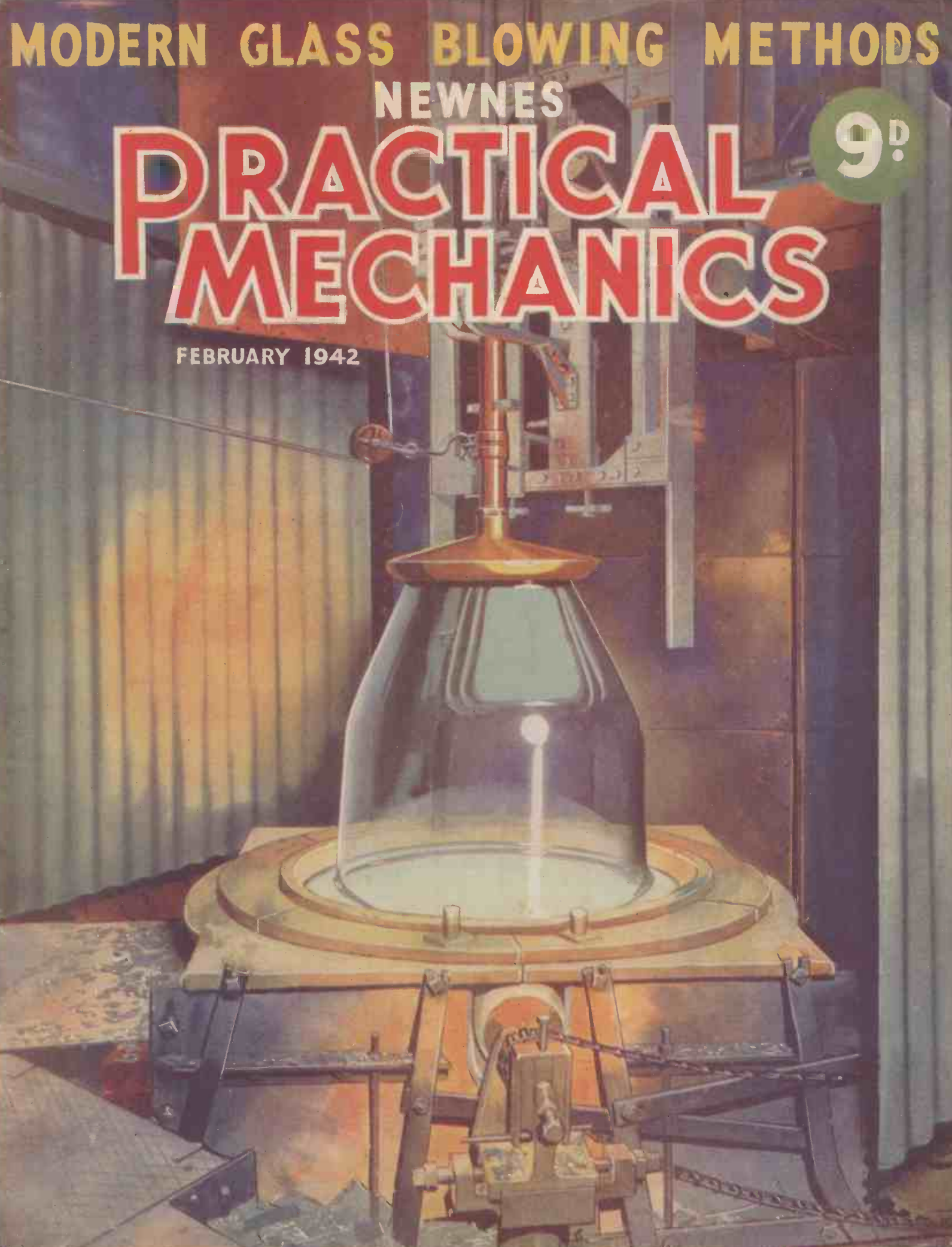
MODERN GLASS BLOWING METHODS

NEWNES

PRACTICAL MECHANICS

9D

FEBRUARY 1942



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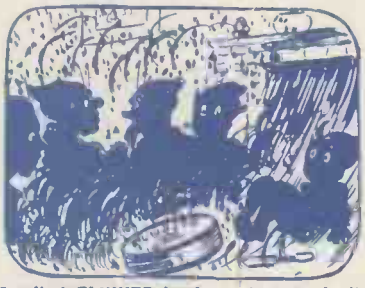

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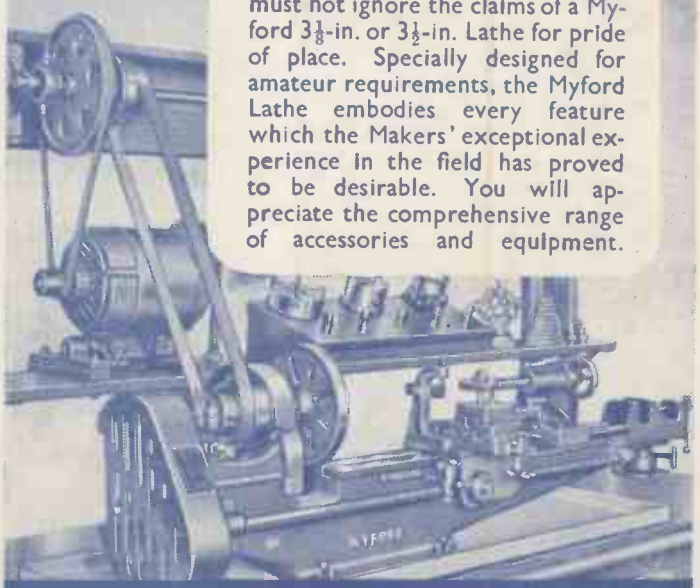

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PRACTICAL MECHANICS

Owing to the paper shortage "The Cyclist" and "Home Movies" are temporarily incorporated
Editor: F. J. CAMM
VOL. IX. FEBRUARY, 1942 No. 101

FAIR COMMENT — BY THE EDITOR

Scientia est Potentia

KNOWLEDGE is power! But is it? Recently there has taken place in London meetings between scientists and technicians at which most of the speakers expressed concern and disquietude at the very poor financial returns such men gained from their lengthy and expensive training. For example, it was shown that many without previous experience of fire duties were employed in the A.F.S. at salaries varying between £400 and £500 a year, and these salaries were greatly in excess of the salaries paid to those individuals in their pre-war jobs. Other examples were given of women earning £4 or £5 a week in factories, of youths of 16 and 17 years earning similar amounts, whilst trained technicians and scientific workers find it difficult to command a salary of more than about £4 a week. This is patently wrong, for what encouragement is there for a man to go to the expense, apart from the time involved, of acquiring technical knowledge if he can earn more money without it? It surely is time that manufacturers assessed values at their true worth. Draughtsmen particularly seem poorly paid, and in many cases earn less than unskilled men.

Industry cannot exist without technicians, and unless something is done in the form of ensuring adequate reward for use of technical knowledge we shall kill the desire of men to become technicians as surely as we killed the apprenticeship system after the last war. Teachers, those responsible for training technicians, are just as poorly paid; they are regarded as the Cinderellas of eduction. Surely there is not more important industrial work than that of ensuring an adequate supply of technicians? We know now their value to the State, and we also now know what it means to be short of them.

Post-war Re-building

IT is not an opportune time to consider reforms of this nature, for our main energies and thoughts must be devoted to the winning of the war. It must, however, be part of the rebuilding which we are promised will take place when the war finishes, and a prominent part. We must encourage people to advance because of the reward which advancement brings. No one is anxious to take on a job carrying greater responsibilities unless the salary is commensurate with those responsibilities. If you wish to attract men into particular jobs, part of the attraction must be the money paid. The labourer is always worthy of his hire. Quite frankly, we are appalled at the miserable pittances which are paid to highly qualified people holding important jobs, and who seem friendless and alone with no one to advance their modest claims.

Manufacturers almost entirely adopt the same point of view that the only man worth paying well is the man in the shops responsible for output. But there would be no output, there would be no shops, there would be nothing to make if what are known as the back-room boys were not thinking, experimenting, and testing to produce new designs, new materials, new methods, and new processes.

The capstan worker would be useless without these. Most of them are incapable, because of lack of training, of the higher branches of engineering associated with creation of ideas. Those responsible for starting the wheels of industry and for keeping them turning are worth the extra financial recognition which their work demands. We are glad that this matter has been ventilated at the meetings to which we have referred, and we hope that the Government as well as manufacturers will learn to think a little more of those who are just as important to industry as those with a practical training.

Government Opinion

IN this connection we feel that all Governments are hopelessly out of touch with public opinion. Once a man is elected to Parliament (and this applies to all political parties) the electorate do not see him again until the next General Election. He does not hold a monthly meeting in his constituency to report Parliamentary procedure, to give an account of his month's work in Parliament, to explain his absence from Parliament (indeed, few Members of Parliament put in a regular appearance, and there is no law to compel them to attend; how, then, can they represent their constituents?) and to ask advice as to how they shall vote on matters which will come before Parliament during the following month.

Many of the troubles from which this country has suffered have no doubt been due to this, and some to the apathy of the public. One of the reforms fifty years overdue is proportional representation, in which each Member of Parliament would represent a certain number of voters, and another is the Referendum in which all important questions coming before Parliament are referred back to the electorate for opinion. This would keep Members of Parliament fully employed and fully informed upon the feeling of the country. Under the present system one Member of Parliament may represent a constituency of 50,000 voters, whilst another may represent 100,000. Yet they have equal voting power in Parliament. Obviously, the man representng the larger constituency should have the larger voting power according to the number of people he represents. A majority verdict in Parliament to-day analysed on this basis can mean really a minority of opinion, if the votes represented by the majority party are multiplied by the constituents they represent, and the votes of the minority are treated in the same way. Many false pieces of legislation which have not met with public approval have found their way on to the Statute Book by this means, as well as by the neglectful absence of Members of Parliament from the House when important matters are being discussed. If a Member of Parliament is absent more than a certain number of times during each Session, he should forfeit his seat. This is not a political question, it is a question which vitally concerns the very basis of democracy, namely, the accurate representation of the views of the people and the, government of the people, by the people, for the people. Once we have achieved this we have gone far to remove the cause of the very things which are being so severely criticised to-day, and not the least of them is the poor pay of the technicians.

Waste Paper

WE made an appeal a short time ago for readers to search out every scrap of unwanted paper from their homes. Doubtless readers have seen references to this matter in the daily papers. It is a vitally urgent matter for 100,000 tons of waste paper are achieved, and that object has not yet been obtained. The paper is required for the manufacture of vital war materials, and although there has been a generous response to the various appeals we have as yet not tapped anything but a tithe of the vast quantities of paper in the form of old books, catalogues, newspapers, periodicals, Christmas cards, calendars, etc., which exist in every home.

A few hours spent in the evenings or week-ends would locate in your home a useful contribution to the thousands of tons of paper still required. Your local Authority will collect it, and if there is any trouble in that connection we shall be glad to attend to it for you and to arrange for its collection.

Binding

MESSRS. A. W. BAIN & CO., who have hitherto undertaken the binding arrangement for *Practical Mechanics* have informed us that, owing to shortage of materials, they are unable to accept further orders at the moment.

Modern Glass

A Brief Description of Modern

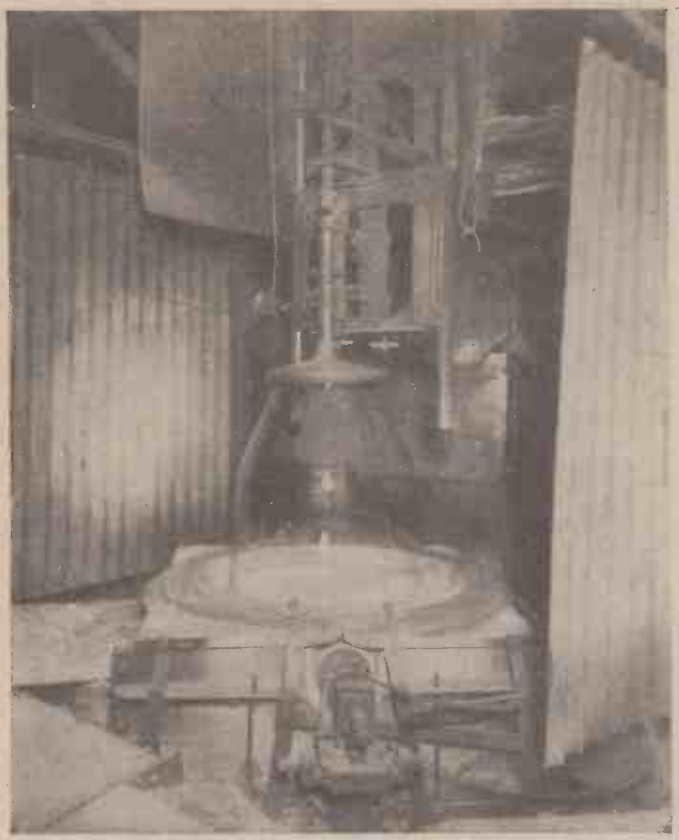


Fig. 2. The beginning of the "draw," in the cylinder drawn process.

THE use of glass for glazing buildings and vehicles, for electrical purposes such as lamps and shades, wireless valves, for bottles and glasses, food containers, and for optical and scientific purposes, is dependent upon four important physical properties, namely, transparency, durability, hardness, and refractive index.

