green cells of plants, and in the human and animal body? All these are definite chemical compounds, yet they are, in many instances, so enormously complicated in make-up or structure that they have, even in our present times, successfully taxed the utmost ingenuity of the modern chemist to elucidate their inner composition.

Such materials and compounds come within the province of what is now called *Organic* chemistry. Materials of metallic and mineral origin fall, for the most part, under the purview of *inorganic* chemistry, since, categorically, they are not the products of living organisms. There are, of course, certain compounds which come, as it were, within both these great chemical classifications, but these, mainly, are special instances which we cannot very well deal with in our present general survey of the subject.

Wherein lies the distinction between substances belonging to the domain of organic chemistry and those coming within the sphere of inorganic chemistry? In the first place, as we have already explained, many organic chemicals are the products of living organisms. But nowadays, of course, there exist thousands upon thousands of typically organic chemicals which have never been near a living organism. Asperin, T.N.T., Veronal, Benzene, "Congo Red" dye, Aniline and Acetylene are only just a random few of them, and if one had the available space it would be a matter of ease to write down several hundreds of such well-known characteristically organic chemicals which have not proceeded from living organisms.

Carbon Element

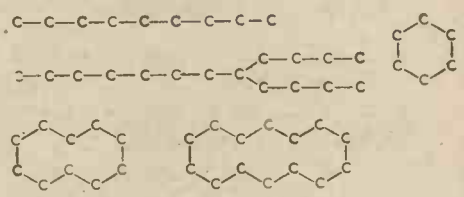
The fact of the matter is that the term "organic" as applied to chemistry is, in some respects, a misnomer. All the countless thousands of these organic substances which have been extracted from their natural sources by chemists or (and for the greater part) created artificially in the laboratory have one fundamental characteristic in common. They all contain carbon united with a small number of other elements, chiefly hydrogen, oxygen and nitrogen, and, now and again, with additional elements such as chlorine, bromine, iodine, sulphur, phosphorus and similar "incidental" elements.

Thus we may correctly say that organic chemistry is the chemistry of the compounds of carbon. This branch of chemistry has had the name "organic" given to it on account of the fact that originally all these carbon compounds were found in the "organic" world, that is to say, in the living world of animals, plants and even lower organisms. It

Friedrich Wohler, who made the first organic material (urea) from artificial sources

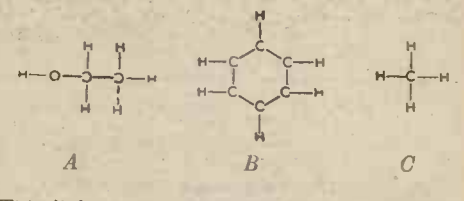
was only after the science of organic chemistry had been properly formulated that it was discovered that these chemical products of living matter could, for the greater part, be built-up or synthesised artificially in the laboratory and that, by studying the unique properties of carbon, their numbers and variety could be augmented quite indefinitely by the ingenuity of the chemical researcher.

Carbon—the common soot of our chimneys—is an element all on its own. Ordinarily, black carbon is not very active. Yet, inherently, carbon possesses the extraordinary and tremendously important property of being able to link its atoms up into chains, or into "rings" or clusters of rings, such as the following:—



Each of the carbon atoms in these linked chains or rings can link up with other atoms, mainly hydrogen, nitrogen and oxygen atoms, forming characteristic chemical compounds, the majority of which are highly important substances.

Take, for instance, a carbon linkage containing merely a couple of carbon atoms (diagram A).



A *B* *C*

This linkage of carbon and hydrogen atoms, together with one atom of oxygen, gives us the age-old "natural" liquid which we call *alcohol*. Scientifically, it is termed "ethyl alcohol, because, chemically speaking, the word "alcohol" now denotes a class of compounds (all of which contain the atom-group -OH) and not merely one particular compound.

Benzene

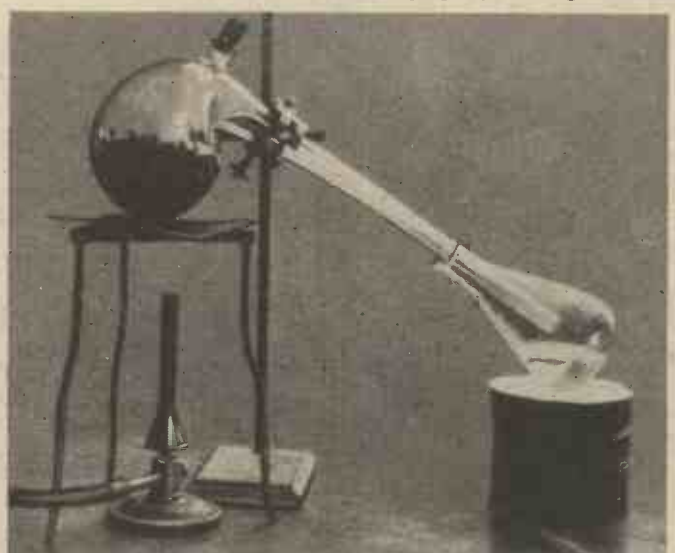
Again, if we arrange a chain of six carbon atoms in the form of a ring, and to each atom we attach a corresponding hydrogen atom, we obtain a well-known liquid which has the following structural composition (diagram B) This is benzene, the well-known limpid, inflammable liquid which is obtained from the distillation of coal. Chemists write it C_6H_6 thereby denoting that it embodies six carbon atoms and six hydrogen atoms, although if we wish to know how those atoms are actually arranged in relation to one another, we must have recourse to the "structural" formula given above.

Note carefully that benzene contains only carbon and hydrogen atoms. For this reason, it is called a "hydrocarbon."

Hydrocarbons

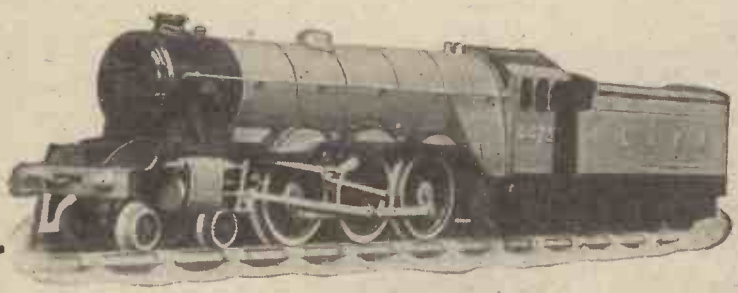
The hydrocarbons form a vast and a vitally important class of substances, the simplest hydrocarbon (and the simplest of all organic compounds) being methane, CH_4, which is a gas (formerly known as "marsh gas," and, in coal mines, as "fire-damp") made up by the union of one atom of carbon with four atoms of hydrogen (diagram C).

Paraffin, petrol and the various lubricating oils are complex mixtures of hydrocarbon liquids, the constituent carbon atoms, in these instances, being arranged in



Making acetic acid by the distillation of sodinm acetate with sulphuric acid. Acetic acid is a product of fermentation, but by the method illustrated it can be prepared artificially.

WARTIME IN THE MODEL WORLD



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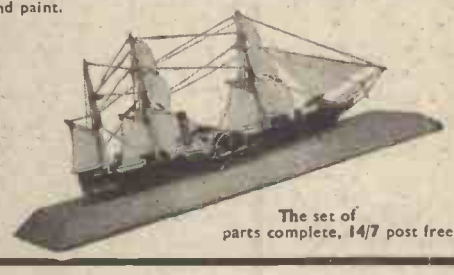

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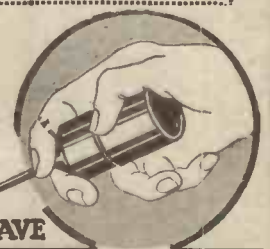

ALL MECHANICS *WILL* HAVE

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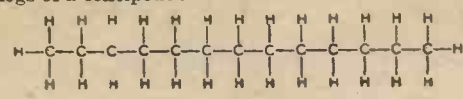
long chains or strings with the attendant hydrogen atoms attached to them like the legs of a centipede:—



"Organic" or carbon-containing materials were first recognised as such about the end of the 18th century. Chemists, previously, had divided up materials into three classes—animal, vegetable and mineral. Now materials became classified into two categories—mineral and non-mineral, and the view arose that it would ever be utterly impossible for any non-mineral or "organic" material to be prepared artificially since the production of any such substance needed the operation of a somewhat mysterious *vis vitalis* or vital force which was active during the life of a plant or an animal, and by virtue of which the organic material was brought into being.

Lavoisier, the great scientific prophet of the new Chemistry, who was so ignominiously put to death by the French revolutionists towards the end of the 18th century, published the fact that all these materials of living origin contain carbon and hydrogen, together with oxygen and sometimes nitrogen and phosphorus. But Lavoisier lived before his time, and his death by execution put back the clock of chemistry, so far as the carbon compounds were concerned, for at least a quarter of a century.

After the turn of the 19th century, chemical pioneers began to pay an increasing amount of attention to these natural products such as acetic acid, alcohol, camphor and so on. But little scientific advance accrued from such investigations, first in view of the fact that no definite system or theory of organic chemistry had then been evolved, and secondly, because of the extreme complexity of some of the chemical substances which these early researchers tried their 'prentice hands upon.

Friedrich Wohler

The first worker to make any real advance in the realm of these natural compounds was Friedrich Wöhler, a German, who was born at Eschersheim, near Frankfurt on 31st July, 1800. He entered upon a scientific career, first becoming a doctor and eventually taking a post as teacher of chemistry in the Berlin Trade School.

One of Wöhler's earliest scientific researches comprised an investigation of cyanic acid and its compounds. Incidentally, Wöhler must go down in history as the discoverer of metallic aluminium which he prepared in small quantity for the first time.

Wöhler's interest in the compounds of cyanic acid led him to the preparation of a white substance known as ammonium cyanate, which is the ammonium salt of the above acid. In 1828, Wöhler made the vital discovery that if ammonium cyanate be heated to 100 deg. C., it almost completely changes into urea.

Now urea is a typical natural product. It occurs to the extent of about 3 per cent. in human urine, and also in the urine of mammals, carnivorus birds and reptiles, having been first extracted from such sources in 1773. On account of its animal origin, it was considered to be impossible of artificial production.

Wöhler's preparation of urea from a purely "inorganic" material such as ammonium cyanate caused a great sensation in the chemical world of the time.

"I must tell you," wrote Wöhler in 1828, to his former chemical teacher, Baron Berzelius, "that I can make urea without the need of kidneys or of any animal whatever."

These words are memorable ones, for, inherently, they announced the birth of modern synthetical organic chemistry. Both ammonium cyanate and urea have the same number of atoms, and both substances may be expressed by the formula, N_2CH_4O. But when ammonium cyanate is heated, its component atoms methodically re-arrange themselves and acquire a new internal structure or pattern, with the result that ammonium cyanate, $NH_4.O.C.N.$, becomes transformed into urea, $NH_2.CO.NH_2$.

Curiously enough, this production by Wöhler of a typically organic material from a non-organic one remained the first of its kind,

Justus von Liebig who with Friedrich Wohler, laid the foundations of modern organic chemistry

almost until the middle of the century. Wöhler seems to have shied at further investigations into synthetical organic chemistry. "Organic chemistry," he wrote (again to his master, Berzelius) "is enough to drive one mad. It gives me the impression of a primeval tropical forest, full of the most remarkable things, a monstrous and boundless thicket, with no way of escape, into which one may well dread to enter." Hence it was that, in the years of his maturity, Friedrich Wöhler, turned to the less complex inorganic chemistry, in which he made many salient and important discoveries.

Von Liebig's School

One of the notable chemists who brought some sort of order and system to the chaotic mass of organic compounds was a lifelong friend of Wöhler's. Justus von Liebig was his name. He was born at Darmstadt on 12th May, 1803, and, in 1826, became Professor of Chemistry at Giessen, in Germany. Liebig's Chemical School at Giessen was the first of its kind. It embodied all the latest in apparatus and laboratory equipment. Consequently, it attracted students from all quarters of Europe, and quickly gained a superlative reputation for itself.

Liebig and Wöhler may rightly be called the originators of modern organic chemistry. Wöhler, by his first classical synthesis of the natural product, urea, from a non-living source and his consequent breakdown of the old *vis vitalis* theory, and Liebig by his efforts at classifying all the known organic compounds into a scientific system introduced into chemistry a new era.

Much of Liebig's work was experimental and practical. He devised new apparatus, among which may be mentioned the well-known "Liebig condenser," which is familiar to laboratory workers the world over. He worked a good deal on animal and vegetable extracts. The famous meat extract which still bears his name is the prototype of countless proprietary scientific foods and entitled its originator to the epithet, "Father of Food Chemistry."

In addition, Liebig did much hard spade work in the domain of agricultural chemistry. Indeed, he laid the foundations of modern agricultural chemistry, and he established our present-day knowledge of chemical fertilisers.