Composition. Glass is a soda lime silicate, that is, it is made from silica (sand), soda and lime. If sand is mixed with soda (in the form of soda ash or saltcake) and heated, the soda melts and the sand dissolves in the soda. If there is an excess of soda, on cooling, a thick syrupy liquid is obtained, but if more sand is added, a hard transparent glassy substance results, but this, unfortunately, is soluble in water, and is known as waterglass. By the addition of lime, the solubility of the sodium silicate is reduced, and with a sufficient quantity of lime a durable glass is obtained which will stand up to the weather, and to all strong acids except hydrofluoric acid.

Physical Properties. All processes of manufacture are governed first by the article which it is required to make, and secondly, by the physical properties of the material employed; in the manufacture of glass, the principal physical properties which influence the processes are:—

1. Vicosity. Glass has not a definite melting point. It first softens, and as the temperature rises, it reaches a point when the glass becomes a thick syrupy liquid which can be gathered on the end of a pipe and blown and finally, at higher temperatures it becomes a thin watery liquid.

2. Devitrification. Although weathering properties can be assured by a high lime content, there is always the danger of crystallisation, or devitrification, occurring. Above a certain temperature, known as devitrification temperature, glass may be kept in a liquid condition without any change occurring, but if the glass is kept below that temperature for any length of time, crystallisation or devitrification occurs.

3. Annealing. A hot sheet of glass left to cool naturally will break, and in order to obtain whole sheets of glass the sheet must be annealed, that is, cooled down gradually in what is known as a lehr.

4. Melting. The melting process takes place in three stages—(1) the initial melting, that is, the chemical reaction between the three ingredients, and this results in a sticky mass full of bubbles. (2) The next stage is the fining operation, which consists simply of raising the temperature so that the glass loses its viscous nature and becomes quite watery, thus allowing the gases forming the bubbles to rise to the surface. At this stage the glass is so thin that it is quite unworkable. (3) The third stage consists of cooling the glass down to a temperature where it is of the correct consistency to proceed with the particular process which is desired.

Manufacturing Processes

The first method of manufacture of sheets of glass through which clear vision could be obtained, was the Old Crown Glass Process, in which the glass was gathered at the end of a blow-pipe, blown into approximately pear-shaped form, the thick end of which was transferred to an iron rod known as a punty. After the blow-pipe had been broken off, the remaining portion, but spinning, was opened out into the form of a disc. This process was the source of the bulls-eye or bullion, then only used for the cheapest form of glazing, but to-day specially made for use to give an antique air to modern villas, inns, etc.

The size of the sheet in the Crown Glass process was very limited, and the next step was the Blown Cylinder Process, in which the glass was blown in the form of a cylinder, split lengthwise and then flattened. Then came the Cylinder Drawn Process, in which the glass was ladled from the tank into a heated double-sided crucible or pot by means of a pipe with a re-entrant lip, which was lowered into the glass (Fig. 1); the latter welled over the edge of the lip and solidified, forming a solid ring by means of which the cylinder was drawn up from the pot, air being supplied to maintain the required diameter. Cylinders 30 in. in diameter and 40 ft. in height were drawn (Fig. 2). The cylinder was then cut off from the pot, lowered on to a rest (Fig. 3), and cut into lengths by means of an electrically heated wire, the sections being split into two, three, or four "shawls," and flattened in a flattening kiln. After flattening, the sheet travelled down the annealing lehr where is was gradually cooled (Fig. 4).

For many years attempts were made to draw a flat sheet in the first instance. The difficulty in doing this is to maintain the width of the sheet. If a "bait" in the form of a sheet of metal is dipped into the molten glass, the glass adheres to the bait, and as the bait is drawn up, the glass is drawn with it in the form of a sheet, but this gradually narrows until finally only a thread is left. There are three successful methods of overcoming this difficulty, and these are as follows:—

The Fourcault Process. In this process the width is maintained by forcing the glass under hydrostatic pressure through a narrow slit in a fireclay float or debiteuse. The debiteuse floats on the surface of the glass in a forehearth or kiln, and is depressed so that the slit is below the level of the surface of the molten glass. Consequently, the glass wells up through the slit and it is drawn away as fast as it is formed. Water coolers, i.e., metal

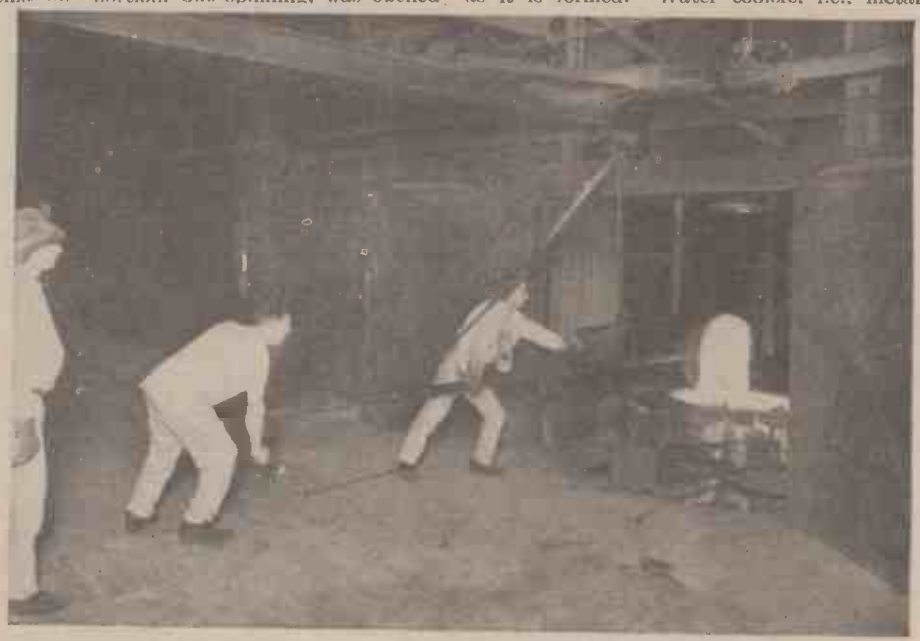


Fig. 1. Teeming the molten glass into the double-sided crucible, or drawing pot.

Making Processes

Methods of Manufacture

boxes through which cold water is circulated, are situated on either side of the sheet so as to solidify it as quickly as possible. As soon as the sheet is solid, it passes through asbestos covered rollers up an annealing tower, and emerges at the top of the tower cool and annealed, where it is cut into lengths as required.

This process was invented at the beginning of the 20th century, but it is only recently that really satisfactory glass has been made in this way, owing to the fact that as the glass has to be solidified quickly by means of the water boxes, the temperature at the top of the float soon drops to below devitrification temperature, and devitrification occurs at the edges of the slit. This causes the characteristic lines of most Fourcault glass. In order to overcome this difficulty, changes were made in the composition of the glass to prevent devitrification, but this led to further disaster as the glass was not durable. Not only did the glass "weather" very rapidly, but in many instances when boxes of the glass were opened it was found that the sheets were stuck together in a solid mass. This difficulty has now been mainly overcome by alterations in the composition of the glass, magnesia and alumina being used to prevent devitrification and to maintain durability, but devitrification still occurs.

At the beginning of the operation, really good glass is drawn, but as time goes on devitrification begins, and this gets worse and worse until, finally, after some days, the process has to be stopped and the whole kiln re-heated so as to melt away all the devitrified glass.

Libbey-Owens Process. In this process the width of the sheet is maintained by pairs of small rollers which grip the edges of the sheet just above the level of the metal in the tank. The sheet is solidified quickly by means of water boxes, as in the Fourcault process. It is then re-heated and bent horizontally over a roller: then travels down a roller lehr, annealed and cut into pieces as desired at the end of the lehr. This process does away with devitrification troubles with the slit in the Fourcault process, but the surface of the glass is not so good owing to the re-heating and bending over the roller. In the early days of this process, this trouble was much greater than it is now, and glass made by the Libbey-Owens process could always be detected by the surface which had been in contact with the roller, which was always slightly spoilt. This difficulty has been largely overcome by the use of highly polished rollers made from untarnishable metals, but the surface is still never as brilliant as the fire polish of the old Crown Glass.

The most modern process of sheet glass manufacture—known as the Pittsburgh Process, has overcome the difficulties of the previous flat drawn processes. To form the glass into a sheet, it first passes from the tank into a drawing kiln, a relatively small extension to the tank and separated from it above the level of the glass surface by a tweel and shut-off. The shut-off is a block of refractory material which floats on the surface of the glass. The tweel is a slab of refractory material suspended from one edge and lowered until it rests on the shut-off, and completes the seal between the tank atmosphere and that of the kiln.

After entering the drawing kiln underneath the shut-off, the glass flows round either side of a submerged clay block of special design, known as the draw-bar, and is drawn up in the form of a sheet from the surface above a series of electrically driven, asbestos-covered rollers mounted in pairs in a cast-iron tower, situated above and parallel to the length of the draw-bar. To start the process, an iron grille known as the "bait" is lowered down between the tower rollers into the glass. When it has remained there for a short period the molten glass sticks to the iron and the bait is slowly lifted, drawing behind it a sheet of glass. When the leading edge of this sheet has passed through the first few tower rollers, the bait can be cracked off from the glass and the rollers engaging the sheet which has followed the bait, draw a continous strip or sheet of glass up into the tower.

Fig. 4. A section of a glass cylinder being split into "shawls" before flattening.

The success of the process lies in the provision of devices for maintaining the width of the ribbon of glass being drawn, since, being in a plastic condition, there is a marked tendency for the glass to "waist." This would occur progressively until the sheet ceased to draw. The usual mechanism employed for this purpose comprises two parts—a fork and a pair of knurled air-cooled rollers. The fork—a slightly curved still plate with a machined slot in it, is placed just above the level of the glass in the kiln so that the edge of the sheet draws through the slot. The knurled rolls are of steel and are placed a few inches above the fork engaging an inch or so of the edge of the sheet. The two rollers are pressed towards each other so as to grip the glass firmly, and are usually driven independently of the tower rollers.

Facing the glass sheet at a position just above the level of the glass in the kiln are water-cooled steel boxes, the purpose of which is to assist in solidifying the sheet as soon as it has been formed.

As the glass is drawn up the tower it gradually cools off, and at a height of about 25 feet above the kiln, it is sufficiently cold to be cut off. The glass is then pulled by hand away from the cut, which opens and enables the cut sheet to be removed and trimmed.

This trimming consists of the removal of the edges, these bearing the marks of the knurled rollers. The glass lost by this edge trimming is returned to the tank and re-melted. We are indebted to Pilkington Bros., Ltd., St. Helens, Lancs., for the illustrations and information contained in this article.

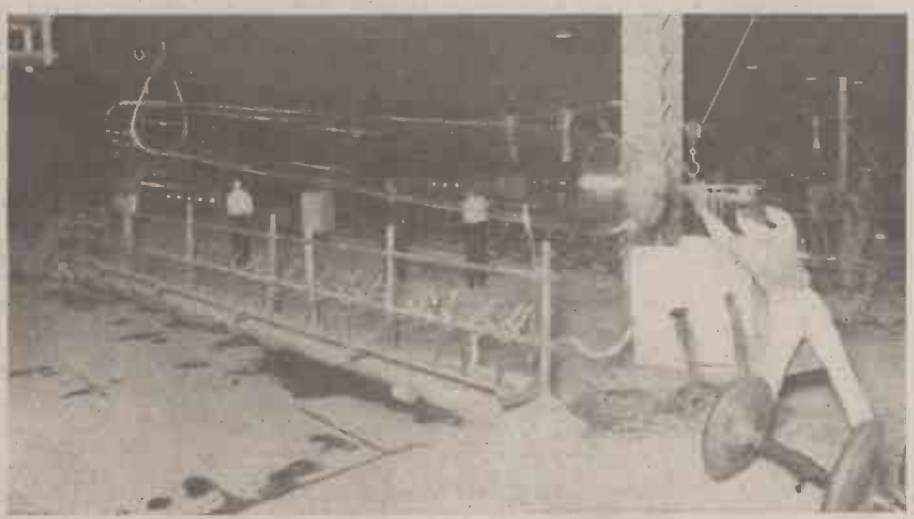
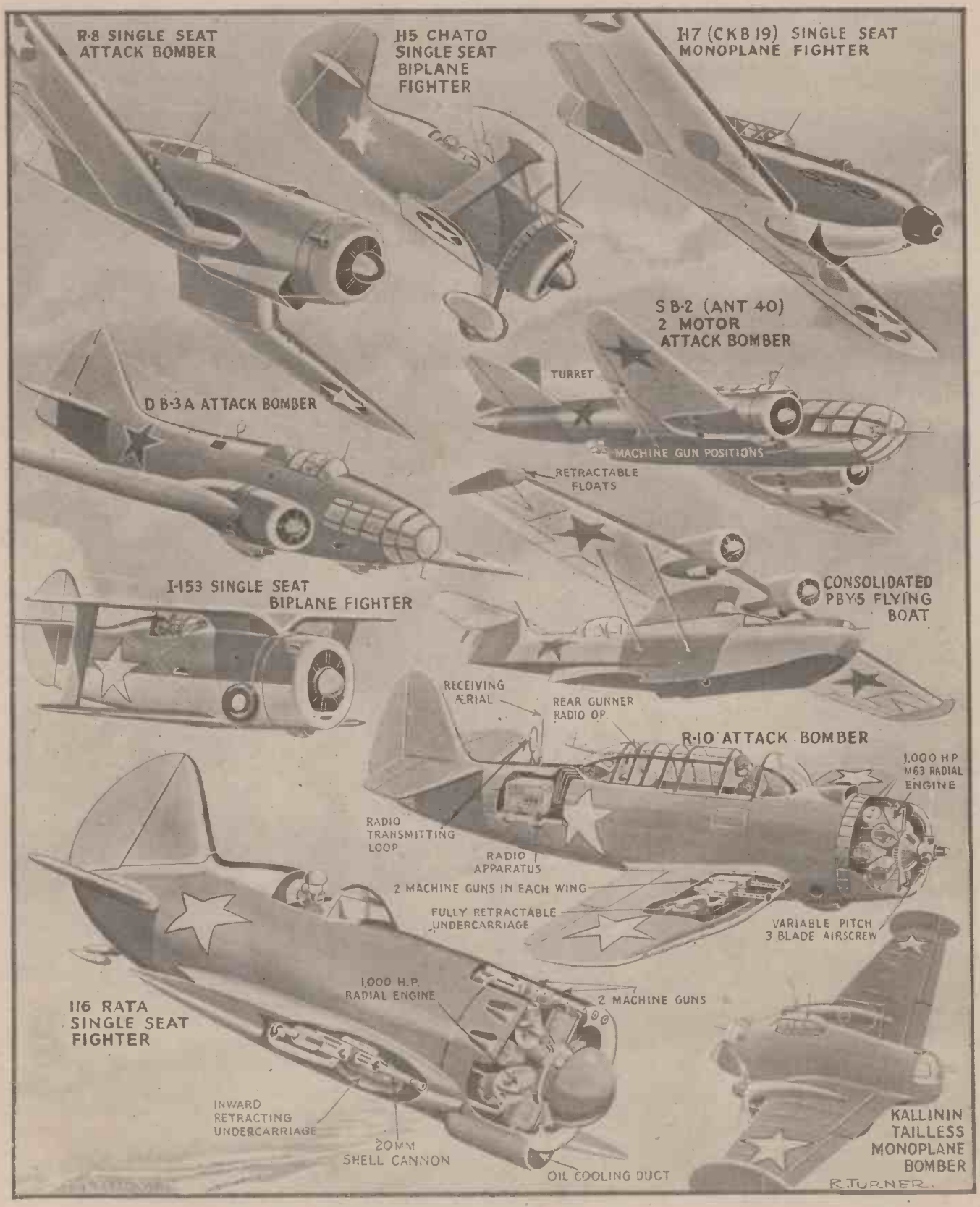


Fig. 3. Lowering on to the rest for cutting up into lengths. The glass cylinder illustrated measures 35 ft. in length by 36 ins. diameter.

TYPES OF RUSSIAN AIRCRAFT



R-8: Speed 228 m.p.h., 4 machine guns, bomb load 1,200 lbs. I-15 Chato: Speed 225 m.p.h., 4 machine guns. I-17 (CKB 19): Speed 310 m.p.h., 4 machine guns and cannon in nose. DB-3A: Bomb load 4,400 lbs., 3 machine guns. SB-2 (Ant 40): Bomb load 1,100 lbs., speed 274 m.p.h., 3 machine gun positions. I-153: Speed 242 m.p.h., 4 machine guns. PBY-5: Speed 190 m.p.h., range 4,000 miles, 1 gun in nose turret and 2 guns in each dorsal blister. R-10: Speed 275 m.p.h. 116 Rata: Speed 300 m.p.h. Kallinin Tailless Monoplane: Bomb load 1,760 lbs., 2 gun turrets.

The Steam Turbine

Types and Operating Principles

IN previous articles on the properties of steam it was shown how the energy in steam is utilised in principle. If we keep in mind the fact that any temperature above that of the atmosphere represents an energy gradient, akin to voltage, it is clear that when steam is cooled back to that of the air, or for that matter, reduced at all, in temperature, the result is a development of work in some form or another. Thus, if the steam is allowed to cool at constant pressure it yields up its potential energy as heat to whatever surrounds

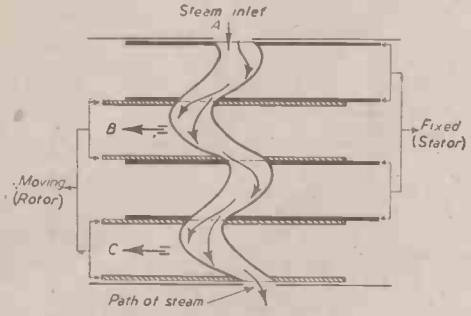


Fig. 1. Illustrating the principle of using steam expansively in a turbine.

it, while if we allow it to expand quickly, so that the minimum heat is lost, the energy is yielded as direct work, the latter being employed in steam engines.

Parsons and De Laval

The turbine may utilise the energy in steam by expansion, as in the reaction type, or by making use of the kinetic energy of a steam jet. The Parsons turbine is an outstanding example of the first method and the De Laval, the second one. Simple diagrams illustrate both principles, as shown in Figs 1 and 2. In practice the two principles are usually combined, as for example, in the well-known Rateau, Curtis and Zoelly turbines. The steam is admitted at A (Fig. 1) and because it endeavours to expand it acquires a velocity which drives it into the channel, or vane, at B, which is attached to a moveable wheel. The latter then tends to revolve and brings a second, third, and so on, vane into alignment with A, so that the wheel, or rotor, to give it its proper name, is kept revolving. After leaving B, the steam passes into a fixed vane, on which the steam, so to speak, gets a hold so that it can shoot itself into the moveable vanes on the rotor C, which is then also made to rotate. A large number of fixed and moveable channels are arranged in series in the turbines employing the Parsons' principle, so that as much energy as possible is extracted from the steam between A and C, the two rotor chambers being, of course, multiplied some dozens of times, and all attached to a common rotor. The fixed vanes are referred to as the stator. In Fig. 1 (B) the revolving energy is supplied to the rotor by virtue of the momentum of the steam impinging on it at A, this momentum coming from the expansion of the steam. That is why it is referred to as being an impulse-type turbine, although one should not liken the principle too closely to that of the Pelton Wheel, in which water jets impinge tangentially on the rotating wheel, because in the case of the steam, the velocity along the axis of the rotor, due to the expansion, will not be unimportant, whereas with water all of the motive power is due to momentum.

Jets

While at first sight they may not seem important, the design of the jets on a turbine determine the efficiency of this prime mover. It has been pointed out that the velocity of the steam due to expansion is made use of, and consequently, it is essential that the maximum speed should be obtained for a particular steam temperature. The relation between jet velocity and pressure of steam (i.e., temperature) is as follows:—

Steam Pressure lb./sq. in. (abs.)	Jet Velocity, ft./sec.
50	2,108
100	2,645
150	2,900
200	3,075
250	3,207

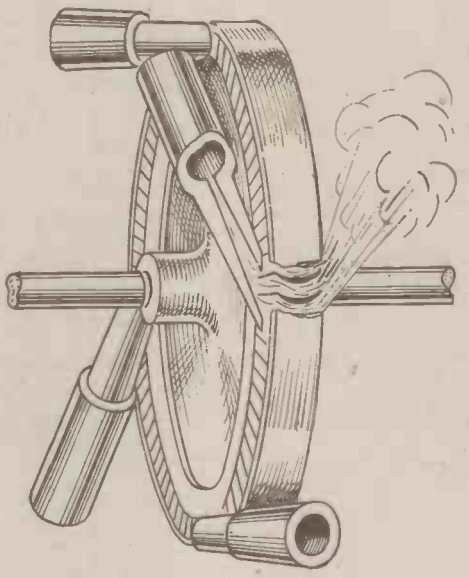


Fig. 2. The principle of the De Laval steam turbine.

In the above table it is assumed that the steam is expanded down to atmospheric pressure, from the initial value given. Furthermore, it is assumed that there is no obstruction to the flow, due to throttling in the jet, and here we come to the necessity for correct jet design. A considerable amount of research has been devoted to the relation of jet taper, the amount of flaring of the nozzle of the jet and other factors, to steam pressures and velocities, and the theory of the subject is intricate. But the relationships can be expressed in simplified form, by reference to Fig. 3. The jet, it will be observed, has a taper, which is calculated, while the nozzle is flared at its extremity, so giving rise to a type referred to as convergent-divergent; that is to say, at the throat section A the inner walls of the jet diverge. This ensures that there is no back pressure, which would reduce the velocity of the steam. The maximum steam discharge, or capacity of the jet is then expressed by the relationship:

$$W = \frac{A \times P}{60 \times \sqrt{1+0.0016f}}$$

where A = Area of throat, in sq. in.
P = Pressure of steam, absolute.
f = Degrees F, superheat of steam.
W = Weight of steam discharged, lb./sec.

The jet angle of 20 deg. given in the illustration happens to be that in the De Laval, while the angle of the blades, or chambers, on the rotor. The velocity of the steam at the outlet of the nozzle is expressed by the relationship:

$$\frac{V}{2g} = J\,h_A$$

where h_A, the available heat in the steam, in B.Th.U./lb., can be calculated from

$$h_A = \left[\frac{144\,(\eta+1)}{J}\right] p_1(v_1-b)\left\{\left[1-\frac{p_2}{p_1}\right]^{\frac{1}{\eta+1}}\right\}$$

where V = velocity of steam.
g = acceleration due to gravity.
J = mechanical equivalent of heat, 778 ft.-lb. per B.Th.U.
h_A = available heat, in B.Th.U. per lb.

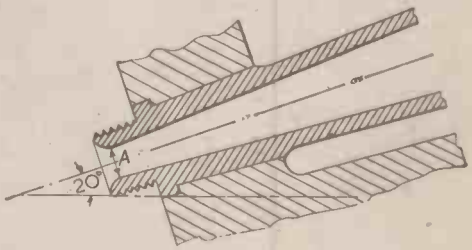


Fig. 3. Section of steam nozzle, showing the jet taper.

$$(n+1) = \frac{13}{3}$$

p_1 = initial pressure of steam, lb. absolute.
p_2 = final pressure of steam, lb. absolute.
v_1 = initial specific volume, in cu. ft./lb.
b = constant, sufficiently low to neglect at pressures below 300 lb./sq. in.

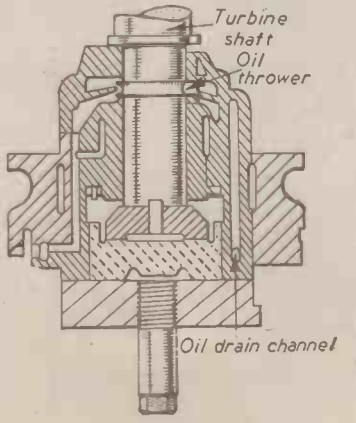
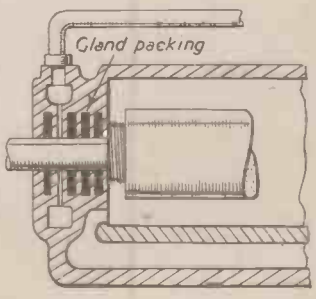


Fig. 4 (left). Section through the step bearing of a Curtis turbine.

Fig. 5 (right). Section of a typical turbine bearing, showing the glands.



The angle of the blades or buckets on the rotor of a turbine are also important, where efficiency is concerned, but it is not proposed to go into the theory of their design, the relationships for jets, given above, serving as an example of the accuracy of knowledge on the subject.

The Rotor

Having designed vanes and dispositions on the stator, the problem may be considered as solved on that part of the turbine. But when the blades have been settled on the rotor there still remains the problem of balancing the moving mass, and ensuring efficient running. This aspect of the problem is best realised when the speeds of modern turbines are known. They are as follow:

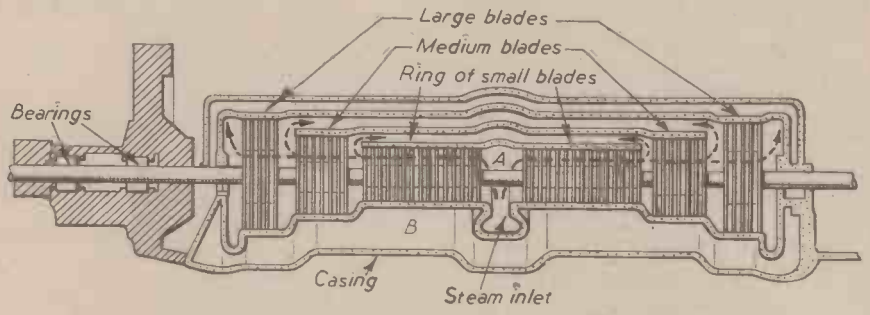


Fig. 6. Longitudinal section of a modern steam turbine.