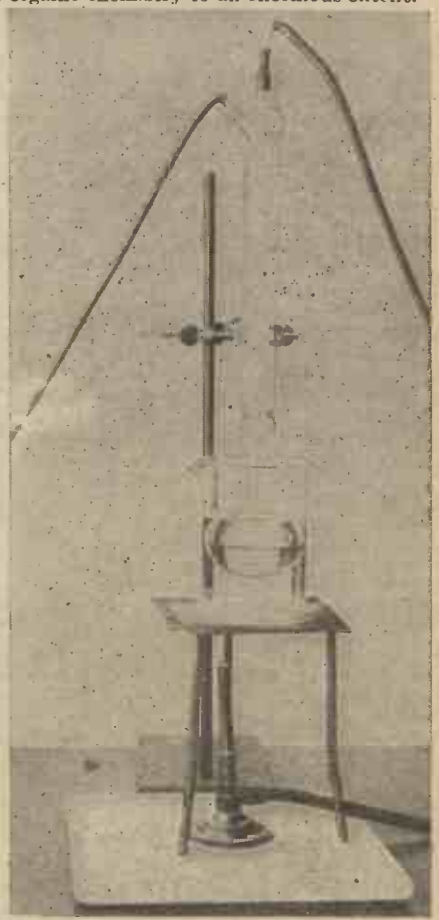
Liebig worked on physiological chemistry, especially on the chemistry of fat, blood, bile and other animal secretions. He studied the processes of fermentation, and of the decay of animal and vegetable matter.

Most of all, he inaugurated the principles of organic analysis, and made it possible for a chemist to determine the relative amounts of carbon, hydrogen, oxygen, nitrogen and other elements contained by any natural or organic compound. These analytical methods are still used at the present day, despite the century which has elapsed since their first formulation.

Justus von Liebig shines greatly as the discoverer of chloroform, which he first made in 1831, although the anaesthetic properties of this liquid were not utilised until Sir James Simpson applied them in 1848.

Liebig was an indefatigable worker, and a prolific writer. He wrote hundreds of papers on chemistry, together with several textbooks. He died at Munich on April 18th, 1874, predeceasing his friend and collaborator, Wöhler, by some eight years.

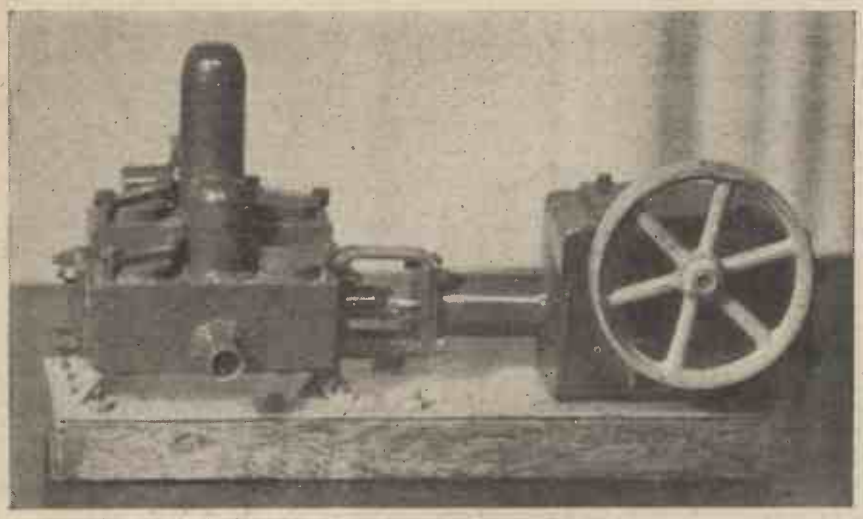
It was due to Liebig and Wöhler that the "radical" theory of organic chemistry originated. This theory, upon which modern organic chemistry arose, postulated that there exist in all organic compounds, "radicals" or clusters of atoms which are able to persist unchanged throughout a series of different, although related, compounds. The theory is too technical to discuss here. Suffice it to say, however, that it was a tremendously important one, and that it advanced the infantile science of organic chemistry to an enormous extent.



Laboratory apparatus for the extraction of alkaloids and other active agents from seeds and plant leaves.

THE WORLD

Motilus wishes all fellow of the season and



Model pump built from odd materials during the black-out evenings of last winter

A Schoolboy's Model Railway

HERE is a model railway designed by a schoolboy of 13 (he is 15 now), and this is what he says about it.

"I am writing this from Mill Hill School, at St. Bees (Cumberland), to which place we were evacuated the beginning of the war.

My line is L.N.E.R., although I have an S.R. and a French locomotive. The two stations are "Woodgrove" with the termini bays on the Up line, and the same on the Down line, with the two main lines running in between. "Condor Park" is a small two-road through station. Passenger trains are more important than Goods.

My line started as a clockwork railway, and then was converted into an electric line. The railway is laid out on tables in the attic of my house. On account of this, it has been difficult to get photographs, the tresses and beams *will* get in the way!

The design may seem strange, but the idea is this:—Up trains leave platforms 1, 2 or 3, get on the main line at A, and then cross over to the Up main line at B. They then proceed around the track as many times as I want them to, and then get diverted into platforms 4, 5, or 6 at C.

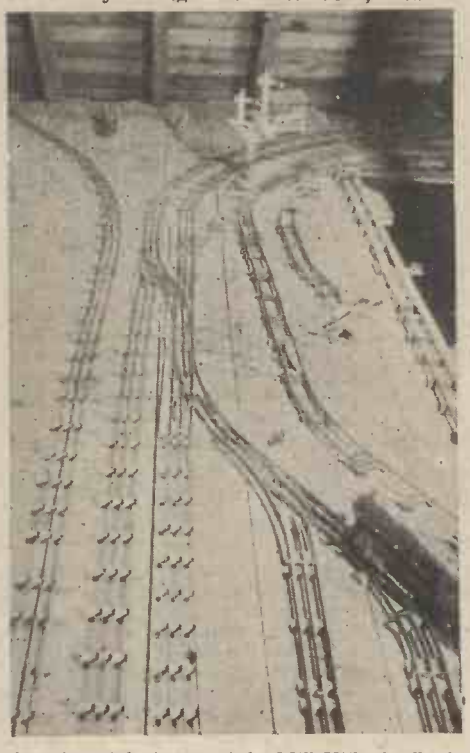
In the same way, Down trains leave platforms 4, 5, or 6, get on to the main line at C, cross over to the Down main line at D, and after going around the track several times, are diverted at A into platforms 1, 2, or 3. Then another engine can back on to the trains and take them out again.

I make my own rails, points and crossovers the electric pick-up rail being in the centre. As I wanted to get this rail cheaply and quickly made, I did not use chairs. My father had the idea of turning the rail, which is brass, upside down and nailing it to the sleeper with gimp pins. It is an inexpensive way, but a very temporary one, and as I get more time I am going to relay the track with proper chairs and wood keys. For points and crossovers I used Bassett-Lowke chairs with the keys cast in.

I make my own coaches with the Leeds Model Co. L.N.E.R. Litho sides. I have made eight of these, and one Travelling Post Office of my own design. These with a Pullman make up my passenger trains. I have about twenty goods trucks, all Hornby. I have limited expresses to 5 or 6 coaches, and goods to 6 feet in length to stop strain on the engine motors.

My electric locomotives run on 12 volts a.c., but as I have only one transformer, I can only run one electric engine at a time. The five engines (all Hornby) are:—Lord Nelson S.R. electric, the Riviera Blue engine Nord electric, Yorkshire L.N.E.R. clockwork, 4-4-2 Tank L.N.E.R. clockwork, and a small 0-4-0 shunting engine L.N.E.R. clockwork.

I have designed the goods yard working to keep free from one trouble. As most of my Hornby trucks have the old type of coupling, a 4 ft. or more goods train cannot be reversed without some of the trucks coming off the line, so all my sidings are continuous, and an



A section of the layout of the Mill Hill schoolboy's model railway.

engine can pull the train backward into the sidings without the trucks coming off. The shunting spur has three short sidings leading off it, they can take three wagons and an engine each. I use them mainly for my petrol wagons. All my old tinplate rails make up the goods yard. The dotted line (E, Fig. 2) shows where I might join up the goods yard to the main line at the other end.

I have no signals yet, but I hope to instal automatic ones when the track is finished. I have no scenery either. I have made two time-tables each lasting an hour, which I only use when my friends come and help me. Generally I work the railway alone, and then I run the trains as I want them."

As the photographs show, the railway is one any schoolboy would be proud to own, and, during holidays, it is open to any model enthusiasts or troops in the vicinity of Gravesend. (Address may be obtained from the Editor.)

A Model Pump

A Worcestershire reader sends this photograph of a model pump built mainly from odd materials. He says, "For five years my spare time has been devoted to designing and building model pumps. I started when I was thirteen years of age. This, my latest achievement, is the result of my experience gained during that time, and it has taken well over a year to complete. All brass tubing, steel plate, steel balls and nuts I purchased from Bassett-Lowke's. The pump's body is lead cast in a wooden mould with wooden cores, but having a sand bottom to prevent flaws. The brass cylinder and brass valve seatings were cast in. All other fittings and studs, except the safety valve, which has a flange, were soldered on by the blow pipe method."

Great use was made of soldering throughout the model. Lathe work was eliminated, but a bench drilling machine was found indispensable. From the illustration it may appear that the gland piece, that is, the link between pump body and crank case, is a casting, but actually it is made from a piece of steel plate, bent to shape and soldered.

With a Stuart Turner No. 10H engine and Babcock boiler No. 501, the engine and pump mounted on a baseboard form an interesting pumping plant with an output of 30 gallons per hour. (Suction and delivery pipes, $\frac{3}{8}$ in. Cylinder, $\frac{5}{16}$ in. bore, 1 in. stroke. Crankshaft

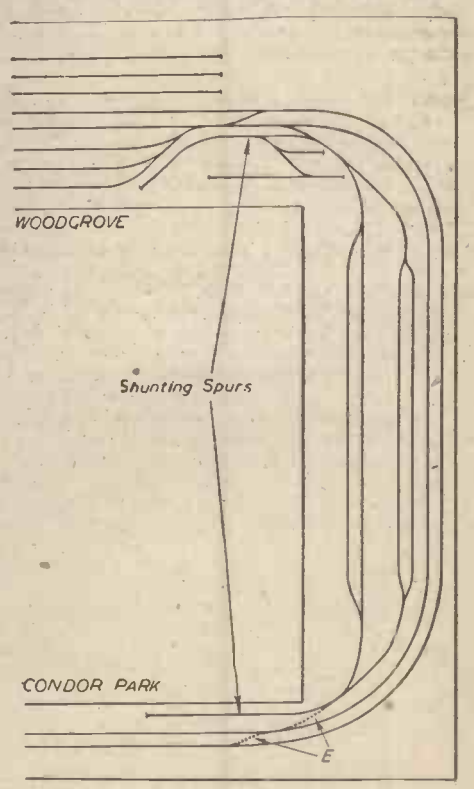


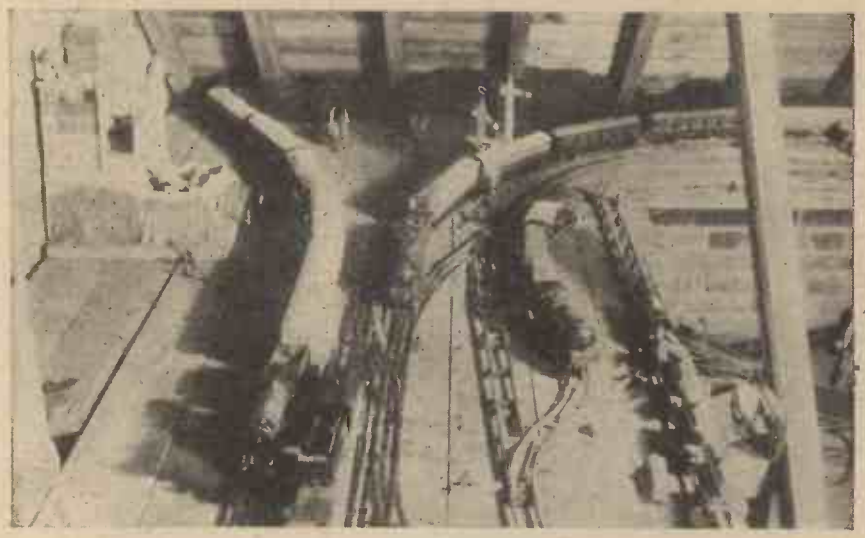
Fig. 1. Part of the track showing stations, etc.

OF MODELS—By "MOTILUS"

model lovers the compliments "good modelling."

speed, 140 r.p.m. Pinion driving shaft, 420 r.p.m.)

The owner, since leaving school two years ago, has been working on his father's farm, and spare time has been very limited. He made most of this model during the long evenings of last winter, and says, "It is probably my last model (while the war is on), and I think it is a successful conclusion to a most interesting hobby."



An interesting corner on the Mill Hill schoolboy's model railway

A Miniature Farm Wagon

I have often referred in these pages to the wonderful collection of models belonging to Mr. Charles P. Wade, of Snowshill Manor, near Broadway, Worcs. On my last visit I had the opportunity of examining the unique set of model farm wagons that are in his collection. They are all exquisitely made, mostly in boxwood, and every detail has been faithfully represented in a scale of 1½ in. to 1 ft. All wrought iron work on them is hand forged, and every working part functions. The collection numbers over 20, and includes the typical wagons of practically every county. The accompanying illustration shows the Hampshire wagon, which, as you will see, is a half locking type with rather shallow body, deepening at hind wheel position with the arched principle very similar to the Berkshire. This model was based on a careful examination of five wagons inspected at Monks Sherborne, near Basingstoke. The colours are yellow body, with red undercarriage and black ironwork—a very interesting example of an English farm wagon.

A realistic model of a Hampshire farm wagon

Model Luton-type Wagon

The list of Wilson Model Transport Vehicles grows. You will remember in our February 1941 issue, we gave some details of the Murray Wilson lorries for "OO" gauge. These little lorries in an incredibly short space of time have become quite famous, and have found their way to model railroads in Venezuela, Malay States, China, North America—and even aboard a Dutch submarine, whose Commander has a fleet of twelve of them on his "under the bunk" layout. Normally turned out with fixed wheel they can now be supplied fitted with revolving wheels at a small additional charge. Special features include cab glazing, treaded rubber tyres, moulded wheels with dummy brake drums, petrol tank and exhaust system. When revolving wheels are fitted, tyres, wheels and axles are all detachable.

The illustration is of the Luton type wagon, of the streamline van type, which has just been added to the range. Bassett-Lowke, Ltd., of Northampton, London and Manchester, are chief agents for the Murray-Wilson wagons.

And now a reference to the shortage of raw materials, which is confirmed by all my friends in the trade. I am afraid conditions will worsen as the war proceeds, which of course has first claim on all raw materials necessary for our great effort. The only thing we can weigh against this is the *very small* quantity of materials used in model making, and the *very great* interest the hobby creates.

My advice to model makers is to go on a shopping expedition when they have a little time, and collect everything they want for the model work they have in prospect for the winter.

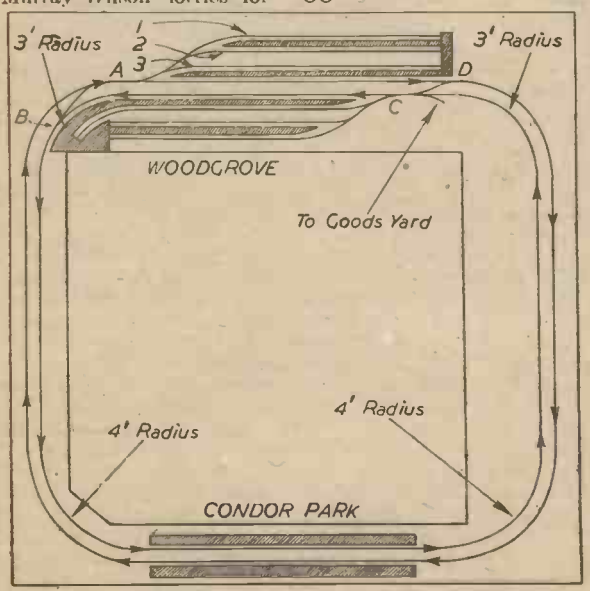


Fig. 2. Complete track layout for the model railway described on the opposite page.

One of the latest additions to the Murray Wilson series of gauge "OO" model wagons—the Luton type.

Grinding Attachment for the Lathe

A Useful Hand-driven Appliance for the small Lathe

WHERE grinding of small surfaces on turned work is required, and the model engineer has no overhead motion for his lathe, the very easily made rig shown in the accompanying drawings may be found a great convenience, and will enable accurate work to be done, either between centres, or in the three-jaw, or the collet, chuck. It is in two parts—the arbor and bearing, which carry the grinding wheel, and the large-wheel with its bracket and operating handle, which drive the arbor by a "V" or round belt.

The arbor bearing and the bracket carrying the driving wheel are both mounted in the holder of the compound slide rest of the lathe. This arrangement becomes necessary when an overhead is not available because the speed of the emery wheel must be very high, and the speed cannot be obtained by hand driving except by using a very large hand turned driving wheel, and a very small driven wheel on the emery wheel arbor.

Shank and Bearing

The shank A, Fig. 1, is a bronze (phosphor bronze or gun metal) casting made from a wooden pattern of the same shape. No cores or core boxes are required. It combines the bearing B which is integral with it. The shank A should be of a size to suit the tool holder on the lathe compound rest. The arm B, which is at an angle, is square in section; A is rectangular, as shown in the projected section. No machining is required on shank A, but it is filled up to fit the tool post.

The spindle C is of mild steel or cast steel—the latter for preference. It has a parallel part, D, and a tapered end at E. The parallel part acts as a bearing as well as the tapered part. The taper is to allow for adjustment. The rear end of the arbor or spindle is threaded of a diameter equal to its plain part. A fine thread should be used as this is for adjustment of the bearing. Fourteen threads to the inch would be suitable, and the thread should be long enough to take two three-sixteenth hexagon lock nuts F.F. and a steel washer G.

The remaining end of the spindle is parallel, the bottom thread diameter is threaded at the end, 14 threads to the inch. The plain part takes the pulley H which has a keyway engaging with the sunk key J in the plain part of the spindle or arbor. The threaded end takes the hexagon lock nuts K.K.

The forward end of the spindle has a shoulder at L, the end being reduced to a standard size to take the emery wheel, and threaded with a fine thread to take a washer and lock nut. This can be conveniently the same size as the thread which holds the pulley at the other end.

To machine the bearing B, chuck the stock in the four-jaw chuck with the shank A projecting outwards. It is then bored out using a straight fluted drill fed up by the poppet headstock. The drill should be $\frac{1}{8}$ in. under the size of the parallel part C of the spindle. The hole is then bored out to fit the spindle snugly with a long boring tool.

The spindle will have been turned to the shape as previously described, and the taper part at E turned by setting the top-slide over. The taper on the spindle can now be used as a setting gauge to set the tool for boring out the taper in the bearing to fit the spindle. To turn the bearing taper a long mandrel should be chucked in the three-jaw chuck projecting enough to allow the shank A to clear the chuck, and of a length to reach up inside the bore to $\frac{1}{4}$ in. back at the end of the taper. The mandrel should be turned a driving fit in the hole in the bearing and the casting driven on. The taper can then be turned at the end using the arbor or spindle as a gauge for fitting.

A small amount of clearance in the bored hole A should be recessed at M when finally boring the casting at the first chucking. This will provide an oil reservoir and an oil hole with countersunk top should be drilled in the top of the casting to lead oil to it.

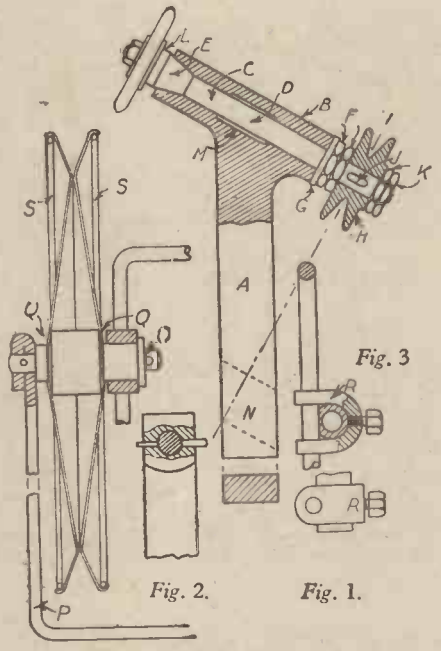


Fig. 2. *Fig. 1.* *Fig. 3*

Sectional details of a hand-driven grinding attachment for a small lathe.

The pulley H is cast in brass or other suitable metal from a plain disc pattern and a keyway cut in it to take the recessed key J in the spindle.

Pulley and Bracket

The small pulley and its attaching bracket is shown in Fig. 2. The bracket is made of $1\frac{1}{4}$ in. by $\frac{1}{4}$ in. steel bar. Its top end is turned over on itself, as shown, to form a thickening to take the bearing pin on which the spindle pulley rotates. The bottom end of the bracket is turned at right angles and may have to be reduced in thickness. It is fitted in a slot cut diagonally in the under side of the shank A of the grinding attachment. The angle slot is shown dotted at N in Fig. 1. Its centre lines up with the centre of the spindle pulley wheel as indicated by the central dotted line.

The inturned bottom end of the bracket is screwed to the shank A (Fig. 1) and fits the slot snugly. Two countersunk screws are used, and it is advisable to tin the bracket and the shank to sweat them together, while screwing up the screws. The doubled-over top end of the bracket is bored for a parallel spindle O which should be a drive fit in the hole. A taper pin at O holds the spindle tight (see Fig. 2). The other end of the spindle has a brass washer held up to the boss of the wheel by a similar taper pin. The boss or hub of the wheel is of brass, and is a close running fit on the spindle. It has a central part having two outside faces Q.Q. turned at a slight angle. The projecting part of the boss or hub extends further on one side than on the other so as to take a crank handle by means of which the wheel is rotated by hand.

This handle is of $\frac{1}{4}$ in. Bessemer rod and is held to the boss by fitting in a half round slot filed in the boss. A bent clip, shown in the end and top view in Fig. 3 at R, fits round the hub and has two holes through which the handle passes. A hexagon set screw, screwed through the opposite side of the clip, when screwed up holds all fast and provides an adjustable fixing for the crank handle, the throw of which can be adjusted as desired.

Built-up Driving Pulley

The large pulley is made of two sheets of thick tinned iron, commonly known as tin plate as used by tinsmiths. The two discs are knocked over at their edges so that, when placed together as shown, they form a V-groove for the belt. They have holes to fit on the shoulders at Q and Q (Fig. 2) of the hub. To dish them as shown they are simply cut from periphery to centre and one edge overlapped over the other and soldered. They are then placed on the hub and soldered to it, and the meeting of the discs at their periphery, which forms the V-groove for the belt, are soldered together.

Finally a bead S, of $\frac{3}{16}$ in. round brass wire, is bent round for each disc and soldered to the extreme edge of the discs to stiffen the edge, and make a strong and neat finish, when the edge is knocked round it and soldered.

The belt-bed diameter of this pulley may well be six times the diameter (effective belt-groove diameter) of the pulley on the grinding wheel arbor, increasing the emery wheel speed by 6 to 1 of the handle turning speed.

The design shows a shank and bearing at an angle and not square. This makes the tool very much more usefully applied for face and slide work than could an arrangement where the shank were square with the grinding spindle axes. It prevents the small pulley fouling the work and makes the grinding job—face or diameter—much more accessible. The length of the bracket P, carrying the driving wheel, from the spindle to the bend at its foot will be determined by the particular tool post arrangement on the lathe compound rest, so that the driving wheel clears the tool post. The length of the foot will also be determined by this. It will be advisable, also, to strengthen it at the corner by brazing in a web of as great a width as the circumstances of the lathe design will allow.

Curiosities of Canning

Foodstuffs of Former Years which have Remained Good for a Century or More

THE world, in peace time as well as in war, is relying to an ever increasing extent upon the various scientific canning processes which have been devised for the preservation of foodstuffs.

There was a time when, quite unjustifiably, canned foods were looked upon as being unwholesome, if, perhaps, palatable. Such opinions have, however, for the most part, been formed in ingorance of the facts, since the essentially nutritious nature of properly canned foods has never been seriously in dispute. Nowadays, the store of canned foods is the standby of every housewife as well as that of nearly all catering establishments and institutions which are rationed on a wartime basis. Canned food provides not only our iron rations, but, in addition, our store of delicacies, for it is by means of the up-to-date canning processes that foods and their flavours are conveyed safely and conveniently to nearly every quarter of the world.

The fundamentals of canning were laid down by a Frenchman, Nicholas Appert, who, undisturbed by the troubled years which prevailed at the end of the 18th century, worked away at the problem of preserving foodstuffs in his house at Massy, in France. Appert clearly demonstrated the fact that if a foodstuff was heated and then sealed away in a container under what we now know as perfectly sterile conditions, the preserved material will not putrify. In fact, Appert showed that a suitable foodstuff could be preserved in this way with all its flavours and palatability for a number of years, and without any decrease in its store of nutriment.

Appert preserved his foodstuffs in tightly-sealed glass bottles and, by this means, he preserved milk, fruits, meats and vegetables for the French Navy.