Blade Speeds.	ft./sec.
De Laval	500-1,380
Rateau	300- 500
Curtis (U.S.A.)	350- 500
Zoelly	300- 500
Parsons, high pressure	130- 170
„ inter. pressure	220- 240
„ low pressure	350- 400
„ high pressure	70- 100
„ low pressure	110- 150

Some typical working speeds for well-known turbines are given below:

Make.	Speed at Optimum Efficiency.
W. H. Allen	6,500 r.p.m.
Brush-Ljungstrom	3,000 r.p.m.
Metro-Vick	3,000 r.p.m.
English Electric	3,000 r.p.m.
Parsons	3,000 r.p.m.
General Electric	1,800 r.p.m.
British Thomson-Houston	1,500 r.p.m.

It is a tribute to the manufacture of modern turbines that they run uninterruptedly with the greatest smoothness, yielding an efficiency (thermal, that is, amount of mechanical energy yielded, calculated on the basis of fuel consumption) ranging from 50 per cent. to over 80 per cent. If this is compared with the corresponding thermal efficiency for, say, the steam engine with less than 50 per cent., it will be seen that the turbine is a desirable form of power generation. Increasing the degree of steam superheat means an improvement in efficiency.

Clearly, with such speeds as the above, careful attention to the design of bearings is called for. Most of the large turbines, used for electric power generation in this country are of the horizontal type; that is to say, the axis of the rotor lies parallel to the ground. But the Curtis, a popular type in the States, is mounted vertically, which calls for a special type of bearing, usually referred to as a step bearing. Because of its interesting design, as indicated in Fig. 4, the rotor shaft, which usually has a speed of 700-800 r.p.m., according to the size, rests on a main casting. Oil is supplied under pressure to the interface of the shaft and bearing block, as floating off the former. The oil, in effect, acts as a sort of cushion, the lubricant being pumped slowly through the bearing continuously, at a few gallons per hour, returning to a reservoir and re-circulated.

In the normal, horizontal turbine the bearings are much the same as on an engine, being usually made of split white metal. A typical design is shown in Fig. 5, the packing glands being seen clearly. The object of these is to provide a steam-tight seal, an important feature in high-pressure turbines.

Some Modern Turbines

Having discussed some of the details which have to be settled before a prime mover of this kind can be built, we can now describe one or two of the better-known types in use to-day. It should be understood that, while there are only two fundamental types of importance, the impulse and reaction turbine, these admit of many modifications, and consequently, there are several large makers of turbines, all of which fill an appropriate role. Thus, a unit which will run at evenly graduated loads is all that is necessary for, say, the generation of electricity on land. But at sea, the load may vary spasmodically, so calling for the use of more complicated arrangements and gearing.

For the most part, the modern turbine is made from Monel metal, a nickel alloy, steel, either forged or cast, and certain non-ferrous metals. The size of the unit depends on the speed and the work it has to perform. De Laval turbines are usually high speed, and, therefore, comparatively small. It is usual to gear a turbine, which gives a wide range of speeds, while it may also fall into one of three major classes: low pressure, intermediate pressure, or high-pressure, this referring to the pressure of the inlet steam. Such pressure would determine, among other things, the speed, the load and output. On board ship the three classes are often employed in conjunction with one another, with suitable intermediate gearing.

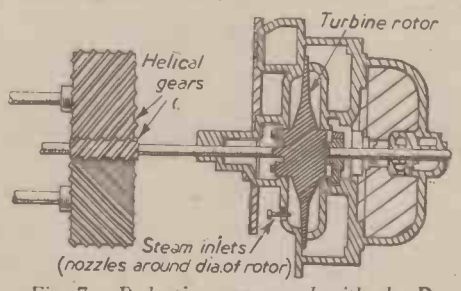


Fig. 7. Reduction gears used with the De Laval turbine.

Fig. 6 shows a modern turbine in outline, the blades on the rotor being represented by lines. The steam is admitted at A and makes its exit at B, when, however, it has not necessarily finished its task. The exhaust steam, as it is called, may be used for other processes. It should be remembered that it may enter at a temperature higher than 500 deg. F., which means that there would be a considerable amount of residual heat to be extracted, care being taken not to hold up the free flow of the steam from the turbine, which would interfere with the efficiency of the latter.

Starting Up

An interesting point in connection with starting up a turbine is that the rotor shaft is first floated free of its bearings by pumping in oil. The speed is then taken up gradually so that a full fluid film of oil is interposed between shaft and bearing, so minimising wear and friction. The speed of the turbine when running is governed in Parsons' units by admitting the steam in blasts, through a valve, which constantly opens and closes, the control being automatic, so keeping the rotor at an even speed. Otherwise, the usual method is to throttle the steam by means of a valve, which may be actuated automatically.

Coming back to the sketch of the Parsons' turbine, shown in Fig. 6, it will be observed that the blades are of varying diameter, the steam passing first through the smaller ones, then through successively larger blades. The point to remember is that the steam, when it enters at A, is at maximum temperature and pressure, and therefore, the energy is easier to extract, so calling for smaller blades. The most characteristic feature of the De Laval type shown in Fig. 7 is its high speed of revolution, which necessitates reduction gears, as indicated at G. The driving pinion for these gears comes directly off the shaft of the turbine rotor, and the drive for which the turbine is required to supply the power, is taken off the shafts of the driven members of the gears. The steam channels in the rotor are not shown in Fig. 7, but they follow the principle given in Fig. 1, the steam nozzles being arranged at intervals around the diameter of the rotor.

Further interesting particulars of the modern steam turbine are given in an article which appeared in the April 1939 issue of *Practical Mechanics*.

Screw Type

In conclusion, it might be added that a great deal of ingenuity has been applied to the design and improvement of turbines over the past thirty years. Several unorthodox types have been tried out, but they would appear to suffer from one drawback or another. An example of this is given by the Screw type which was tried out by Professor Hewitt about forty years ago, and shown in Fig. 8. The object is clear from the sketch, the steam passing through from the inlet to the outlet, turning the screw which constitutes the rotor. As in the Parsons' type, the steam flows both ways; the details of the outlet in Fig. 8 are omitted for clarity.

Whatever may be the relative claims of the Diesel engine and the turbine as prime movers, it is safe to say that the latter is both a highly efficient source of power, and an equally valuable one to a country where coal is abundant for steam generation.

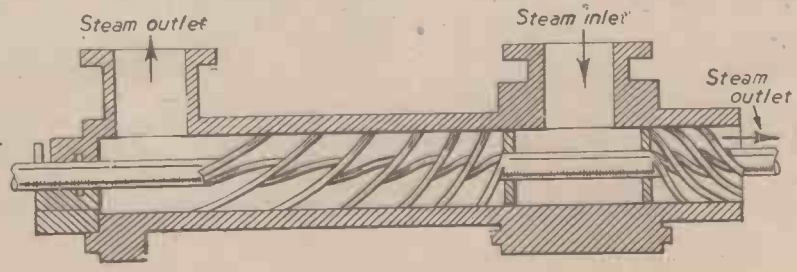


Fig. 8: Section of Professor Hewitt's screw type of turbine.

THE MONTH IN THE WORLD OF

Science and Invention

A brain microtome for cutting sections of the brain as thin as 5/2,500 thousands of an inch.

New Trackless Tank

AN 80-mile-an-hour trackless tank which, it is hoped, will be the means of beating Germany's panzers, is to be tested by the United States Army soon. The tank runs on eight huge wheels, is 30 ft. long and 7 ft. high.

Automatic Cannon

BORIS SHPITALNY, ace Soviet plane designer, has invented a new type of automatic plane cannon. No details of the gun are available.

Electronic View Finder

A NEW American idea for simplifying the job of the television cameraman is an electronic view-finder. This new view-finder replaces the old optical finder, and reproduces exactly the image being picked up by the television camera. The image is supplied by a 5-in. cathode-ray tube operated by an independent power supply unit. The image on the screen is shielded from the effects of stray light by means of an eye shield.

Fastening for Plastic Parts

WITH the rapid increase in the use of plastics in industry, it is perhaps a natural development that a spring fastening for this material should appear on the market. It carries the trade mark "Quickies," and can be used for ¼ in., 5/16 in., and ⅜ in. studs. It is claimed that the simple device will hold the fastening under tension, although adjoining parts may contract or expand due to temperature variations.

Synthetic Tubing Material

A FLEXIBLE, semi-transparent synthetic resin tubing material has been developed as an alternative to copper tubing. It is claimed to be resistant to acids, alkalies and water, and besides being tough, has the valuable property of withstanding temperatures up to 250 deg. F. for short periods. A good idea of the properties of "Saran," as it is called, is offered by the fatigue test in which the material was flexed through 15 deg. at 1,750 per minute for 2,500,000 cycles without breakdown, whereas copper failed at 500 cycles.

Largest Evaporators Yet Constructed

THE vessel illustrated on this page is one of four welded evaporators constructed by G. A. Harvey & Co. (London) Ltd., Woolwich Road, London, S.E.7, to the order of Tate & Lyle, Ltd., Plaistow, using "Fleetweld" Electrodes, manufactured by the Lincoln Electric Company Limited, of Welwyn Garden City, Herts.

These evaporators are of particular interest, as they are claimed to be the largest welded pressure vessels so far made to Lloyd's Class 1 Code. They have a length of 26 ft. 9 in. with an internal diameter of 11 ft. and are designed for a working pressure of 250 lbs. per sq. in. Each of the evaporators consists of two shells, 10 ft. 4 in. high, and a domed bottom and cover 3 ft. deep. The bottom shell, known as the Calandria section, is 1.15/32 ins. in thickness and has two tube plates each in one piece 1 in. thick. There are 1,792 tubes of 1½ in. diameter, 9 ft. ½ in. long, welded into and connecting the two plates. The thickness of the top shell is 1⅛ in. and that of the bottom and top dished and flanged ends 1⅜ in., the plates for these ends had a diameter before dishing and flanging of 13 ft. 5½ in.—the maximum width that can be rolled in England. The Calandria section was tested to 375 lbs. per sq. in. and the upper shell to 285 lbs.

Owing to the high working steam pressure on the shells of the evaporators, the constructional work had to be of the highest order, as not only had it to conform to Lloyd's Class 1 Code for welded pressure vessels, but the work was independently surveyed by the Vulcan Boiler and General Insruance Company Ltd., to the A.S.M.E. Code. All the main seams were X-rayed to ascertain that imperfections in the form of slag were not present, and altogether about 1,200 exographs were taken of the four vessels.

The largest evaporators yet constructed (see paragraph on this page).

New Lens Glass

THE Eastman Kodak Company have produced a new lens glass, which it is claimed bends or refracts light more than ordinary glass, and contains no silica, the principal constituent of the latter. Instead, tungsten, tantalum and lanthanum are used, and among the properties ascribed to the new material are a wider angle of vision, making it particularly suitable for aerial cameras.

Smoke Meter for Diesels

THE amount of smoke in an engine exhaust is a measure of the efficiency, inefficiency, to be exact, of the unit. Smoke is made up of very fine particles of carbon, formed due to the incomplete combustion of the fuel. A complete absence of smoke, on the other hand, may not mean that combustion efficiency is at a maximum, for there might be an excess of air going to the cylinders. But the presence of smoke does point to a too-rich mixture, faulty ignition or too little air. It is not always possible to see small amounts of smoke in an exhaust, which prompted Schweitzer to des-

cribe in *Power*, November 1941, a simple diesel smoke indicator. It makes use of a standard light meter and source of light. He states that between 25 and 75 per cent. engine load the smoke should be zero, and his light recording device will show 50 per cent. smoke when such a percentage is only just visible to the naked eye.

Giant Dam for Hydro-electric Power

THE construction of the monster Boulder Dam a couple of years ago drew attention to the vast scheme upon which the U.S. Government had embarked to generate as much electric power from her rivers and waterfalls as possible. New York State and her neighbours are fortunate in having a natural water drop, or ridge over which all the rivers flowing into the Atlantic at that part of the coast have to fall. This has given rise to a number of hydro-electric power stations, which have made electricity both cheap and plentiful. But the State Department are not content with that and have, for many years, been building dams in various parts of the country, both for power generation and irrigation. This work is handled by the Bureau of Reclamation, and the problems which have been surmounted and the magnitude of the tasks have contributed to making the Bureau one of the finest exponents on the subject in the world. The latest Friant Dam, near San Francisco, offers a good example of the difficulties to be overcome. The enormous amount of concrete going into the 2,160,000 cubic yards going into the dam has its origin in gravel brought from pits three miles away. The roots of the dam itself meant excavating 1,300,000 cubic yards, including solid rock of a quartz-mica schist character, which had to be blasted. Some idea of the mixing and other equipment required is conveyed by the fact that 10,000 cubic yards of concrete had to be poured in 24 hours, or nearly quarter of a million yards per month, while all the time scores of pneumatic drills were at work on the rocks. Two gigantic hammer cranes operated on the rising walls of the dam, not to mention many other jib cranes. Alongside the main dam a diversion channel had to be cut, to by-pass the river, the channel being 1,700 ft. long and 50 ft. wide. The gravel pit referred to above extended over 55 acres. But the Friant Dam is by no means the largest in the States, even though it may be the latest. The Boulder Dam is 726 ft. high, or over twice the height of the dome of St. Paul's Cathedral, London.

Electro-gravitic Lift

Some Interesting Particulars Concerning the "Aeromotor"

By W. D. VERSCHOYLE

As the inventor sees the heavily armoured and gunned 100-*ton aerial tank of the future, with* 2,000 *h.p. enclosed lift engines, dynamos, and radiators, and two* 1,000 *h.p. pusher propelling engines.*

IN the November issue of *Practical Mechanics* two practical sources of aerial lift are described, and a note may be of interest concerning another which, though still in its infancy, looks like turning out to be of considerable value.

The fundamental difference between this and all others is that whereas the latter depend on some form of aerial reaction, this new source of lift is independent of the air.

Whether we use planes, vertical propellers, or rotating cylinders, the effort in each case aims at overcoming the downward pull of gravity. Each known method of overcoming this pull gives an indirect solution of the real problem, more or less effective, but still not by direct action on gravity itself.

The new source of lift derives from direct action on gravity through a newly discovered method of applying electrical energy to that end, this having followed from continuation of a research initiated by Faraday nearly a century ago which sought a connection between electricity and gravity.

Clearly, once this connection is known, with unlimited electrical power available a wide field of practical utility is opened up, in which its applicability to aviation is of prime importance.

After many hundreds of costly experiments, the connection was discovered in 1908, but, thereafter, many hundreds more were needed before the electrical factors implicated were known with sufficient certainty. Even now there are technical difficulties to be overcome before these factors can be raised to values that will give a lift of the magnitude required in aviation.

Briefly, the present position can be thus stated. It has been found that:

$$L = ABC$$

where L is the lift; A and B the factors implicated; and C a constant based on hundreds of quantitative experiments. This relation holds so accurately for all easily reached values of A and B that extrapolation may be considered justifiable; and giving them values that are commonplaces in other electrical departments it can be shown that L should easily reach 116 lbs. per h.p. correctly applied.

Furthermore, the theoretic limit which L approaches as the values of A and B are raised is many times greater than 116 lbs., for the eventual limit may be expected to come, not from the values of A and B, but from limitations of gravitic response. But astronomers assure us that this response may be thousands of times greater than anything known on this earth, and consequently the limit of L may be far above any practical value the aviation engineer is likely to demand.

For reasons which will be obvious, it is not deemed advisable to publish full details of electro-gravitic methods beyond indicating briefly how the problem has been attacked.

A new working theory of material constitution had first to be formulated, under which gravity becomes the principal binding force, not only in the macrocosm, but also in the microcosm. Under the guidance of this theory the gravity field existing between the earth and any external mass of matter, such as an aeroplane, became the point of attack. Some new kind of ray had then to be found capable of affecting this field, and in what I have called the *Y-rays* the necessary agent was found. These rays have extraordinary characteristics, but are of such a nature that their generation presents only small technical difficulty in design and manufacture of the necessary generators. We may then safely contemplate the future generation of Y-rays of sufficient intensity to deal with the gravity field existing between the earth and an aerial machine weighing one or a hundred tons, and such a possibility opens up wide avenues of advance in aviation practice, both for peace and war time purposes.

Employing electro-gravitic principles, the aerial machine of the future will have no wings, rotating cylinders, or vertical propellers, and something like 40 per cent. of resistance to translative motion will thus be eliminated. Needing no initial high ground velocity to get into the air, it will rise straight up from, or alight anywhere on the earth's surface, proceeding then to its destination at velocities very much greater than any yet attained. It may be any weight from 400 lbs., the equivalent of a motor cycle, to 400 tons—a super-tank or a peace-time rapid transportation unit.

But for the *aeromotor*, as it is proposed to call this machine, the introductory difficulties recently mentioned in "Fair Comment" greatly exceed what the aeroplane had to contend with. Forty years ago it was thought in high places "the heavier than air machine is scientifically impossible," and "the aeroplane is an interesting innovation, but will never be of any use for war purposes." Now, I am assured in the same high places, "you must be working on a fallacy. We can never hope to overcome gravity in the way suggested." My balance gives assurance to the contrary, and I have more confidence in its judgment. Besides, as long ago as 1936 I demonstrated an electro-gravitically actuated model aeromotor going to my laboratory ceiling, and a film of the same operation was shown in the principal London cinemas.

The Properties of Acetylene-Gas Fuel

How Acetylene Gas is being used as a Motor Fuel Substitute in Switzerland

AS the result of the petrol shortage and the restrictions affecting motor traffic in Switzerland, the number of acetylene-gas-operated cars in actual use in that country is increasing daily. Up to last May the Office for Motor Fuel Substitutes, Production of "Energy and Heat" Department, had so far issued about 4,000 licences for the conversion of motor vehicles to the use of fuel substitutes. More than half that number of licences relate to vehicles equipped with a type of acetylene-gas generator which can now be seen on the roads under the cover of the blue flag. This shows, therefore, that acetylene gas may be regarded as an excellent motor fuel substitute, destined to become extremely popular. In November, 1939, the possibilities were being considered—still problematical at the time—of using acetylene gas to make up, in a certain measure, for the shortage of petrol. To-day, important industrial undertakings have embarked upon the manufacture of acetylene generators, and mention may be made here of a leading firm of motor car constructors, whose name is known all over the world, i.e., Messrs. General Motors Suisse S.A., of Bienne, who did not hesitate to undertake the manufacture and assembly, on the belt system, of their own make of acetylene generators.

In view of such striking developments, we consider it will be of interest now to refer again to the use of acetylene gas as a motor fuel, and place on record the results attained by the latest experiments, and also the rapid progress now achieved. Let us see what the Chief of the Technical Department of Swiss General Motors himself has to say about it.

Calcium Carbide

Calcium carbide is a synthetic product resulting from a combination of carbon and quicklime. It is manufactured in electric furnaces provided with carbon linings. The production of one metric ton of carbide requires approximately 1,000 kg. of quick-lime and 600 kg. of carbon (coke, charcoal or anthracite).

Calcium carbide in the molten state comes out like iron from the blast furnace. It is cooled in large crucibles, then crushed, and graded according to grain structure.

In the pure state calcium carbide (Ca C2) forms transparent crystals, while as sold on the market the product is of a greyish black colour, owing to the impurities it contains. It has a marked tendency to combine with water, even when the latter is in the form of vapour or moisture contained in the air. Calcium carbide must accordingly be kept dry in sealed metal containers.

When placed in contact with water, calcium carbide gives rise to the production of "carbide gas" (acetylene) (C2 H2), slaked lime (Ca O H2), and heat.

The theoretical yield of 1 kilogram of calcium carbide is 348 litres of gas, using 0.6 litre of water.

But in practice the gas yield of calcium carbide ranges from 270 to 300 litres of gas per kilogram, according to the quality of the material used, and the impurities contained in it. Owing to the fact that spent carbide is converted into a kind of slime which adheres to fresh carbide, the spent carbide coating must be moistened first before the water can act on the fresh material. Appreciably more water must, therefore, be used to ensure this result.

The Acetylene Generator

The heat generated while gasification takes place amounts to approximately 450 calories. This heat is led out of the generator partly by the current of air, but mainly as a result of the evaporation of the water injected. The evaporation heat is 540 calories, which means that the evaporation of every litre of water removes from the generator a quantity of heat equal to 540 calories. Under conditions of continuous operation, one must reckon with approximately 0.6 to 0.8 litre of water, only for cooling. Thus, the temperature of the generator is kept automatically at 80-90 deg. C.

The "carbide gas" thus produced contains a certain amount of impurities of a mechanical and chemical nature (lime, potash and sulphur), and also some water vapour.

The water content per cubic metre of saturated carbide gas is as follows:—

about	13 grams at	15 deg. C.
,,	83 ,,	50 deg. C.
,,	425 ,,	90 deg. C.

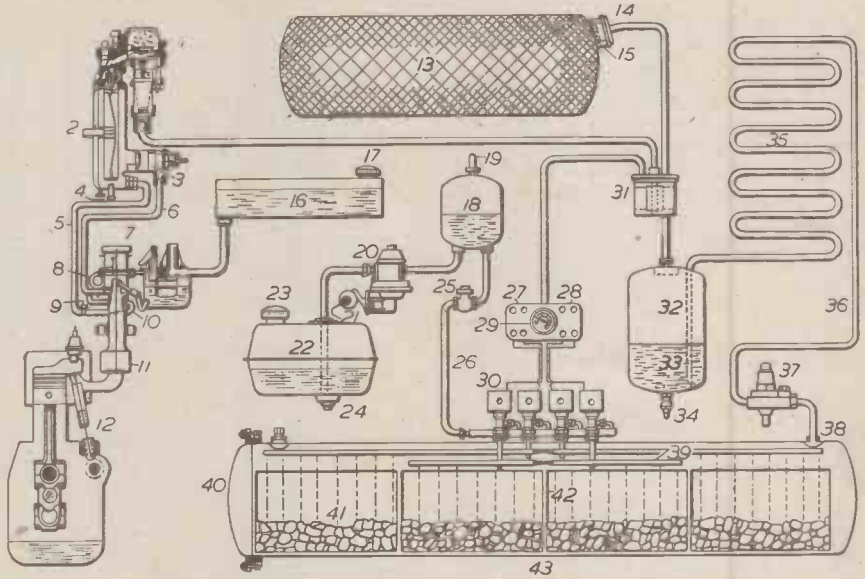
In addition to this saturation vapour, the gas also carries away the water vapour which comes from the steam in the generator.

As all these extraneous substances would have detrimental effects on the engine, they must be eliminated from the gas as thoroughly as possible. The water vapour is removed in a cooling coil, the vapour being condensed in the coil and retained in a suitable receptacle. This receptacle also serves to remove any impurities of a chemical nature. Further purification is effected in a special filter provided after the condensation receptacle.

"Carbide gas" (acetylene) is a non-saturated hydrocarbon, i.e., two atoms of hydrogen are combined with only two atoms of carbon, while six atoms of hydrogen would be required for saturation. As a result of this, the gas is unstable and reacts very easily. It constitutes the raw material used for many synthetic products, such as fabrics, artificial rubber and acetic acid. Its calorific value is very high, and greater than that of most other gases, it being in fact 13,000 calories per cubic metre, while that of some other gases may be stated as follows:

Coal gas	3,800 Cal.
Producer gas ..	1,300 Cal.
Wood gas	1,300 Cal.

A violent explosion is obtained with a mixture of the gas and air in the proportion (volume) of 1 : 12.5. Compared with other gaseous mixtures, a mixture of carbide gas and air is explosive within very wide percentage limits, as shown by the following figures.



Present type of acetylene generator (G.M. Carbor): 1. Pressure reducer. 2. Double pressure reducer. 3. Check valve. 4. Regulation. 5. Slow running pipe. 6. Main pipe. 7. Gas and air mixer. 8. Vacuum diaphragm. 9. Slow running adjustment. 10. Vacuum pipe. 11. Induction collector. 12. Engine. 13. Gas container. 14. Filter. 15. Nozzle. 16. Tank for alcohol. 17. Filler cap. 18. Equaliser. 19. Inflation valve. 20. Feed pump. 21. Cam shaft. 22. Water tank. 23. Filler cap. 24. Drain plug. 25. Check valve. 26. Water pipe. 27. Test lamps. 28. Control buttons. 29. Pressure gauge. 30. Solenoid valves. 31. Gas filter. 32. Condenser. 33. Condensate. 34. Water outlet. 35. Cooling coil. 36. Gas pipe. 37. Safety and stop valve. 38. Gas outlet connection. 39. Watering tubes. 40. Cover. 41. Calcium carbide. 42. Slides. 43. Generator.

Percentages of fuels which produce an explosive mixture with air:

Petrol ..	from 2.5%	to 4.8%
Benzol ..	,, 1.5%	,, 8.0%
Methane ..	,, 5.0%	,, 25.0%
Coal gas ..	,, 8.0%	,, 25.0%
Acetylene	,, 3.0%	,, 82.0%

The foregoing percentages clearly show how great is the risk of explosion with carbide gas (acetylene) in a closed room. Consequently the use of naked lights or smoking should be carefully avoided in premises where acetylene generators are installed.

Not only are mixtures of carbide gas and air explosive themselves, but the gas in the pure state can explode as the result of mere impact if compressed at more than two atmospheres. The pressure in the equipment should, therefore, never exceed 1.5 atmospheres. A safety valve which opens at that limit keeps the pressure below the figure mentioned above. In no circumstances should the safety valve be set to operate at a pressure exceeding 1.5 atmospheres, nor should the safety valve ever be rendered inoperative. The satisfactory working of the safety valve must be checked frequently, and at regular intervals.

A Highly Detonating Gas

One of the principal difficulties which had hitherto prevented the use of carbide gas (acetylene) as a motor fuel is its low resistance to detonation, this being lower than octane number 40, while that of other fuels in current use is as follows: good grade petrol, 74; petrol-benzol mixture, 80; and wood gas, 105. Several methods are available for remedying this disadvantage, such as by lowering compression, or retarding combustion by the use of more air or the addition of a liquid, such as water or a mixture of alcohol and water, which will exert a braking effect on combustion. All these methods have their advantages, and their disadvantages.

The best solution would, no doubt, be to have an engine specially designed to run on carbide gas only. But as we have to adapt ourselves to existing engines, our problem really consists in devising the best possible compromise in the circumstances. We begin by timing the engine for the use, in the first instance, of a mixture of gas and air only, without any addition. This mixture is so weak that, owing to the fact that carburation takes place slowly, there is no knocking whatever. But as the efficiency of such a mixture is low, then some alcohol is added, or a mixture of three parts of alcohol for one of water in order to improve the output.