The introduction of "tins" into the practice of canning was apparently brought about by a couple of Englishmen, John Hall and Bryan Donkin, the former being the founder of the Dartford Iron Works, and the latter a Fellow of the Royal Society. Whether Hall and Donkin obtained their ideas directly from Appert is still in some dispute, but since it was these men who first put foodstuffs into convenient metal containers, they may certainly be looked upon as the true fathers of the world's canning industry.

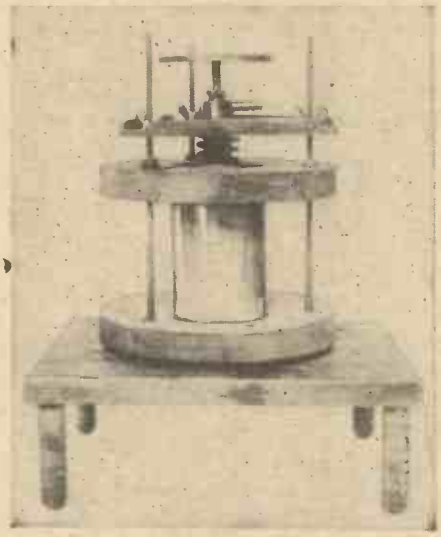
Early Canners

Hall and Donkin introduced their canned foods about the year 1813. They were highly successful in their activities, and their "embalmed provisions," as the Hall and Donkin tinned foodstuffs were termed by certain Naval officials of the day, rapidly rose to a status of considerable importance in the minds of the Admiralty authorities. All told, it is estimated that Hall and Donkin supplied nearly 24,000 cans of preserved meat (in fifteen different varieties) to the Admiralty, as well as several varieties of canned soups and vegetables. It is, indeed, from Hall and Donkin's original "Soup and Bouilli" ("Bouilli" being a term for boiled or stewed meat) that the celebrated appellation of *bully beef* originated among the men of the Services.

In 1824, the Hall and Donkin enterprise supplied a large quantity of canned meat for the provisioning of the expedition of Sir Edward Parry, the explorer, in search of the North-west passage. A few of these tins which were taken by Parry to the Arctic in 1824 were brought back, and they were again included in Parry's fourth expedition in 1826, being finally again returned to London unused.

Eventually, one of these tins of roast veal found its way into the Royal United Services Institution at Greenwich, and a similar tin containing carrots and gravy was placed unopened in the National Maritime Museum, also at Greenwich.

There these historic tins, the sole representatives of what were practically the world's first canned foodstuffs, remained until recent times. Interest having been aroused in the subject of the entirely unique examples of early canned foodstuffs, it was decided to open the cans under strictly scientific conditions, and to examine their contents both chemically and bacteriologically.



The apparatus used for piercing the lids of the historic cans of preserved foods, and for collecting the internal gases for analysis.
(Courtesy of International Tin Research Council)

The design of the opening apparatus necessitated some care and thought, since it was essential to collect and examine any gases which might have been generated in the cans with the passing of the years. After some preliminary experiments, an apparatus was constructed which enabled the cans to be punctured whilst, at the same time, not allowing any of their internal gases to escape into the external atmosphere.

A can of roast veal made in 1824 which has been opened and found to be in good condition.
(Courtesy of International Tin Research Council)

Tinned Meat 115 Years Old

The cans were opened in the bacteriological laboratory of the Food Manufacturers' Research Association in the presence of a number of interested scientists. The oldest of the cans, those above-mentioned, were nearly 115 years of age. When the can of Hall and Donkin's roast veal which had been to the Arctic twice, was opened, gases escaped into the collecting apparatus at such high pressure that it became impossible to measure the gas pressure which had prevailed inside the tin. These gases had been formed not by any decomposition of the food contents of the can, but by the action of the liquid in the can on the walls of the latter. The gas comprised mostly hydrogen, there being about 85 per cent. of this gas in the tin, the remainder of the escaping gases being carbon dioxide and nitrogen, with a just perceptible trace of oxygen.

On turning out the contents of the tin, about 3¼ lbs. of perfectly cooked meat, together with some thin milky fluid, were obtained. The meat had a bright pink colour, like tinned salmon, but this colour quickly changed to the brownish-grey colouration of cooked meat. The meat was in excellent condition and, furthermore, its fat retained more than half the amount of Vitamin D (the fat vitamin) which it must originally have had 115 years previously. Rats and cats ate portions of the meat with avidity and without any harm.

The tin of carrots and gravy also contained high-pressure gases, the main constituent of which was hydrogen. The carrots to the eye, looked perfectly fresh, like cold carrots left over from a lunch or dinner. These 115-year-old carrots had a sweet taste with just a perceptible metallic flavour, and further examination showed them to contain almost a normal amount of carotene, which is the parent substance of Vitamin A, so essential in preserving the individual from night blindness.

What was, perhaps, the most astounding feature of the Hall and Donkin tin of carrots and gravy was that, on bacteriological examination, it was found to contain the living spores or seeds of certain bacteria, germs, which, although in a quiescent condition, were definitely alive even after their more than a century's confinement in their iron coffin.

Vitamins Preserved

The examination of these historic cans of more than a hundred years old food showed that bacteria are, as has long been suspected, possessed of amazing powers of endurance and vitality. It demonstrated, also, the facts that foods and even their contained vitamins are capable of surviving long years in a sealed container and that even after the elapse of a century it is possible for a properly canned foodstuff to retain much of its palatability and its original nourishment.

Since the opening of the Hall and Donkin tins of roast veal and carrots and gravy, other historic cans of foodstuffs have similarly been scientifically examined. For example, a tin of roast beef supplied to the 1852 Arctic expedition under Captain Sir Edward Belcher, was opened

and found to be in fairly good condition, although not so palatable as the Hall and Donkin roast veal owing, no doubt, to an inefficient system of canning. The meat, in this instance, was in a solid "pack," similar to our present-day corned beef, and not unlike it in general colour and appearance.

Tins of dried powdered carrots which had been supplied for the British Crimea expedition, and which had been originally packed about 1855, were also examined. Three such tins were available. Their lids fitted tightly, but were not actually sealed. The tins were badly rusted on their outsides, but inside, the tins had been carefully lined with brown paper, and the metal surface of the interior was actually bright and shining. The vegetable contents of the tins presented the appearance

An 1824 can of "carrots and gravy" in which living spores of bacteria were found. The contents of the can were in perfect condition.

(Courtesy of International Tin Research Council)

of a brown powder which had been compacted into a hard mass and which gave forth an odour of curry. The foodstuff, however, was not in as good a condition as were the tinned carrots of Sir Edward Parry's 1824 expedition.

A tin of tripe manufactured about 1880 was examined. This early example of American canning proved to be in first-class condition. A similar tin of tripe had shortly before been consumed by a provision dealer who had discovered the two tins after they had lain long-forgotten for nearly sixty years, and who had averred that he had felt no ill effects from his feast of this foodstuff of former times.

The tripe was in good condition, except in one or two places where it had been in contact with corroded parts of the tin. It was fed to rats over a period of nearly three weeks and without any harm occurring to the animals.

"Portable Soup"

Perhaps the oldest foodstuff which has come down to our modern world is a cake of "portable soup," made about the year 1771, and carried by the celebrated Captain Cook on his voyages of 1772-1773. This unique exhibit had lain in the Museum of the United Services Institution at Greenwich.

Captain Cook's "portable soup" had the appearance of ordinary glue. It comprised a flat slab roughly 4 inches by 3½ inches in area and about two-thirds of an inch in thickness. It is supposed that the "portable soup" was originally prepared by some process analogous to that of glue-making, i.e., by the careful evaporation of vegetable and meat "stock." The "soup" had remained free from putrifaction in precisely the same way that solid glue resists all putrescent influences, being entirely free from contained water. A small amount of the cake of "soup" was dissolved in water. It formed a clear, pale yellow solution, but, after the elapse of the years, the soup substance had become completely inodorous and almost completely tasteless.

No doubt, as time goes on, other interesting examples of early preserved foodstuffs, canned or uncanned, will turn up and will be submitted to scientific examination and analysis.

Such foodstuff freaks point to the lesson that canning, at least, is definitely an entirely satisfactory mode of preserving foods over long periods, provided that the process is carried out with care. Meats, properly heat-sterilised, are, perhaps, the most stable of foodstuffs to can, for, in such a condition, they may be preserved almost indefinitely. Fruits are not so satisfactory to can, for the acid in their juices attacks the interior tin of the can, which action not only deprives the stored fruit of its attractive colour but, worse still, takes away greatly from its palatability.

Canned Vegetables and Fruit

To some extent, but to a considerably less degree, the same applies to the canning of vegetables. In recent years, however, many of the drawbacks to the canning of fruits and vegetables have been permanently overcome by a proper understanding of the importance of effectively lacquering the interior of the can so that a barrier is interposed between the fruit or vegetable acids and the tin lining of the can. Canned fruits in well-lacquered tins will remain in good condition for years, providing that the lacquer lining of the can is uniform and continuous and free from pin-holes.

Jams keep well in cans, as also does honey. Unsweetened milk may safely be stored in cans for three years or so, but sweetened milk is one of the most unsatisfactory of foods to can, since it does not usually remain in good condition for more than a year.

In former years, cases of ptomaine poisoning through eating canned meats were not infrequent. This was due to canned foodstuffs not being thoroughly sterilised in the first instance. Nowadays, such cases of poisoning are few and far between. Canning has become a high science as well as an art, and the principles and importance of adequate sterilisation are well realised.

The juice of fruits must not dissolve more than about 300 parts per million of metallic tin from the walls of the can, otherwise the fruits may be injurious to health, since tin salts are poisonous. But nowadays, most fruit tins are double-lacquered on their insides, so that, even after years of storage, contamination of the fruit juices with dissolved tin rarely exceeds 80 parts per million.

If a can of foodstuffs is observed to have bulging ends, it is a sign that internal gas pressure exists and that something has gone awry with the well-being of the contents of the tin. Such cans should always be rejected or, at least, treated with caution. But nowadays these bulging, gas-generating cans of foodstuffs are seldom, if ever, met with by the public. The "embalmed provisions" of Hall and Donkin, originally designed for long expeditionary voyages, have, in our time, evolved into the delicacies of our civilisation. Canning, as an art and a science, has an interesting history behind it and few branches of modern industry have more greatly excelled in their products than the present-day practice

An 1852 tin of preserved meat recently examined by food experts.

(Courtesy of International Tin Research Council)

of foodstuff canning which, particularly in wartime, provides us with ample amounts of clean, wholesome, fresh and palatable food.

Roget's Dictionary of Electrical Terms. By S. R. Roget, 432 pages. Published by Sir Isaac Pitman and Sons, Ltd. Price 12s. 6d.

THIS book is now in its fourth edition and has been revised and enlarged. In the compilation of this collection of expressions in common use in the science and applications of electricity and magnetism, the endeavour has been made to steer a middle course between incompleteness and a redundancy which would defeat the objects of the work by inconvenient bulk and clumsiness in use. The subject matter has, therefore, been kept within the electrical side of the boundary, even where it interlocks considerably with neighbouring branches of science or practice. The range covered embraces electric light, power and traction, electrical communication, including radio and other miscellaneous applications in some detail, as well as the general science of electricity and magnetism. It will be noticed in comparing different explanations that the standard of knowledge assumed on the part of the reader is somewhat variable.

Air Cadets Handbook No. 1. Navigation and Signalling. By W. J. D. Allan. Published by George Allen and Unwin. 80 pages. Price 2s. net.

THIS handy little book is intended for the young men who are now joining the Air Training Corps. The author, who has had many years experience of air navigation training, deals with the subject in a very comprehensive manner. There are seven chapters, the first six covering subjects including The Form of the Earth; Rhumb Lines; Conical Projections; Mercator's Projections; Use of Maps; Drift; Map Reading; Deviation; Compasses; and Time and Speed Scales. The seventh chapter deals with Signalling; The Aldis Lamp and the Morse Code. Various parts of the text are illustrated with explanatory diagrsms.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 96 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.

Purifying CO_2 Gas

FOR many years I have made my own "soda water" for drinking, using "bought" CO_2 gas for the purpose. I now propose to make my own CO_2 gas in a glass Schrodter apparatus from commercial HCl and washing soda. I presume that this gas will be tainted by impurities from the two commercial quality acids in the Schrodter apparatus, and the impure washing soda. Please state how I can free the CO_2 from these impurities sufficiently for my purpose.—G. H. Child (Hove).

IT is not a very safe proposition to manufacture your carbon dioxide gas for carbonating purposes from impure acids, since impure mineral acids usually contain a little arsenic, which latter may easily contaminate the carbon dioxide gas and prove difficult to remove. At a very little extra cost, you could employ pure acids, such as pure hydrochloric acid, and at once overcome this difficulty. Furthermore, bicarbonate of soda would give a purer gas than ordinary washing soda.