Owing to the tendency to self-ignition shown by carbide gas when it is subjected to high pressure, it cannot be compressed to any degree for storage purposes. On the other hand, as additional gasification occurs in all slide systems, owing to the fact that the moist slime originating from the spent carbide will act upon the fresh carbide even after the water has been cut off, the equipment must include a special container to receive the gas produced by such additional gasification, and to yield this gas up again when the pressure of the gas is lowered.

The Part Played by Acetone

Acetone has the property of absorbing a large quantity of carbide gas and yielding it up again when pressure is reduced. One litre of acetone is capable, at a temperature of 15 deg. C. and under pressure of one atmosphere, of absorbing 24 litres of gas. The absorption capacity of acetone increases with the pressure, and diminishes with the temperature. Use of this property of acetone may be made in a gas accumulator such as embodied, for instance, in the G.M. Carbor generator.

The latter contains charcoal, which substance absorbs acetone very readily.

All combinations of copper and acetylene are explosive. Consequently, no component parts or pipes made of copper can be used. On the other hand, brass components may be employed so long as they do not contain more than 70 per cent. copper.

Precautions

All acetylene gas users must exercise the utmost care in making sure that no gas can escape from their generating equipment, not only for the sake of economy, but also for reasons of safety. Acetylene is a highly explosive gas when mixed with air, within very wide percentage limits. For instance, just a spark or a naked light may cause the explosion of a mixture of air and acetylene containing only 3 per cent. of that gas. It is, therefore, imperative to see that all joints, metal pipes or rubber tubing are in perfectly gas-tight condition.

Particular attention should be given to the pressure reducer which, if not absolutely gas-tight, might allow a certain quantity of gas to escape while the engine was stopped. This gas would accumulate under the bonnet and explode on the engine being started again. This shows how very careful users should be.

Cambridge Mechanical Mallet

A Novel Instrument for the Use of Palaeontologists

THIS handy instrument, made by the Cambridge Instrument Company, Ltd., has been devised to facilitate the work of the palaeontologist and others in removing fossilised and similar specimens from the hard rock in which they may be imbedded.

The Cambridge mechanical mallet in operation.

Although free from vibration, the mallet delivers up to 700 blows a minute, the rapidity and strength of which will quickly remove the heaviest encrustation. It has been estimated that the mallet will clear a specimen in one-tenth the time possible with the more laborious non-mechanical methods.

Notwithstanding the efficiency of the mallet for coarser work, the perfection of its balance, and the latitude of adjustment of both the strength and frequency of its blows, enable it to be used for delicate work. The operator is advised, however, to do the final clearing of the less robust specimens by the slower methods with which he is acquainted. The strength of the blow may easily be varied over a wide range by the adjustment of a control screw on the mallet handle. Should a yet further range be needed driving springs of graded strength can be supplied, which can be exchanged for the existing one with the minimum trouble.

Hardened Chisels

The chisels supplied are made of specially hardened and tempered steel, but owing to the severe conditions of this work, they need frequently to be sharpened if the best results are to be obtained. This need has been anticipated by the provision of an emery wheel carried on the driving motor. As it is quite unnecessary to remove the chisel from the mallet, the operator will not be induced by the tiresomeness of such repetition to delay in remedying the recurrent bluntness, which would otherwise jeopardise his work.

It should be added that another important feature that had a bearing on the design of the mallet, was the possibility of its use in the field. The field-worker is often unduly laden on his return to the laboratory with the results of his excavations, much of which is redundant embedding material which will at once be discarded. To obviate the need of transporting this useless debris from the field, the mallet may be used to make a preliminary clearing of the excavated specimens immediately ex situ.

Operates on 12 Volts

Therefore, the mallet may be supplied to order in conjunction with a twelve-volt driving motor. This can be conveniently driven off a car battery, or from any portable accumulator of sufficient capacity. The same motor may also be used off any mains supply in conjunction with a suitable resistance or transformer.

The automatic mallet, which has been designed in collaboration with Mr. F. R. Parrington of the Zoological Department, Cambridge University, has successfully been tried out under a variety of conditions. In particular, the rapidity and ease with which it dealt with a collection of Karro Vertebrates from Tanganyika, encased in the hardest of rocks, is a testimony to its efficiency.

The standard outfit consists of a mallet, driving shaft reduction gear, electric motor (⅛ h.p.), pulley-wheel, and small emery grinding wheel.

ELECTRICAL ACCESSORIES

The folder issued by Highstone Utilities of London, contains a good range of useful electrical accessories which include morse tapping keys, microphones, electric fires, irons, crystal radio receivers, electric soldering irons, kettles, small motors for working models, electric clocks, all-electric portable radio sets, and many electric fittings.

Tail First

A Semi-technical Survey of the Factors to be Considered in the Design of the Canard Type of Aircraft

ON a conventional design the efficiency of an aircraft's tailplane is reduced by the fact that it lies in the region of disturbed air caused by the passage of the wings through it. At large angles of attack, this turbulent region is particularly noticeable, and the tailplane is consequently very inefficient. Varying the relative position of the tailplane with respect to the fuselage has often been resorted to in order to obviate this loss, but whilst such modification may be effective at certain altitudes it does not follow that this is true throughout flight range. As an example, a high tailplane position is extremely good at low angles of attack, but its efficiency falls off rapidly at about 12 degrees so that control near the stall is relatively poor.

Canard Type

The only real solution is to remove the tailplane completely from the region likely to be affected by the wings, and so we get the tail first, or ente or canard type in which the tailplane is mounted in front of the wings, and is thus in undisturbed air. This would result in a reversal of the conditions. The wing is now affected by the "tailplane" downwash, but as the latter is relatively small, this loss is not very considerable.

(Canard or ente means "duck," although the choice of this word seems an anomaly at first. Possibly its derivation is found in the fact that in flight the wings of these machines appear a long way back and thus the resemblance to a duck in flight.)

There is no doubt that an improvement in stability will result from such a layout, in fact, it should be possible to design a "stall-proof" aeroplane along these lines. The biplane gliders built by the Wright brothers about 1900, and from which the first successful power-driven machine was built, were all canard types. The tailplane was carried in front of the biplane wings on outriggers and its altitude could be altered by the pilot to preserve longitudinal control. A vertical rudder was later added behind the wings to work in conjunction with the wing warping for lateral control.

Many other of the early flying machines were canard types, as the stability of such was greatly appreciated at the time. However, it was soon discovered that aeroplanes flew faster the "other way round," and in the mad chase after speed, and still more speed, the canard was generally disregarded, but a revival of interest is noted in recent years.

Angle of Incidence

Now let us consider the mechanics of the case. We find that in canard designs the "tailplane" is set at a higher angle of incidence than the wings, see Fig 1 (*a*), and thus is lifting or carrying part of the load in level flight. For stability in horizontal flight then:—

$W = L + l$ .. .. (1)

$La = lb$ .. .. (2)

where W = weight of machine.
L = lift of main wing.
a = moment anm of main wing, i.e. distance of C.P. of main wing to C.G. on Fig. 1 (*a*).
l = lift of "tailplane."
b = moment anm of "tailplane."

In order to simplify the analysis let us assume that both the tailplane and wing have the same aerofoil section and are identical in plan form, but not necessarily the same *size*.

Then $l = C_L \rho/2\ S_T V^2$ .. (3)

$L = C_L \rho/2\ SV^2$ .. (4)

where S_T = area of "tailplane."
S = area of wing.

Lift Curve Slope

Further, the slope of the lift curve of any aerofoil is approximately a straight line from zero lift to within a few degrees of the stalling point, and thus $spdC_L/da$, or rate of change of lift coefficient with angle of attack, is constant. The value of spC_L/da is about .07 for most aerofoils. From the diagram we see that the "tailplane" is orginally set at an angle of incidence of a_T degrees, and the wing at a_W degrees. Thus, the tailplane is always at a_T-a_W degrees incidence above that of the wing.

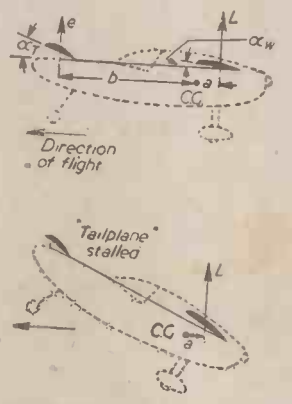


Fig. 1 Diagrams of a Canard type of aeroplane

Thus we can rewrite formula (3):—

$$l = C_L [1 + .07 (a_T - a_W)]\ \rho/2\ S_T V^2 \quad (5)$$

and dividing this by (4) we get:—

$$\frac{l}{L} = \frac{[1 + .07 (a_T - a_W)]\ S_T}{S} \quad .. \quad (6)$$

Whence, solving for l and substituting in (1)

$$W = L\left\{1 + \frac{(1 + .07 (a_T - a_W))S_T}{S} \quad ..\right\} \quad (7)$$

from which the relative sizes and settings of wing and "tailpiece" can be decided.

If, on the other hand, different sections are employed for wing and "tailplane," this requires modification. The constant value of the *slope* of the lift curve still holds good (neglecting differences due to aspect ratio), and the formulae for L and l can be rewritten, thus:—

$L = .07 a_{ZW}\ \rho/2\ SV^2$

$l = .07\ a_{ZT}\ \rho/2\ S_T V^2$

where a_{ZW} = angle of attack of wing *measured from zero lift.*
a_{ZT} = angle of attack of tailplane, *measured from zero lift.*

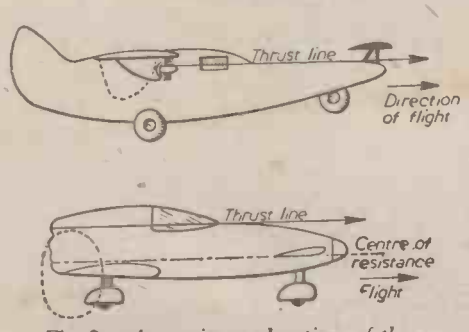


Fig. 2. Approximate elevations of the Focke-Wulfe and the T.K.5

Eliminating l as before, we are finally left with:—

$$W = L\left\{1 + \frac{a_{ZT}\ S_T}{a_{ZW}\ S}\right\} \quad .. \quad (8)$$

It is seen that when the machine assumes a climbing attitude, both l and L increase uniformly maintaining the balance of stability. Actually, however, the centre of pressure travel of the wing will be greater than that of the tailplane due to the former's greater chord, which means that its moment about the C.G. is reduced, resulting in a slight unbalance. However, this effect is slight, and can be overcome by suitable choice of aerofoil sections for the "tailplane" and wing.

Angle of Attack

When the machine reaches such an altitude that the angle of attack of the tailplane is about 16 degrees, see Fig. 1 (*b*), the latter has reached its stalling angle and thus its lift, l, rapidly falls off. The main wing is still several degrees below stalling, however (actually a_T-a_W degrees), and is thus lifting strongly. This means a powerful negative (diving) moment about the C. G. which brings the nose down. Thus while the tailplane can be stalled, the machine as a whole cannot, unless the manoeuvre is carried out with such violence that the inertia forces overcome the corrective force of the wings and momentarily cause the latter to stall as well. Such a stall is seldom likely to occur and, in any case, could be entirely prevented by fitting slots to the wing and thus increasing its range.

Notable amongst the aircraft firms that have been attracted by this "fool-proof" layout are Focke Wulfe, Lockheeds, and the De Havilland Technical School, as well as many other interested parties, mainly individualists.

The disposition of the various components lends itself admirably to the tricycle undercarriage, and as far back as 1932 the author was privileged to witness the performance of the Focke Wulfe "Ente," a twin engine, four-seater type with tricycle undercarriage, and was particularly impressed by its demonstration of stability and "fool-proof" flying at Hanworth.

Thrust Line

Comparing this design with the T.K.5. a product of the De H. Technical Students. it appears that the position of the thrust line on canard types is very important. Extreme difficulty was experienced in trying to get the T.K.5 off the ground due to the fact that the thrust line was some distance above the centre of resistance. A speed of over 80 m.p.h. could be reached on the ground with no signs of lifting, rather the reverse in fact, and it was suggested that, having attained this speed. the engine should suddenly have been shut off when the machine would probably have soared into the air straight away! However, had it risen under these conditions, the starting of the engine again would introduce a diving moment and a hurried descent! Subsequently, modifications were suggested, increasing the angle of incidence of the "tailplane" to lift the nose, but the war has. unfortunately, brought no further news of this interesting little machine.

Fig. 2 shows approximate elevations of the Focke-Wulfe and the T.K.5. not to any scale.

and some interesting conclusions can be drawn. The thrust line of the former nearly coincides with the centre of resistance, being slightly below it, and thus there is little tendency to nose up and none at all to nose down when the motors are running.

Low C.L. of Resistance

The other machine is a low-wing job and the "estimated" centre of resistance lies approximately on a line about three feet below the thrust line, thus being unavoidable on a low-wing layout with an inverted, direct-drive Gipsy engine. Thus with the motor running, there is a strong diving tendency and in order to get the nose to lift the "tailplane" must be adjusted to carry a considerable load, i.e. its own "flight" load plus the load induced by the engine.

It is thus possible to achieve balance, but when the engine is shut off, a considerable part of the down load on the tailplane disappears and, if the incidence remains the same, it will immediately rise and stall. This does not mean that the whole machine will stall, but it will rock up and down, describing a series of phugoidal oscillations until the tailplane is adjusted by the pilot to meet the new conditions.

Now such a divergence between "engine on" and "engine off" trim means throwing considerable responsibility on the pilot, or the fitting of a rather complicated control which varies the tailplane incidence with the throttle, and thus is departing from the desirable "fool-proof" characteristics. If this adjustment were not carried out quickly, the subsequent uneven motion with the tailplane stalling at the peak of each phugoid would be, to say the least, extremely worrying to the pilot!

Thus thrust line position seems of paramount importance and should be studied carefully in deciding the general layout. A suggested design for a simple single-seater canard is illustraed in Fig. 3, and also serves to show some of the disadvantages of the type.

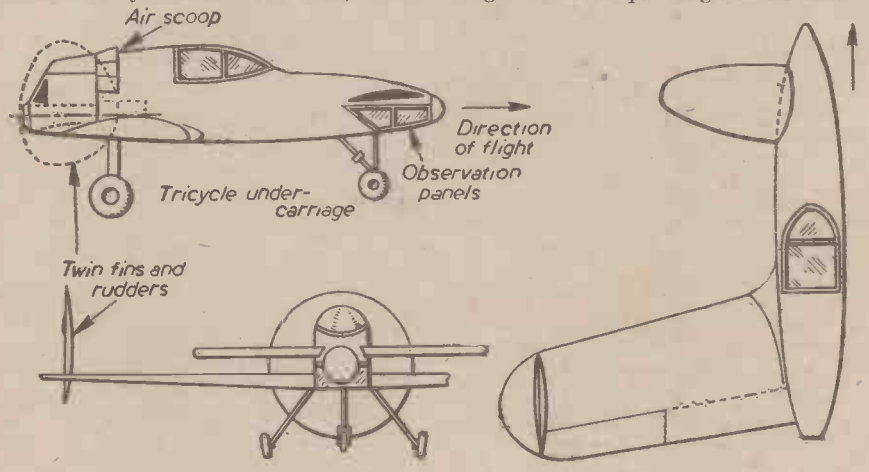


Fig. 3. A suggested design for a single-seater Canard

"Cabane" Mounting

In order to maintain the wing efficiency it is desirable to place the tailplane relatively high, which, with a relatively high wing position, may mean mounting on a "cabane." This tends to obscure the pilot's vision directly ahead, and, more certainly, slightly upwards. Wherever it is put it is going the "blot out" some of the forward view and the optimum position must be chosen or the loss compensated for.

An upright engine is desirable for a single engine machine, but, for a multi-seater, twin engines mounted on the wings are a far better arrangement. However, the machine is quite small, and we are thus more or less confined to a single engine.

Now, we must have the engine somewhere near the C.G., or else balancing will be a very real problem, which automatically places it near the main wings, i.e. aft of the fuselage, whence a pusher propeller is the obvious solution. There are two main difficulties to overcome here; firstly, the fact that the wing centre section and engine are going to interfere with one another, necessitating great care to ensure that the structure is as strong as possible and, secondly, it is anticipated that the cooling of the engine might prove troublesome. Scoops can be so arranged to deflect air on to the cylinders in the normal way. In theory relatively simple; in practice—well, the author anticipates that some experimenting would have to be carried out to get good results.

Having decided the salient points, the rest of the layout fits in fairly easily. The tailplane spoils the downward view and, as this is important during landing, observation panels are included in the fuselage, at the lower front.

Resistance of Tailplane

Now the drag of such a design is higher than the conventional type owing to the extra resistance of the "tailplane," at a moderately high angle of attack, and so it is not suited for "fast" work. Bearing this in mind, it would seem advisable to fix the undercarriage, streamlining as far as possible, and sacrifice a few m.p.h. to save a little weight and constructional worries.

Flaps are practically essential if the landing speed is to be kept down to reasonable limits. The altitude of the plane is about 10 degrees when landing (i.e. tailplane just stalling), with the main wing lift several degrees below maximum, so that in order to increase the lift value at low speeds some form of auxiliary device is advisable.

The resulting type should prove particularly interesting, although no spectacular performance is anticipated.

R. H. W.

Protective Coatings

How Metals Such as Steel and Iron are Protected Against Corrosion

THE chemical instability of metals, especially of steel and of iron, cause them always to tend to revert to the oxidised state in which they are found in nature, and introduces one of the most serious maintenance problems in engineering. The provision of protective coatings against metallic corrosion (often combined with erosion in hydraulic engineering) is, therefore, a subject of first importance.

Iron Castings

Anti-corrosion coatings for iron castings used in waterworks practice are usually of the much specified Dr. Angus Smith's solution type, and have been outstandingly successful. Smith's solution, which is applied at temperatures between 350 deg. and 450 deg. F., has the following composition: coal tar 112 lb., tallow 7 lb., quick lime 10 lb., pine resin 4 lb., coal tar naphtha sufficient to thin.

The improved dipping solution employed in our works has also a tar basis, with the addition of rubber compounds, thinned by a special dipping oil. The tar used is in accordance with B.S.S. No. 76, 1930 (1). Castings destined for tropical climates are given an anti-corrosion coating of harder texture, having a bituminous base. An important characteristic of both these coatings is their toughness and freedom from any tendency to chip with rough handling of the castings.

For Steel Protection

The protection of steel, with which corrosion generally tends to be much more rapid than with iron, is a matter which has been very closely investigated. For general waterworks purposes the use of good quality bituminous enamel has been found simple, inexpensive and effective. Ordinary paints on the other hand, including those with lead and metallic bases, have not proved so successful for under water protection of steel, especially when any abrasive influences are present tending to cause erosion. A recently reported investigation in the U.S.A. to discover an effective and economical protective coating for steel sluice gates, revealed the following procedure which, it is claimed, gives satisfactory results:—Firstly: complete removel of all mill scale, either by acid pickling or sand blasting. Secondly: inhibitive treatment of the newly cleaned surfaces with a phosphoric acid-sodium dichromate solution. Thirdly: application of at laest three coats of synthetic phenol resinoid tung oil varnish vehicle paint, pigmented to suit the particular conditions.

Other processes used with success to combat combined corrosion and erosion of steel structures include the use of tar compounds to which have been added cement and grit in various proportions, and of special cements which are sprayed on to the steel in relatively thick coatings, sometimes reinforced with steel wire fabric previously spot welded to the steel surfaces.

Two important factors in the preservation of steel are: (1) to ensure wherever possible that all mill scale is removed prior to treatment; and (2) to secure a continuous protective coating free from pin holes and porosity.

Small Scale Cosmetic Making

An Interesting Activity for the Enterprising Amateur

THE mild famine in cosmetic preparations which has occurred during recent times has been occasioned not merely by the increasing scarcity of some of the raw materials used in cosmetic production, but, also, by the increased demand which has arisen for these once derided preparations.

There are few women nowadays who do not enlist the aid of cosmetics at least to some extent as a means of heightening their natural attractions and, this being the case, the man who has the ability and the ingenuity to produce a few simple "beauty preparations" in his own amateur laboratory, or workshop, will find an ample outlet for the products of such activities.

It is still possible to purchase at various druggists' shops, and from wholesale sources, small quantities of the main cosmetic-making materials, so that any scientifically-inclined individual, provided that he goes about his task with care, will, at least, be able satisfactorily to meet "local demands" in respect of the more straightforward articles of cosmetic use.

Cosmetics, in general, are simply-prepared products. Their making, however, does definitely call for some manipulative skill (which is easily acquired) and for some experience. Also, there is the fact that many of the successful present-day beauty preparations are manufactured to secret formulae. For these reasons, it may be possible that the beginner in cosmetic production will not immediately hit upon the precise article which he essays to bring into being. He will have to be prepared to experiment.

Toilet Powders

Perhaps the class of cosmetic products for which there is the most demand is that which embodies the various face and toilet powders. These are essentially simple in constitution. For example, an excellent toilet powder for after-shave use, perspiration-absorption, and similar purposes can be made up by mixing:—

Talc	8 parts
Boric acid ..	1 part
Starch	1 part

This preparation, if necessary, may be perfumed by adding to it a few drops of any concentrated alcoholic perfume.

The preparation of a successful face powder is a little more difficult operation, but it is a task which admits of endless variations.

In general, face powders must have three properties, viz., *adherence*, *opacity* and *slip*. The property of adherence, by which is meant the clinging character of the powder, is imparted by a metallic salt of stearic acid, such as zinc or magnesium stearate, or by starch or kaolin (China clay). *Opacity* signifies the covering power of the powder, which property is mainly conferred by zinc oxide, chalk or titanium oxide, whilst *slip* denotes the manner by which the powder goes on easily and evenly over the skin. This latter property is conferred by the existence of talc in the powder.

There are literally hundreds of different formulae for face powders, as reference to any book of formulae will show. The following, however, is a good all-round standard formulae, which is capable of considerable individual variation:—

Talc	50 parts
Precipitated chalk ..	15 „
Zinc oxide	15 „
Zinc (or magnesium) stearate	5 „
Kaolin (China clay) ..	15 parts
Starch	5 „

The above materials must, of course, be perfectly pure and quite dry. It is best to ensure their freedom from moisture by placing them in a warm oven for several hours. The ingredients must be ground to the finest

Sieving an ingredient of face powder—a highly important operation in the manufacture of these preparations.

possible degree of pulverisation, and, preferably, they should all be sieved through silk or at least through a No. 300 wire mesh. Intimate mixing of the ingredients is also an essential.

It is in all cases necessary to colour or "shade" the resulting face powder. This is done by mixing one part of the pigment with nine parts of talc, this latter mixture being called the "colour base." Finally, the face powder, made as above, is coloured or "shaded" by mixing five parts of colour base with every 100 parts of powder.

The "raw" colour must on no account be added directly to the powder, otherwise faulty colour shading will result. In every case the face powder must always be coloured or shaded by incorporating various amounts of different colour bases with it.

Colour Bases

The best materials for making the necessary colour bases for the different face powders are as follows:—

Rachel or Cream powders. Yellow ochre.

Brunette powders. Equal parts yellow ochre base and burnt sienna base.

Flesh-colour powders. Yellow ochre, plus rouge or geranium.

Scarlet powders. Rouge.

To take one example. Suppose we desire to make a *Brunette* powder. In this instance, we prepare two colour bases, the one containing one part yellow ochre mixed with nine parts talc, and the other containing one part burnt sienna mixed with nine parts of talc. We mix these two colour bases in equal proportions, and of the resulting "Brunette" base we mix five parts with every 100 parts of the plain face powder.

It is as well to have a small amount of burnt sienna base on hand, this being useful for dulling down any powder which is too brightly coloured.

Yellow ochre, burnt sienna and other pigments can be obtained from any colourman. Like all the other ingredients of the face powder, they must be perfectly moisture-free and finely ground and sieved.

Powders are perfumed by adding a few drops of any alcoholic perfume to the finished product. Beware of perfuming the product too strongly. A faint, clinging perfume is far more attractive than a strong and blatant one.

What are known in the trade as "Rouge Compacts" are frequently in demand. These are merely compacted discs of powder material which impart small amounts of powder to the puff when the latter is gently wiped over them. A good rouge compact can be made according to the following formula:—

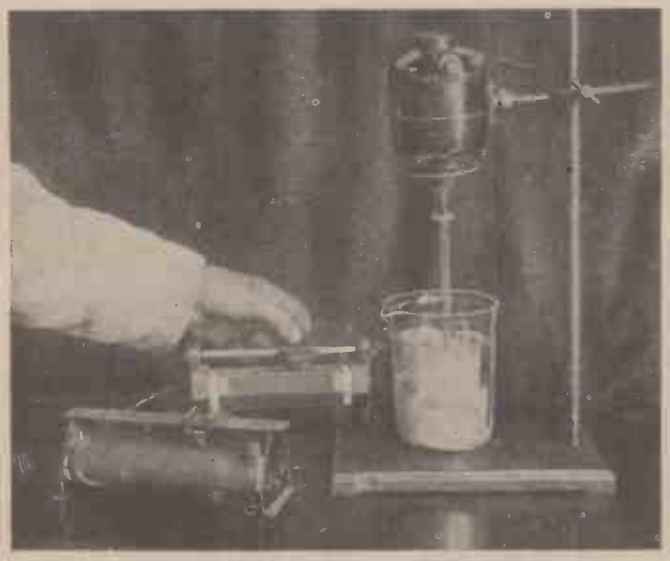
Carmine	1 part
Talc	21 parts
Gum acacia	1½ parts
Ammonia	a trace

First mix the carmine, talc and gum acacia in a mortar. Add a drop of two of ammonia and a little water. Pound the mass into a stiff paste, adding extra water if this be necessary. finally, add a few drops of perfume, and fill into moulds at once. The material will harden, and will then be fit for use. Any small, shallow, round tins can be employed as moulds.

"Liquid" Powders

"Liquid" powders are in great favour in some districts. These are merely suspensions of the powder ingredients in water. A satisfactory formula for a liquid powder is the following:—

Grinding pigments into "colour bases" for the shading of cosmetic powders.