However, as a general rule, you will find that the main impurity in the generated gas will be acid vapour, mechanically carried over by the gas. This can be removed by passing the gas through three containers, the first containing marble chippings through which the gas can flow *upwards*. The second container is filled with a 5 per cent. solution of bicarbonate of soda, through which the gas is bubbled, whilst the third container contains a 1 per cent. solution of sodium bicarbonate. The stream of carbon dioxide gas after passing through these containers, will be sufficiently pure for carbonation purposes, but, of course, if impure materials are used the possibility of arsenic contamination must always be borne in mind.

Earth Content

WHAT percentage of the following are contained in the earth :—calcium nitrate, magnesium sulphate, potassium phosphate and ferric tartrate ; also the quantity to make one gallon of the solution ?—G. L. (Yorks).

IT is, unfortunately, quite impossible for us to give you actual figures referring to the percentages of the chemical substances you mention in earths and soils, for the amounts of these materials vary enormously not only in different localities, but at different depths of soils and under different climatic conditions. Ferric tartrate is very seldom present in soils. Calcium nitrate and magnesium sulphate, being easily soluble, are usually washed away and quickly removed by rains from subsoils and potassium phosphate usually exists, even in fertile soils, only in slight traces.

The amount of the different salts which can be dissolved in a gallon of water depends entirely upon the required strength of the resulting solutions. Calcium nitrate is extremely soluble and will readily dissolve in less than its own weight of water. Magnesium sulphate will dissolve in about twice its weight of water. Potassium phosphate is similarly soluble. Ferric tartrate is less soluble. The amount of any of these salts which can be dissolved in any given quantity of water depends, also, upon the temperature of the water.

Thermo-couples

I HAVE recently seen references to a thermo-electric densitometer employing a silver-bismuth thermo-couple.

Can you please give me the general principle of such a thermo-couple and its approximate sensitivity to light? How would it be used in this instrument? Are these thermo-couples purchasable, if so, can you give me the approximate cost?—G. Ormerod (Abu-Sueir, Egypt).

THERMO-COUPLES are not sensitive to light rays. Some of the more delicate thermo-couples, however, are sensitive to the heat rays accompanying some light rays, and, in virtue of this fact, are able to give some measure of the radiation passing through a given medium and falling upon them. The silver-bismuth thermo-couple operates upon ordinary thermo-couple lines, that is to say a silver element and a bismuth element make contact at one end, the opposite ends being connected together through an external circuit containing the necessary current-measuring apparatus. Heat falling upon the contacting ends of the two dissimilar metals sets up a thermo-electric effect, the result being that a very small current flows in the external circuit. In order to increase the amount of current, thermo-couples are often constructed by combining a number of single thermo-couple contacts in the one instrument.

As we have already explained, the silver-bismuth thermo-couple (or any other thermo-couple, for that matter) is not actually sensitive to light. Its sensitivity to the heat rays admixed with light depends upon their radiating source and the screen, medium or filter, through which they have passed. It is possible, however, to make very delicate thermo-couples. Some of these are fixed in the eyepiece of a telescope, and are able to measure the heat radiations of stars situated countless millions of miles out in space. We doubt whether you will be able to purchase a silver-bismuth thermo-couple of the type you mention. You might, however, try the General Electric Company, Wembley, and, also, Messrs. Electradix Radios, 19 Broughton Street, London, S.W.8.

Phosphorized Ether and Ethyl Iodide

I SHALL be glad if you will give me information on the following subjects:

(1) What is phosphorised ether, and how can I make it?

(2) I have some ethyl iodide, which I have prepared myself by the usual method, from iodine, red phosphorus, and ethyl alcohol. How can I keep it to stop it from going brown, due to the separation of iodine, as it invariably does in ordinary circumstances?

(3) I have in my possession a very good set of chemical weights, but they are in grains; as most modern chemical books give the weights in grams, how may I convert grains to grams, and vice versa?

(4) I want to obtain an arc lamp. Can you tell me of a good firm where I may obtain a second hand one at a reasonably cheap price?—J. S. E. Gilbart (Bury St. Edmunds).

A PHOSPHORISED ether is merely a solution of yellow phosphorus in ether. It is a dangerous solution to prepare, and still more dangerous, perhaps, to keep. We would advise you not to attempt to prepare this solution.

(2) Ethyl iodide invariably undergoes slight decomposition, with the consequent liberation of free iodine, when allowed to stand in contact with air, moisture and/or light. In order to obtain perfectly colourless ethyl iodide, you must distil the liquid *in vacuo* at as low a temperature as possible, and the distilled liquid must be sealed up in a tube or other vessel and then stored in the dark. Even under these conditions, the ethyl iodide may gradually darken in colour, particularly if it is slightly impure, and if air and moisture remain within the tube.

(3) To convert grams into grains, multiply by 15.43. To convert grains into grams, divide by 15.43.

(4) You may be able to obtain a second-hand arc lamp from Electradix Radios, Ltd., at address given above.

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Phone: Temple Bar 4363

Telegrams: Newnes, Rand, London

Comments of the Month

By F. J. C

"The Incorporated Institute of Cycle Retailers and Repairers"

THE National Association of Cycle and Motor Cycle Traders is making efforts to form a body which will improve the status of the Retail Cycle Trade. The new body is the Incorporated Institute of Cycle Retailers and Repairers, and this has since been incorporated. The objects of the Institute are the setting up of a standard of efficiency for dealers, mechanics, and managers, and the certification of that standard by the granting of certificates to all who pass the examination.

We welcome this move, for too long has the cycle retail trade been the victim of any opportunist who cared to take some back street dwelling, stock a few accessories, call himself a cycle engineer or repairer, and thus draw profits which should go to the legitimate retailer. If the scheme is properly carried out, it must result in an improvement in the status of cycle dealers.

The greengrocer-tobacconist-wireless-gramophone-newsagent-cycle dealer should go. Members of the public are entitled to expect efficiency, especially in the matter of repairs. We do not know how far this Institute will duplicate the work of The British Society of Motor Cycle and Cycle Manufacturers and Traders, which has done much to improve the status of the cycle retail trade by refusing to supply its goods to any except approved retailers. Membership of the Institute should not be made too easy, nor should there be any loopholes by means of which unqualified people are able to become members, and thus by using the Institute's official abbreviation after their names are able to convey to the public the impression that they are qualified cycle repairers when they are not. The status of the Institute should be kept high, and if possible it should be modelled on the lines of the Institution of Mechanical Engineers, the Institution of Automobile Engineers, and the Institution of Electrical Engineers.

Members without Examination

ONE of the problems which always confronts Institutions concerns the admittance as members without examination of those who can prove that they are qualified without it. We suppose, therefore, that in the rules of the Institute there will be a proviso which will safeguard legitimate and experienced traders who have been in the business for so many years that they are established and their reputations unimpeachable. Many such may not be able to pass an examination, but they are none the less qualified. The work of the Institute will not fructify for a number of years, for it will take some time to weed out the qualified from the unqualified and to rebuild the retail selling side of the cycle industry, even if that is achieved. From a preliminary inspection of the objects of the new Institute we feel that it is modelled on proper lines. For example, it is proposed that there shall be three grades of membership: Fellows who shall be entitled to use the qualifying letters, F.I.C.T., and the designation "Incorporated Cycle Trader and Repairer"; Corporate Members who shall be entitled to use the designation of "Incorporated Cycle Traders and Repairers," but without qualifying letters, and "Associates" who shall be entitled to use the qualifying letters A.I.C.T., and the designation of "Certified Retail Cycle Manager" or "Certified Cycle Mechanic," as the case may be. It will not be possible for persons to obtain the diplomas and other qualifications merely by joining and paying a fee.

The qualifications required of a Fellow are: That he has attained the age of 25, has been engaged in the trade for at least three years immediately preceding the date of his application, and that he conforms to the official definition of a bona fide cycle trader as laid down by the N.A.; that he has passed such examinations as may from time to time be prescribed or approved by the Council, and acquired a theoretical knowledge of the trade, both in its retailing and repairing branches.

Corporate Members

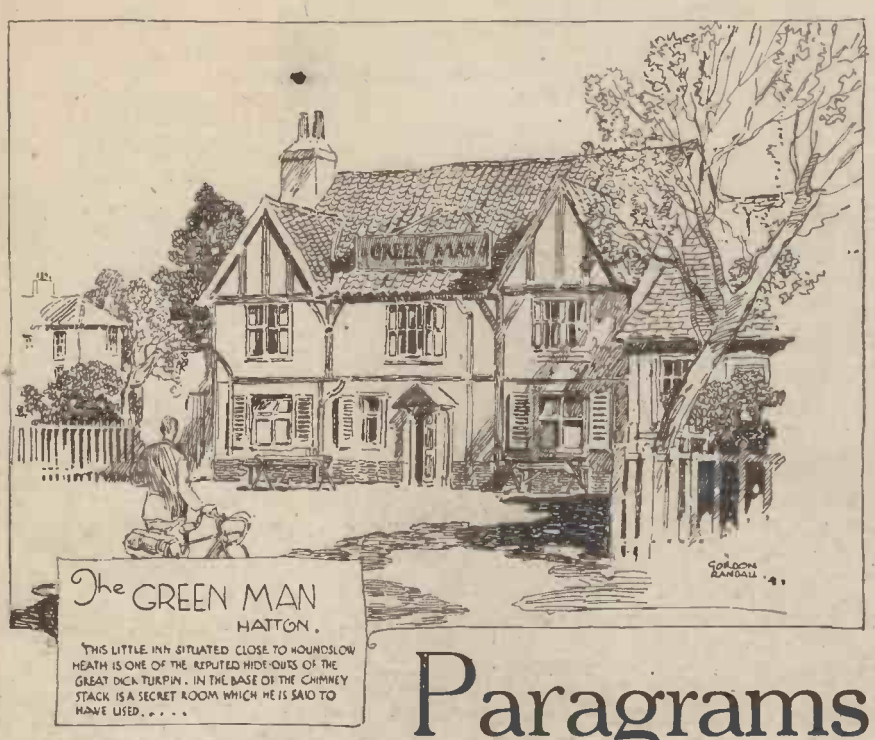
CORPORATE Members must similarly have been engaged in the trade for three years immediately prior to application, and as the qualifications chiefly apply to multiple companies, the company must show to the satisfaction of the Council that it conforms to the official definition of a bona fide cycle trader, that it possesses at least five retail depots, and that it employs a proper and systematic method of testing the skill and proficiency of its employees. It must undertake to give preference to applicants for employment who are associates of, or otherwise qualified under the examinations of the Institution. An Associate of the Institute is the qualification for repairers, managers, or mechanics. He must have attained the age of 22 years, and been engaged in the trade for at least two years preceding the date of his application, otherwise his qualifications conform to that for Fellow. The Council will also be empowered to grant honorary fellowship upon any person who has rendered signal service to the trade. Local boards of examiners will be appointed, and a syllabus of examinations will be drawn up. Passing the examinations will not in itself constitute a title of membership, but successful candidates must also comply with the other conditions mentioned above. Members must be proposed and seconded to ensure that only persons of good character are elected to membership. When elected, each member will be issued with a diploma under the Seal of the Institute, which will be returnable should he cease to be a member.

To ensure a standard of business integrity amongst members, one of the articles of association gives the Council power to formulate such codes of trade ethics, business principles, customs and professional conduct as it shall from time to time think proper, and which every member of the Institute shall be bound to observe and perform.

The idea of an Institute run on these lines is good; it remains to be seen whether it will work out in practice.

Death of William Hume

WE regret to record the death during the last week of October of William Hume, at his home at Belfast. We see according to a contemporary that he is described as "one of the first men to win a cycle race on pneumatic tyres." Actually he was the first. The periodical also states that he was the first to purchase a bicycle fitted with Dunlop tyres. We do not think that he was the first. One of the first was undoubtedly C. A. (Bath Road) Smith. However, it is beyond all doubt that William Hume was the first man to win a race on pneumatic tyres, and he told the story in a signed article in our issue dated July 20th, 1938. As he himself says, J. B. Dunlop invited a *number* of Belfast riders to try out his first pneumatic tyres, fitted to a safety machine built by W. Edlin and Company. That momentous race was held at the Queen's College, Belfast Sports Meeting, at the North of Ireland Cricket Club Grounds on the 18th May, 1889. Hume cleared the bill by winning the four races for which he was entered. William Hume was in later years a linen manufacturer in Belfast.



Paragrams

Alex. Calder in China

THE many friends of Alex. Calder, a Glasgow hostel member, and keen tourist in pre-war days, who is serving in the Navy, will be pleased to know that he is well and busy in Chinese waters.

John Park Near Home

JOHN PARK, one of the best time trialists in Scotland before joining the Navy last year, and a member of the West of Scotland Clarion, has recently been stationed near home, and has been able to look up old friends and clubmates.

Bob Charles Likes Navy

ROBERT CHARLES, former secretary of the Thornliebank (Glasgow) Clarion, and an occasional rider and frequent helper in time trials, likes his work as a signaller in the Navy. He is able to travel home now and then, and keeps in touch with clubmates.

Clubmen in Iceland

SOUTHGATE Cycling Club have two members, both of whom are in the Royal Navy, serving in Iceland. One is W. J. Carter, club champion for five consecutive years, and one of the fastest short distance riders of his day.

Cycle-Roller Competition

BISHOPSGATE Police Station staged a cycle-roller competition open to Regular, Special and War Reserve Police. It was won by D. MacCarthy (War Reserve) over the distance of half a mile. Gears were limited to 84.

Ealing Rider's Near East Adventures

JIM PURVES, one-time champion of the Ealing C.C., who just before the war was putting up some remarkable long-distance rides with the Vegetarian C.C., was posted as "missing" in the Near East. Actually he was captured in Syria but was released under Armistice terms.

Clubman's B.E. Medal

ARTHUR H. WARNER, Coventry C.C., has been awarded the British Empire Medal for his courage while on duty in Coventry during a heavy raid. He was a cyclist dispatch rider.

Well-known Clubmen in Services

SYD JONAS, the record-breaking Anfielder, is in Malta, and members of the "Black' Anfielders in the Near East include J. R. Band, W. P. Rock, T. T. Samuel, R. Barker and J. E. Reeves. Among members of this famous club in the Royal Navy are Dick Ryalls and Len Killip.

Dundee C.A. Road Championship

DUNDEE Thistle Road Club won the Dundee Cycling Association road championship; their second consecutive win. They secured eighty-four points, forty of which were secured by Allan Lowson. He was fastest in twelve trials out of seventeen. The Charles Star C.C. showed improvement by finishing with sixty-two points.

Liverpool Rider in Egypt

ERIC MUSTILL, Phoenix C.C., of Liverpool, was given leave after being evacuated from Crete. He writes to say he spent it cycling in Egypt.

Bristol Track Rider

B. LEE, Bristol South C.C., who had many successes at path meetings this year, is the son of H. H. Lee, Kentish Wheelers, one of the most outstanding riders on the track fifteen years ago.

Club Secretary's Marriage

HARRY CLARKE, hon. sec., Tricycle Association, and chairman of Southgate C.C., has married Miss Winifred Wiseman, of the C.T.C Northern Section.

Famous Rider as P.T. Instructor

JACK HOLMES, the famous Yorkshire Road Club mass-start expert, is now a corporal physical training instructor and sometimes joins members of the Kings Lynn C.C., near to whom he is stationed, on their runs.

Veteran Timekeeper's Ride

BILLY PETT, cheerful 68-year-old South London timekeeper, rode a private 25-mile and clocked 1 hr. 14 mins. 41 secs., just to celebrate his birthday.

Team Race Victories

TOWARDS the close of the time-trial season, Barnsley Road Club scored twenty-one team race victories. The team, which was represented by J. Simpson, J. Hurrell, H. Bailey, E. H. Nixon, and J. Carr, had an aggregate of 3.9.40 for 25 miles.

Welsh R.R.A. Records

THERE have been several attempts this year—and some successes—on Welsh R.R.A. records. The twenty-four-hour was twice beaten, by A. G. Eaglen and C. Kenward, both of the Cwmcarn C.C., who did 348½ miles and 374 miles respectively.

Southgate Rider as Night Flyer

EDDIE MOLL, Southgate C.C., is specialising in night flying in the Royal Air Force. He is in Canada.

Cyclist D.F.C. Missing

PETER WISE, Unity C.C., a sergeant pilot who was awarded the Distinguished Flying Cross in March, is posted as "missing."

Girl Rider's 25-mile Record

RIDING in her first time-trial, sixteen-year-old Grace House, Oxford City Road Club, clocked 1.14.40 for 25 miles and set up a new club record.

"Bob" Greig Passes On

ABERDEEN'S tallest clubman, "Bob" Greig, Bon Accord C.C., lost his life while serving with the Forces in the Near East.

Clubman Killed in Action

AFTER taking part in flying duties over Berlin and other parts of Germany, "Pip" Reay, North Shields Poly C.C., has been killed in action. He was a great cyclist in all its phases; cycle polo in particular.

Leeds Club Carrying On

LEEDS St. Christopher C.C. are carrying on in a praiseworthy fashion, although thirty of their members are serving with the Forces. Junior members, and ladies, are holding the fort.

Club Vice-President Missing

SGT.-PILOT R. S. CRAIG, vice-president of Glasgow United C.C., and well-known road and track man in the West of Scotland, has been reported missing, following a raid over Germany. He is the fourth member posted as "missing."

Well-known Rider as Parachutist

WELL-KNOWN member of the Dale Park C.C., J. Causton, has undergone special training with his unit and is now a fully fledged parachutist.

Young Record Breaker

SIXTEEN year old R. G. Wilson, Oxford City Road Club, has broken several club records, his latest being the "30" with 1.16.9.

North Road Clubman's Success

A. B. MARSH, North Road C.C., holder of National tricycle record, is one of the ten R.A.F. cadets selected to go to the Univeristy of Miami, Florida, to take a course in aerial navigation. He passed out top of his colleagues, and was listed higher than 68 American candidates.

Cumnock Rally in 1942

AT the annual general meeting of the West of Scotland Cyclists' Defence Committee, it was unanimously agreed to recommend to the new executive committee that the Cumnock rally be held again in 1942, provided conditions prevailing then permit.

Secretary Robert Marshall reported at the meeting that this year's Cumnock rally actually had greater support than the 1940 rally, and stated that there was a cash balance on the running of the 1941 event.

No Surcharges at London Youth Hostels

LONDON Regional Group of the Youth Hostels Association has abolished surcharges for cooking at the hostels in its area.

Clydeside Wants Better Lighting

THE West of Scotland Cyclists' Defence Committee has passed a resolution urging that better front lighting for bicycles should be legalised.

Two Popular Hostels

KEMSING and Winchester youth hostels are the first in the London area to reach the 5,000 bed-night figure in a year.

Clarion Advances

EASTLEIGH and Newcastle Clarion sections have now more than 100 members each.

Latest National Trust Acquisition

LATEST acquisition of the National Trust is Hollows Farm, Borrowdale, already known to many cyclists as a youth hostel. The addition of the farm and surrounding lands to the Trust property means that much of central Borrowdale is in the hands of the nation.

Clarion Handbook in 1942

WHEN the National Clarion war-time executive meets shortly, it will discuss the possibilities of a club handbook in 1942. The Clarion has issued its handbook every year since the start of the war.

Clarion Jubilee

THE National Clarion C.C. celebrates its jubilee in 1944, and preparations are already going ahead for the event.

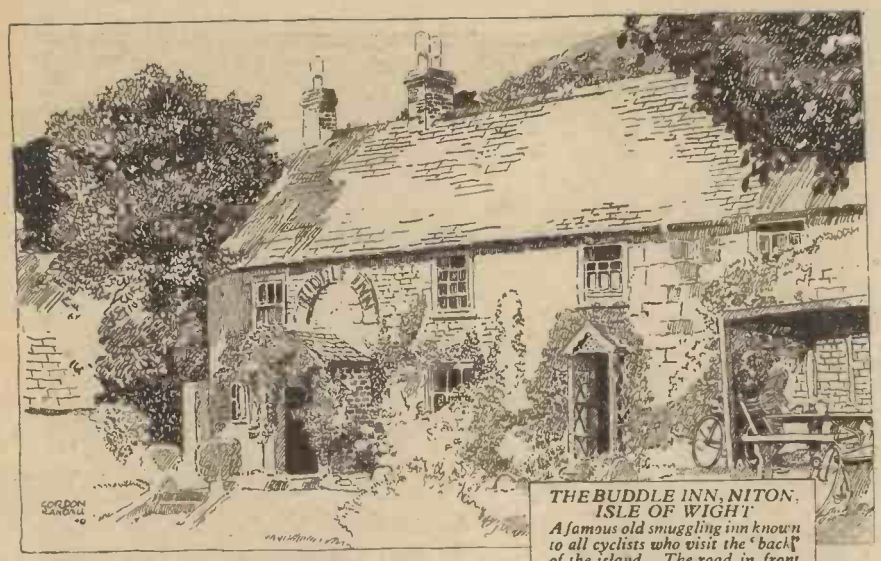
Serious Cycle Thefts

DURING the hearing of a case against a woman cycle thief, Superintendent Williams, of York, stated that the position was growing serious. Some 700 bicycles had been stolen in the city during the past twelve months.

Snowdon Hostels Increased Patronage

AT the twelve hostels open in Snowdonia in 1941, 4,300 visits have been paid, compared with 2,800 during 1940.

The Merseyside Regional Group of the Youth Hostels Association intends to keep open the hostels at Delamere, Maeshafn, Idwal Cottage, and Llanwrst throughout the year, as well as five other hostels, which may be used on prior application.



THE BUDDLE INN, NITON, ISLE OF WIGHT
A famous old smuggling inn known to all cyclists who visit the 'back' of the island. The road in front overlooks St. Catherine's Lighthouse, perched far below on the rocks.

Around the Wheelworld

By ICARUS

Club War Records

I WONDER how many clubs are compiling a war record which includes details of the activities of their members during the war, either on Service, or in munition factories. This record can easily be compiled from members' correspondence, either to the Secretary, or other members. The latter should be encouraged to pool their correspondence and to place it at the disposal of whoever is charged with the task of compiling the record. There will be a plentiful supply of photographs which could be included in a special album and suitably captioned. Such a record will not only make interesting reading for later generations of members, but it will form a club roll of merit, and a monograph to the club's contribution to the war.

Annual General Meeting

CYCLING organisations now busily engaged planning their annual luncheons and dinners and dances will shortly have to meet to decide the agenda for their annual general meetings. Every member will receive notice of this meeting, and they should use the opportunity to table propositions on matters which they think will improve the club or remedy defects in its organisation. If you have a secretary, for example, who does not carry out the instructions of his committee, who acts as a pocket dictator, and regards himself as the proprietor of the club, and the sole custodian of its interests—if, in short, he usurps the power of the committee and acts on his own initiative without instructions from the committee, he should be removed from his office. That attitude is far too common in the cycling world. Conversely, there is often a tendency for the older members of the club to presume that they own it, because they helped to build it up. That is the tendency which needs to be watched.

The annual general meeting will undoubtedly include an item concerning next year's racing programme, and it is too early as yet to forecast what next year's racing programmes will be. The Government is drawing more and more men from the ranks of cyclists, and it will intensify its call towards the Spring of next year. Those still able to cycle may therefore be less free next year to devote much time to club affairs. Many may not have the opportunities to practice or train. Even the womenfolk are being harnessed to the war effort. These are points which will be keenly debated at annual general meetings.

Attend to Your Cycle Lamp

IT is necessary to remind cyclists of the regulations concerning lamps. Lighting up time is now the same as blackout time; the legal hours of darkness from October to April is half an hour after sunset, to half an hour before sunrise. During these hours of darkness cyclists must carry a white front light, and a red rear light, neither of which must exceed 7 watts in power, whether the lamps are electric or oil-burning, and a white patch at the rear of their machine of not less than 12 in. in extent. Of this patch, not less than 6 sq. in. must be on the off-side of the centre line of the cycle, and over 10 in. above ground level. It must be actually white in colour, not silver or aluminium. There is only one method of legally masking the front lamp. The upper half of the lens must be obscured, and the lower half of the reflector painted matt black; or otherwise made non-effective. Side or rear windows must be totally blacked out. One of the simplest and most satisfactory methods of making your front lamp comply with the law which avoids spoiling the reflector with paint, is to fit the 6d. Lucas "Masklite." This is a one-piece fitment adjustable to any size of headlamp, and consisting of a semi-circular shield for the top half of the lamp glass, and a cup for the underside of the bulb, which acts on the bottom half of the reflector as would a coat of matt paint. The "Masklite" slips into place behind the lens of the lamp, and cannot shift out of position. It can easily be removed.

Prize Trust Fund

THE National Committee of the R.T.C. has approved the suggestion that a Trust Fund should be created in which prize money can be invested. The reason for this is that it is becoming almost impossible for clubs to purchase the appropriate prizes, and it was felt that prizewinners would approve the idea of a fund itself invested in War Savings Certificates, and which could be redeemed after the war when prices will fall, and the purchase of luxury items will not provide the problem it does to-day.

F.O.T.C. Dinner Echo

AS mentioned last month, I was present (by invitation of several of the members) for cocktails before the F.O.T.C. dinner commenced. One who apparently finds matters concerning cycle politics confusing states that the Fellowship is not a cycling club which, of course, was one of the statements I made; and, secondly, he says, that the Fellowship luncheon is confined *exclusively* to members. This I deny. As I stated last month, I chatted with two of those present who regularly cycle; I did not say that only two members of the Fellowship cycled, nor did I even say that the two with whom I chatted had cycled to the meeting! It seems that the writer in question, anxious to be critical, does not, or cannot understand what he reads.

He also states that he saw the attempt of an outsider to gate crash the luncheon. I certainly saw one outsider there, but whether he was permitted to stay (I gather that he did not as the Secretary had asked him to leave!) I cannot say. I was merely present (by invitation) for cocktails, and left just before the luncheon commenced. I did not see the Hon. Sec. of the F.O.T.C., but I did observe the gate crasher. I quite agree with the writer of the paragraph to which I am referring that this gate crasher was "attempting to join in the proceedings." Presumably, he is an *unwanted* fellow—whether unwanted by the police or anyone else is not stated. I agree that it is a breach of etiquette for anyone to force their presence at a cycling function. In connection with some cycling functions (not, of course, the F.O.T.C.), it would not only be a breach of etiquette but a case of insanity, bearing in mind the manner in which some of the club meetings are conducted, and the type of people who conduct them.

I have no doubt that the Secretary of the F.O.T.C. could disclose the name of the person whom he asked to leave the meeting. He did not chat with me nor did I see him there, otherwise I am certain that he would have enlisted my aid in drawing public attention to the gate crashing. I am known to so many members of the F.O.T.C. that it is a very natural thing they should have requested me as a busy journalist to be present for cocktails, in order to take my notes of a meeting to which pressmen are not normally invited. I am much appreciative of their courtesy.

The Tale of a Trike and a Tandem

By C. A. SMITH

THIS price list of Humber Ltd. before me is dated 1895. The fashionable cycle of the time. Everyone rode a Beeston Humber, from the Prince of Wales downwards. You could see them in Battersea Park by the score, but the countryside was bare of these "out for show" bicycle riders. Now let us look at the list of cycles. Twenty-five pounds buys a bicycle, plus £5 for pneumatic tyres, and an additional £2 for a Carter gearcase. I rode a Humber bicycle in the Bath Road Hundred of 1890. At that time there was a lot of trouble with the gear. Any type of toothed wheel was common, and although Hans Renolds had had his tooth form accepted by the Trade, they all said "rats," I can do better. So when my chain collapsed in this hundred, I consulted Hans Renolds, got some "blanks" from Humber Ltd., and sent them to Renolds for cutting the teeth. After that I had no more trouble with gears; no more broken chains, thank goodness! So I went on racing until my Beeston Humber let me down on Marlboro' Hill in 1895. The cheap (and nasty!) bicycle had not yet come to the front. Then a page or two further we come to the Beeston Humber tricycle: £30 for this, and having an extra wheel, an additional £7 10s. for the pneumatic tyres. The charge for the gearcase was £2, the same as for the two-wheeler. The brake, of course, was an extra, so that there was very little change out of £40. If I recollect rightly, G. P. Mills designed this tricycle. The only snags about it were the four bearings on the axle, and a good mechanic was wanted to adjust them. Mills and Gamble, Biggleswade, was where this machine was born. The start of the small maker! There was no Beeston Humber tricycle when I created the Bath and back tricycle record in 1891. I rode a "trike," a "Swift," built for M. A. Holbein, which was kindly lent to me. Of course, it was too large for me, but it ran nicely, and I did 16 hours 13 mins.

Beeston Humber

I eventually got a Beeston Humber trike in 1896, and now (1941) fitted with wooden rims and Constrictor tyres and a one-inch block chain and properly cut (Renoldd toothform) chainwheels, it is as good as new! It has ha't its ups and downs, of course, but there you are—you can e beat a good 'un, can you? A page or two along and wr come to the Beeston Humber tandem, £34 plus £5 foo tyres plus £4 for gearcase. I had one, and it put an end tn my racing career! F. Lowe and I rode fifty miles ie 2 hours and 31 mins. in 1892, but I can't remember tht name of the maker of the machine. I had all sorts o partners on the tandem at various times, and when I first went to Street Cobham in 1895, Lord Queensbury often joined me on it. He was busy training for a ten miles bicycle race with C. B. Lawes. The loser was to pay for two Beeston Humber bicycles. Well, to cut it short, Lord Queensbury romped home in front, beating Lawes who was riding on a very high gear. And the policeman stationed at the Hut could do nothing to stop the riders (there were no phones in those days), and as we all rode into Street Cobham very slowly on the return journey, the police on the watch had no chance of making a case! However, on the same morning I had taken Sir Claude de Crespigny for a spin (he had never been on a cycle of any sort!) and as we descended Pains Hill (you know the hill I mean, the one before one crosses the Mole into the Cobhams coming from Guildford) we passed two police officers walking down the hill.

Fined 25/- Each

They followed us into the house and asked for the names and addresses. "Sir Claude de Crespigny" was too much of a mouthful for the poor Super from Hersham at that early hour, and so I remember I had to write it down for him! That cost us 25/- each at Kingston, though why Sir Claude was fined I know not. He had no control on the back seat of the tandem, had he? Now, I will tell you how that Beeston Humber put an end to my racing. We, a Bath Road Club party, had been sleeping at Theale on the 15th April, 1805 (just outside Reading Newbury way), and we started out with an easterly wind just behind us, with the intention of riding to Calne and back. Safely through Savernake Forest I recollect reaching the top of Marlboro' Hill, and letting the tandem bicycle go with my partner, Jessop, on behind. Then came the awful crash! The head had gone! And in the "Aylesbury Arms" Hotel, Marlboro', I laid for weeks, ten days unconscious.

Sea Breezes

However, later on in June a Ramsgate wherry—with Frank Shorland on board—the sea breezes restored me to health and strength, and after consulting Dr. E. B. Turner, I resumed cycling. Bidlake some years ago told me that Humbers had made six tandems all alike to the one I had, and that all the six had collapsed at the same place. He gave me the names of the riders, and some, I think, were well-known members of the North Road C.C. I notice an advertisement in Nairns News of the Wheel, dated March, 1896, the Trafalgar Bicycle Club, Catherine Lodge, Trafalgar Square, South Kensington; I notice on the Committee the names of Lord Marcus Beresford, the Earl of Essex, the Earl of Minto, Hwfa Williams, etc., with many patrons. Every facility for practice, if you please. The garden contained a covered track or velodrome about 130 yards in circumference, where it goes on to state, "exercise can be taken in all weathers," and the track is far better and larger than any existing private velo in Europe! Annual sub. £5 5s. I don't think the Trafalgar Club met with much support from these Londou bikists!

WAYSIDE THOUGHTS

By F. J. URRY

Worth carrying on

IT is not difficult to maintain interest in cycling if you are a lover of the countryside. There is no better way of becoming intimate with country interests than via the bicycle, because you have so wide a choice in the matter of direction, and the hours of your going and returning are of your own choice. If a desired journey is contemplated, and the leisure hours fit awkwardly with public transport, think how frequently that visit is postponed, and the time at your disposal frittered away without any return of satisfaction. Not so with a bicycle: you simply go your way at and in your own time, and on the journey gather that satisfaction that comes of freedom, healthy exercise, easy travel, and more than all these things put together, the ever delightful lure of the country. Take some food with you these days, and you are a self-contained unit, with happiness as your immediate prerogative. Make no mistake about that, for it is, in my opinion, the highest expression of cycling pleasure. And I will tell you another little thing that costs nothing, but often brings to you a most comforting return. It is merely a proper expression of thanks to the diminishing band of folk who still entertain us cyclists along the road. In the uneasy years of peace between the two great world wars there developed along the road a host of calling places where we were entertained at a very moderate cost. We took that service for granted, indeed, we almost demanded it, paid the modest price, and departed. To those who still care for our needs I think our thanks are due in a great degree, for I know something of the difficulties the caterer has to face in these times, and as a result admire the folk who are carrying on for a mere pittance of their former profit. Yes, our thanks are due to them, and geniality proffered by the caller makes life a brighter thing for all concerned; and what is more to the point often helps in the production of a pleasant addition to the provender.

That position of yours

ON a recent occasion I was riding with a prominent member of the industry, a man in middle life, and on our return journey of some twenty miles he found the going hard because the wind went tearing past. He wanted to know why it was I seemed to make headway without undue strain, and I told him, that in my judgment it was mainly due to position and the careful selection of gear ratios. To prove my contention to his satisfaction, we changed bicycles over the last few miles of the journey, and when he had settled down to the changed position, found he could easily make me struggle to keep even, and indeed seemed to enjoy having me in the minor place. As a matter of fact, his position on a really beautiful bicycle was the one I have come to expect middle-aged folk to adopt, almost bolt upright with the handlegrips waist high. His 3-speed gave a normal of 72 in., with a 96 in. high and a 54 in. low. Well, it is all wrong for easy touring conditions, and especially wrong when a boisterous wind is disputing your passage. A few days later I met my friend in town, and he told me he had fitted a slightly dropped bar, and reduced his normal gear to 63 in., with the result that he was riding much easier, and as far as he had been able to ascertain, just as fast if not a trifle faster. That little story is quite true, and I give it you now as sound advice for the folk who ride for pleasure and convenience, and have no speed pretentions. If we could only persuade people to ride properly—all people who cycle—what a pastime this would be! Half the bicycle owners in the land seem afraid to try out the right ideas that mean easy propulsion, comfort and wheeling satisfaction, and I often wonder why.

This freedom

AT this moment of writing no one knows what is in store for us in the way of raids during the depth of the winter. We do know what was happening to us a year ago, and it is rather wonderful to give a moment's memory to that condition, and a moment's thankfulness. All through that difficult period I rode my bicycle for workaday purposes, often by new and unsuspected routes, yet even so, I was thus enabled to keep a far better time record than all my friends who depended on car, bus or tram transport. At that time the mobility of the bicycle did not need proof, it was self-advertising. To-day I remember those things with a sense of gratitude, and for that reason alone would not dream of foregoing my daily journey. Naturally, one hopes that winter travel will be free from the upsetting difficulties connected with raids; but we are warned what to expect; to be prepared for the worst, and it seems to me that those of us who can ride bicycles will be doing no less than a duty if they fit themselves and their bicycles to meet the possible conditions of travel delay. To be free of the limitations of time tables is a great thing, but to be a perfectly free travel agent, always capable of keeping very close to a regular schedule, is a greater. Think it over before you put that machine away for the winter, for remember if you ride regularly, you ride easily, and the habit becomes a pleasure you can always extend to include the countryside when opportunity occurs.

Keep it in order

THERE are many rumours regarding the possible restrictions on the building of bicycles, and no doubt some of them are exaggerated. Already machines are in short supply, and as far as I can make out the numbers for the 1942 season will be considerably reduced, not only on account of the shortage of material, but by reason of the absorption of cycle builders and mechanics into munitions making. Bicycles will be hard to get next year, and so will replacements and repairs, so I advise everyone to do their buying now, to overhaul their present machines, and have them put into first-class order; chains, tyres, brake-blocks, etc., renewed if they show signs of wear, and not wait until such things are at their last gasp before the changes are made, for by that time you may discover the goods are unobtainable, or at best you may have to make do with a substitute. This position is not surprising, it is merely following, a little sooner it is true, the conditions that applied in 1917-8. The only difference is we know it will happen to-day, whereas in the earlier struggle many of us were caught napping by the rather silly caption, "business as usual." Some folk, already disappointed because they cannot obtain the goods they desire, are apt to blame the makers. That is unfair, and if you give the matter a moment's thought, absurd, because few of us can purchase in unrationed goods the things we want, and the cycle trade has its quota for materials in exactly the same manner as other manufacturers. The Lease-Lend Act has certainly had something to do with the matter, for steel is a precious metal these days, and there is not enough of it to go round.

NEWS FROM SCOTLAND

Ayrshire Events in 1942

THE Ayrshire and Dumfriesshire C.A. has had a successful year of open events, and hopes to go ahead with promotions in 1942.

Increase in Clarion Subscription

NATIONAL Clarion annual subscription has been increased to 6s. 0d.

Glasgow Needs Messengers

PART-TIME and full-time cyclist messengers are wanted by the Scottish Western No. 1 Area of the National Fire Service. Applicants, who must be aged 15-18, will be trained in first-aid as well as fire-fighting. Full details from Fire Service Headquarters, 33 Ingram Street, Glasgow.

Armour Wins Final Scots Event

J. ARMOUR, Auchterderran Wheelers, who has been the best Scots "25" man this year, won the final event north of the Border with a time of 1 hr. 2 mins. 56 secs. It had been hoped that Armour would be able to make another challenge to the Scots "25" record in this event, which was promoted by his own club, but conditions were against this. There was an entry of 46, and Glasgow Wheelers again took the team award.

Lucky Park

JOHN PARK, West of Scotland Clarion, who was very successful in open events last year, is now in the Navy, and is lucky enough to be stationed not far from his home. He keeps contact with old clubmates.

Kilmarnock Star in R.A.F.

W. WHITE, Kilmarnock, a member of the Ayrshire Clarion C. & A.C., and its leading time trialist in recent years, has joined the R.A.F.

In Hong Kong

ALEX. CALDER, keen youth hosteller and tourist in pre-war days, when he lived in Glasgow and worked at the Glasgow Cycle Company, is now enjoying life in the Navy—at Hong Kong.

Loss of Dumfriesshire Cyclist

WALTER WILSON, of the Loreburn Wheelers, a Dumfries club, has been reported lost at sea. He was serving on H.M.S. Hood.

Wilson was very well known to Cumnock rally supporters as the winner of events at the sports run by the West of Scotland Cyclists' Defence Committee.

Hendry Breaks Climb Record

ALEX. HENDRY, Glasgow Wheelers, and W. Barclay, Gilbertfield Wheelers, both broke the record for the Hamilton hill climb, most famous of Scots events of this kind.

The previous record was set up last year by T. M'Nulty, Glasgow Wheelers, and was 1 min. 53 2-5 secs. Hendry clocked 1-49 4-5, and Barclay 1-51.

Brinkins Wins Clydeside Climb

JIMMIE BRINKINS, Glasgow Wheelers, won the West of Scotland T.T.A. hill climb, for the second year in succession, with a time of 2 mins 14 secs.

Albert Wright in Navy

ALBERT WRIGHT, formerly connected with the Cyclists' Touring Club, Manchester D.A., and particularly its Rochdale Section, has joined the Navy.

Bill Robinson Likes R.A.M.C.

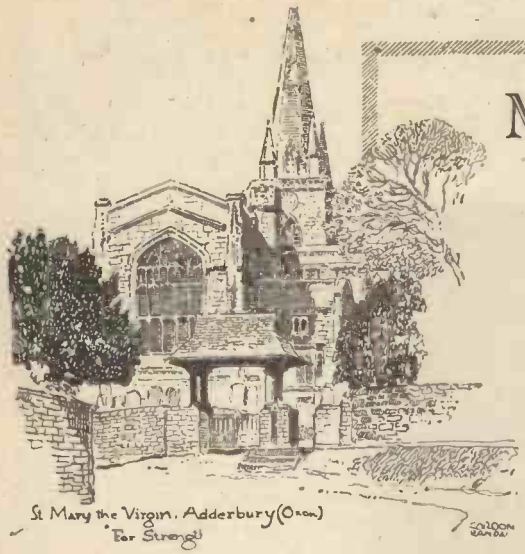
"BILL" ROBINSON, known in East Lancashire and the West Riding as a keen youth hosteller, climber, camper, and rough-stuff cyclist, is serving with the R.A.M.C. somewhere in the South of England. Besides doing some cycling, he plays cricket, football, and tennis, and also swims, and likes his new life.

One Hundred at Aberdeen Gathering

OVER one hundred cyclists were present at the joint presentation held by the North-East of Scotland T.T.A. and Aberdeen Wheelers. Councillor Fraser McIntosh presented the prizes, and John Topp, Aberdeen Wheelers, was the principal prizewinner.

New Aberdeen Official

A. ("SANDY") DUNCAN has joined the Navy, and his place as secretary of the Aberdeen Wheelers has been taken by A. Brand, 11 Morningside Place, Aberdeen.



My Point of View

BY "WAYFARER"

Up Against it

JUST at the moment when it seemed to me that all catering problems had "yielded to treatment," and that I was on top of the world in this respect, I found that I was up against it—that I had met my Waterloo, not to mention Surbiton and all stations to Woking. On a recent Saturday afternoon, after turning a 21-mile ride into 30 miles (by dint of roundabout lane explorations), I stopped for tea, only to discover that a favourite catering establishment had "packed up" for the time being. At my next house of call "she" (whoever that might be!) was out, but would not be very long—only half-an-hour, in fact! I did not wait. Facing towards home, I made my third call, to find that Mrs. Blank was out. I was advised to try the house across the road—which, when you come to think of it, is a good way of getting rid of a possibly unwanted customer. And the house across the road no longer catered. I purposely missed the next house (returning later to learn that there was nothing doing owing to the presence of evacuees), going on to a farm, where the answer was "Sorry! Full up!" Anxiety now began to possess me, owing to the empty state of the interior. I pressed on, still in the direction of home, and went off the road into an adjacent village, where the pub (advertising teas) proved to be as dead as the proverbial door-nail. An adjoining grocer's shop, ignoring the pathos written all over my face, did not rise to the occasion, but referred me to the local post office. And there, after 6 p.m., with some 40 miles achieved since lunch, my long-drawn-out effort was crowned with success. True, all they could offer me was a pot of tea and some cake. That combination served my purpose, and I subsequently completed my journey in comfort. I am no pessimist, but I feel quite sure that our catering difficulties are destined to get worse before they improve. We shall have to stick to the places of which we know, and I do hope that it will not be necessary for us to take our own food and drink and consume it in the open. We may come to that!

Nothing About

SOME time ago I asked a girl, who displayed an interest in something I had written, whether she were a cyclist, and the answer was "No! Daddy doesn't think it is safe on the roads!" That is a perfectly damnable doctrine—more so now than ever—which is widely held, and which is doing endless harm to the cycling movement. In normal times, the doctrine that our roads are not safe from the cycling viewpoint will not bear examination, and I have been at pains, on many an occasion, to expose this bogey and that of overcrowding. Let me say again that there is very little overcrowding: there is very little congestion. Traffic conditions in or near the large centres of population are no index to the state of affairs prevailing elsewhere, and one might almost say, without exaggeration, that loneliness was a greater bugbear than congestion. Now, in these war days, I find the roads a short distance away from towns and cities deserted and quiet. On my recent journey into North and Mid-Wales I travelled, at times, for miles without seeing anything but isolated units of traffic, and I felt then (as before and since) that we cyclists are back, in point of time, some 40 or 50 years. Halcyon days, my masters!

If anybody were to suggest that I have carefully selected my facts in speaking of a tour done in Wales during September, I shall be quite prepared to shift my ground and come back to the vicinity of that vast city in which I live. And there my experience is exactly the same. Within 10 miles (or less) of my suburban home, I can obtain all the solitude I want. Saturday after Saturday (on Sundays, too, occasionally), in Warwickshire, in Worcestershire, and in Shropshire, I have revelled in pre-war conditions of travel. (And here, when I say "pre-war," I am speaking of the Boer war!) If somebody will be good enough to show me where this much-proclaimed congestion exists, I will show him a hundred places where loneliness and seclusion are the order of the day. Let's get the facts right—and let us see to it that our children are not denied the delights and advantages of cycling because of the bogey of overcrowded and dangerous roads.

No Trouble

MY deep and abiding faith in the magical properties of the bicycle makes me ready at all times to praise "the bridge that carries me." This is no new thought, but it always comes back to me forcefully at the end of a holiday spent awheel—in other words, at the end of all my holidays, for they are invariably devoted to cycling. You set forth and make your way—in normal times, at any rate—into the wilds of England, Wales, Scotland, and Ireland, confidently expecting that your steed will do all that you ask of it—and no back-answers! Nor are you disappointed. In that little bag which hangs from the saddle you carry a tyre repair outfit, a set of spanners, and perhaps a spot of oil. For all the use they are, in the normal course of events, this luggage might just as well take the form of a bottle of salad dressing, or a knitting needle, or a bag of worms . . . anything as a mascot! I have not carried oil for years, preferring, if lubrication becomes necessary in the course of a tour, to beg or borrow a penny-worth from a garage. You can travel thousands of miles without needing a tyre repair outfit. As for the set of spanners—well, they are about the last things you require. I quite agree that it would be unwise to leave them at home, because they might be needed—for instance, if a chain adjustment were called for. Generally, however, they are so much dead weight, and the magical bicycle—the no-trouble bicycle—piles up hundreds of miles without requiring the slightest attention. When you pause and think of the achievements and the possibilities of the bicycle—that frail travel-instrument which is so often despised by ignorant people—you cannot help dwelling on its magical properties, and on the inestimable benefits it has conferred on mankind. The no-trouble bicycle is indeed "a boon and a blessing."

Notes of a Highwayman

By Leonard Ellis

Home of the Poets

THIS little sanctuary, buried amid the beeches of Bucks, is spared to us in spite of repeated attempts by rich Americans to buy it, lock, stock and barrel, including the remains of William Penn, for transportation to the States. From thoughts of Milton one recalls that it is easy to continue our excursion through this part of the county by searching out the literary associations. Milton, as is well known, completed "Paradise Lost" at the half-timbered cottage in Chalfont St. Giles. Part of his life was lived at Horton, near Windsor, and he came to Chalfont to try and escape the Great Plague. Thomas Gray's tomb is at Stoke Poges, and the church there is always associated with his immortal "Elegy," although a great many people have different views on the subject. At Beaconsfield we can find the tomb of Edmund Waller. He was born at the Manor House, at Coleshill, a few miles away, in 1605. An old oak tree in the village is still known as Waller's Oak.

Makers Planning Ahead

THE recent month's of summer have given me a few glorious journeys, not, unfortunately, of long duration, but sufficiently tour-like in their consequences to make me more keenly appreciative of the pastime than ever, if that were possible. Recently I spent a week-end scouting round Wales with an old tandem companion, mainly over the big roads so well known to me, ways which have taken on a curious loneliness these days, for motor traffic has almost disappeared from them, and except for the smoother surfaces of the roads, they otherwise reminded me of the ways in the early days of motoring, when a passing or overtaking car was almost a novelty. Not being particular, the two of us had little difficulty in finding accommodation, the ease of which, to some extent, was due to our acquaintance with old hosts along the route. Indeed, the week-end was planned with that consideration in view. The crew of our tandem attracted some small attention, for both the members were over 60 and hoary haired, and we liked to think in our excusable egotism, we were rather a good advertisement for the pastime. This journey gave us the opportunity of trying out a new S.A. medium ratio 4-speed gear, fitted with a hub brake—the correct retardation method for a tandem—and it did its job perfectly. Our normal gear was 68 with a top of nearly 80, a second gear of about 57, and a low of approximately 49, a nice combination for rather ancient riders, and the job suited them delightfully. It is early yet to say the combination will stand the stresses of the double human power plant applied to the low gear; but it took us up many long, and some stiff slopes without any complaint, while the brake was in every way perfect. This hub, I believe, is the first one to be made—a 4-speed and brake combined—and is not on the market; but if it continues to act in the manner of its introduction to serious road service, then I predict a successful future for its tandem value after the war is over and the happy days return once more.

A Norman Arch

CYCLISTS, especially those who are interested in ecclesiology, should not pass the church at Tickencote, Rutland, without inspecting the interior, for the structure contains the finest Norman arch in the country. This remarkable feature is the only part of the original fabric that was not taken down in 1792, when the church was rebuilt, and, though at one time the edifice in general was much neglected, the arch appears not to have been in any way damaged. Certainly there are no indications that it has been altered or re-chiselled. Its decoration is unusually rich. A section of it consists of cats' heads, and among the grotesques on it are a muzzled bear and reversed heads of a king and queen.

The Gathering Stone

AMONG Scotland's odd relics of warfare is the Gathering Stone at Sheriffmuir, near Dunblane, in Perthshire. It is so called because round it assembled troops on the eve of the indecisive battle between Jacobites under Mar and Hanoverians commanded by Argyll on November 13th, 1715. In common with other stones of historical interest

in Scotland, the one at Sheriffmuir is enclosed in iron bars to prevent relic-hunters from carrying it away piecemeal. A good deal of it was filched and added to collections before it was protected.

A Hobby for Cyclists

IF any cyclist wants a hobby that is virtually inexhaustible, he might collect field-names, the origin of which is often curious. Thus, about a mile from Burnham Market, Norfolk, is Shilling's Field, named from a miscreant who in 1786 here murdered John Raven, a carrier. Shilling was executed, and afterwards his body was gibbeted on a hill overlooking the spot where he committed the crime. Unfortunately for him, the carrier lived long enough to describe the attack on him and to state that he had recognised his assailant as a man named Shilling.

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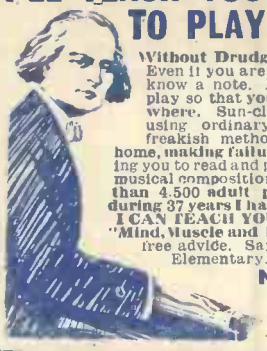

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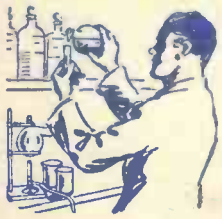

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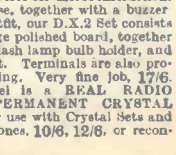

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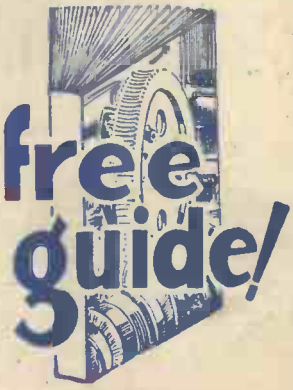

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