Making vanishing cream. The stearic acid is placed in a vessel surrounded by hot water, and electrically stirred

Light magnesium carbonate	1 gram.
Zinc oxide	10 gram.
Yellow ochre	0.02 gram.
Burnt sienna	0.02 gram.
Glycerine	5 ccs.
Water (preferably distilled)	100 ccs.

The ingredients are mixed together in a mortar with a little of the water until a smooth cream is obtained. Gradually, this is thinned out with further additions of water and glycerine until the whole of these ingredients have been added. A few drops of perfume may, of course, be added, and, naturally, the colour of the "liquid" powder can be varied by ringing the changes on the incorporated pigments. By slightly increasing the colour-proportion in the above formula a good "sunburn tan" preparation can be made. Before using these preparations it is always very necessary to "shake the bottle."

Vanishing Creams

Vanishing creams are important preparations nowadays. All of them, however, are nothing more nor less than emulsions of stearic acid. Just at the moment stearin or stearic acid is in short supply, but it is normally quite plentiful, costing about a shilling a pound. Vanishing creams contain up to 75 per cent. of water. Hence their sale at heightened prices has always been a profitable proposition.

Perhaps the best vanishing cream is made with an emulsifying material known as *triethanolamine*, but as supplies of this chemical are now Government-restricted, we will confine ourselves to describing the almost equally satisfactory method of making a vanishing cream by means of ammonia.

The following is the basic formula for this type of vanishing cream:—

Stearic acid	20 grams.
Glycerine	4 ccs.
Strong ammonia	1.5 ccs.
Water	72 ccs.

Place the stearic acid in a jar surrounded by hot water so that it melts to a clear liquid. If possible, arrange for this to be stirred at high speed by means of an agitator blade attached to a vertical electric motor. In default of this motor, use a fork to whip up by hand the contents of the jar at the highest possible speed. During the agitation of the molten stearic acid gradually add about 65 ccs. of the water (previously heated to boiling-point and containing all the glycerine specified in the formula). Dilute the strong ammonia with the remainder of the water and at once add it to the mixture, stirring rapidly all the time. Finally, continue the stirring until the resulting vanishing cream has cooled down to normal temperature, and during this cooling-down add a few drops of perfume. The vanishing cream should have a "pearly" appearance (due to the presence of free stearic acid droplets) and it should be kept in containers having tight lids in order to prevent its going hard owing to the slow evaporation of water from it.

Skin creams, massage creams and similar preparations are merely perfumed variants of ordinary cold cream, the standard formula for which preparation is as follows:—

Liquid paraffin . .	61 ccs.
White wax (*Not* paraffin wax)	19 grams.
Borax . .	1 gram.
Water . .	20 ccs.

Melt the wax and then add the oil and heat to about 80 deg. C. Dissolve the borax in the water (heated to about 80 deg. C.) and add it to the white wax solution. Stir rapidly and well. Allow to cool, and during the cooling add about 0.1 cc. perfume essence.

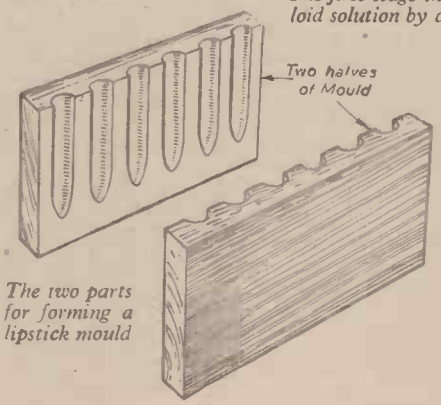
Lipsticks

Lipsticks provide an interesting preparative task for the amateur chemist. These are essentially wax mixtures containing colour. A good formula for a lipstick compound is the following:—

Vaseline . .	7½ ozs.
Beeswax . .	5 ozs.
Spermaceti	200 grains
Carmine . .	6 drams.

The ingredients are melted together and the colour (carmine or other pigment) added. If required, a few drops of perfume may be stirred in when the mixed waxes are just on the point of re-solidifying. The material should then be gently heated again until it is able to be poured into wooden moulds.

A good lip-stick mould can be made easily by drilling a number of ¼-inch diameter holes to a depth of about three inches in a sound block of wood. The wood is then carefully sawn across, thereby sectionising the holes. For moulding purposes, the two halves of the wooden block are held firmly together by means of cramps or even strong rubber bands, and after the lipstick mixture has solidified in the moulds, the two halves of the wooden block are pulled apart, thereby rendering the removal of the lipsticks an easy matter. Before pouring, the interior of the moulds should be well lubricated with liquid paraffin or almond oil. Various colours can be imparted to the lipstick mixtures by the use of wax or oil-soluble dyes such as eosin. Rouge may also be used.



The two parts for forming a lipstick mould

Nail Varnishes

Nail varnishes are easy of preparation. Make a mixture of equal parts of amyl acetate and acetone, and dissolve in this scrap celluloid until a thick, viscous liquid results. Colour this with a few drops of surgical spirit (or even methylated spirit) in which some dye has been dissolved. A fair amount of colour is necessary, and if the varnish tends to dry dull, increase the amount of amyl acetate in the celluloid solution. Remember always that nail varnishes are inflammable.

Hair fixatives for male use are in considerable demand at the present time. These are made from gum tragacanth. A good formula for a hair fixative is:—

Gum tragacanth . .	1 part
Boric acid . .	1 part
Water . .	200 parts

Dissolve the boric acid in the hot water. Allow to cool and then pour the liquid over the gum tragacanth contained in a jar. Allow to stand overnight, and then stir the swollen mass until a uniform cream has been obtained. Perfume as desired. In order to prevent the cream from going mouldy, add a teaspoonful or two of surgical spirit to every half-pint of cream so made. If the cream is too thick, thin down cautiously with water. A trace of dye can be added to impart colour, if desired. For best results, the final preparation should be pressed through a muslin rag.

The first stage in the making of nail varnish. Preparing the celluloid solution by dissolving scrap celluloid in an appropriate solvent

Astringent lotions for relaxed skins and after-shave use are numerous. An all-round formula for a preparation of this type is:—

Alum	1 oz.
Potassium carbonate . .	¼ oz.
Glycerine	½ oz.
Water (or Rosewater) . .	10 ozs.

To the above ingredients properly mixed and dissolved, add water to bring the volume up to 1½ pints. If rose water is not used in the above formula, a few drops of any required perfume can be added.

Peculiar Wings

Details of the Stepped Section and the Non-Stall Arrangement

By R. H. WARRING

THE original "stepped wing" section was suggested by T. O. Kimpton, one of the lesser known pioneers who has had intimate connection with the aircraft industry dating back before the last Great War, and whose friendship I have been fortunate enough to claim for several years.

The basic idea of the stepped wing is a section on which the top surface is not continuous, but is broken up in the form of a step, situated about one-third of the chord length back from the leading edge as in Fig. 1, somewhat after the style of an outboard motorboat hull inverted. It was thought that besides giving characteristics similar to that of a "full" section, shown dotted on the figure, the burble point (i.e. stalling point) might occur at higher angles of attack.

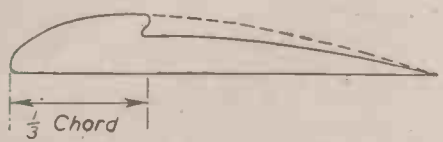


Fig. 1. The principle of the stepped wing.

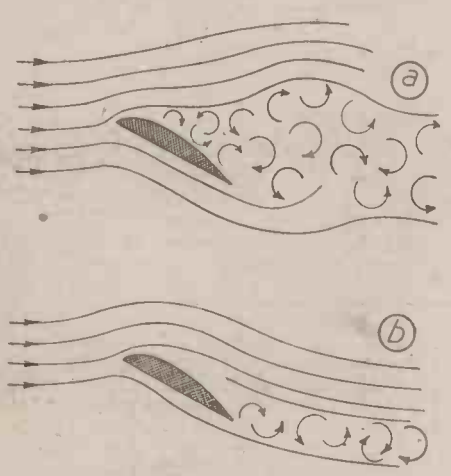


Fig. 2. Illustrating the air flow over a stalled wing.

Airflow

To understand this we must get some idea of the airflow over a stalled wing. Fig. 2(a) shows the flow over an aerofoil that is stalled, indicating the break-away over the top surface and the consequently turbulent wake indicating high drag. By applying suction to the rear of the top surface Fig. 2(b), this turbulent flow is once again reduced to mainly laminar flow at the same angle of attack.

It is thought that the introduction of a step might produce this suction effect and at the same time preserve the characteristics of the full aerofoil, which would result in a general increase in performance. Due to other interests at the time, the subject was not pursued farther, and many years elapsed before it was again taken up. Experiments were conducted with models fitted with such wings and it was endeavoured to compare their performance with conventional types. Unfortunately, no wind tunnel tests were made, and so the results obtained were mainly qualitative and not quantitative.

In general, it appeared that the normal aerofoil characteristics were maintained and control was quite good around the stalling angle, this being particularly noted on the models observed by the author. However, it is impossible to give any conclusive statement in the absence of test data, although the subject definitely proved interesting enough to warrant further development.

We can, however, consider the question from a theoretical side by analogy with similar flows. It was at first argued by many people, the author included, that the presence of a step would cause the airflow to break away from the top surface at the step at all angles of attack, with a consequent loss of lift and an early stall. However, upon further consideration, it appears that, provided the depth of the step is not excessive, there is little chance of this occurring from observations in a smoke tunnel of the flow over an aerofoil fitted with a "spoiler."

Position of "Spoiler"

A spoiler is a slat fitted to a wing parallel to the direction of airflow across the wing in an unyawed position, which lies flat against the top surface when not in use, but can be raised when desired to break up the airflow and destroy the lift, thus steepening the gliding angle. Its use is generally confined to high performance sailplanes, which, with their extremely high lift/drag ratio, and consequently flat gliding angle, find some difficulty in landing.

Now when the spoiler is only partly raised, the result is an *increase* in lift. The streamlines are deflected upwards slightly, flow smoothly over the spoiler, and then return to follow the upper surface of the aerofoil as shown in Fig. 3(a). From this it seems logical to deduce that the flow over a stepped wing would also tend to conform to conventional streamlines, with a slight "hump," as in Fig. 3(b) corresponding to the flow over a section something like Fig. 3(c). The "dead" region in Fig. 3(b) would thus be contributing a strong suction effect which we have seen will tend to delay the stall, although it is probable that there will be some eddying here as well.

Increased Range of Incidences

Thus, from a study of the streamlines it seems possible to predict that a stepped wing will have a *slightly* higher drag value at all angles of attack than that of a similar full section, although this *may* be negligible for small steps but at the same time the useful range of incidences should be increased. The effect will obviously depend upon.

(i) The shape of the basic aerofoil section.
(ii) The depth of the step.
(iii) The position of the step.
(iv) The velocity of the airstream (possibly).

(iv) follows from the fact that at very low speeds or very high speeds the streamline flow may possibly be distorted.

It would seem that little advantage would be gained by "stepping" a thin section and, indeed, the resulting structure by still further reducing the thickness will be very weak and twist easily. Its application, then, is mainly confined to thick sections.

The depth of the step is the most important of all these criteria, and it is impossible to give any general rule in the absence of suitable experimental data. It seems probable that there will be an "optimum" depth depending upon the profile of the basic aerofoil.

The position of the step does not appear to be critical. T. O. Kimpton suggested that it be placed at the point of maximum thickness, but, in general, a point of from 30-40 per cent. of the chord length from the leading edge will be found suitable, depending, of course, on the original profile of the aerofoil again.

Mechanical Difficulties

A further development of the stepped wing at once suggests itself, namely, that the whole of the step portion be hinged at the leading edge so that its attitude may be varied at will, giving, in effect, a variable camber wing. Experimental types in which a *normal* wing section is used, and the camber controlled by the pilot have been built, but little success has resulted due to the mechanical difficulties being too great. If the same *effect* could be given by the adjustable step then the majority of these difficulties are removed.

Referring to Fig. 4(a), it will be seen that the basic section is quite thin—a "high speed" type—and the top surface from A to B consists of a flap lying flush with the surface of the aerofoil, but hinged at A. To transform this high speed section into one with high lift characteristics, the flap is raised to

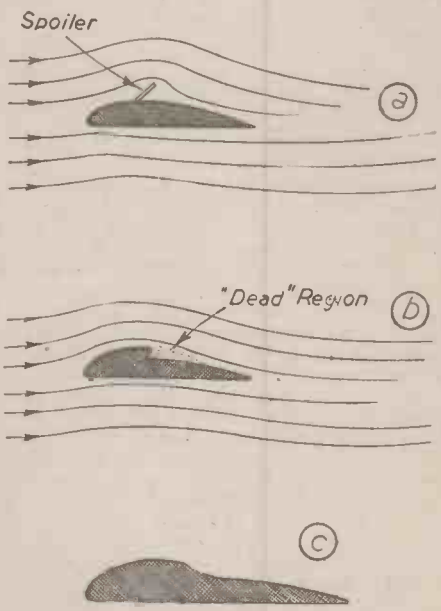


Fig. 3. Illustrating the effect of using a "spoiler."

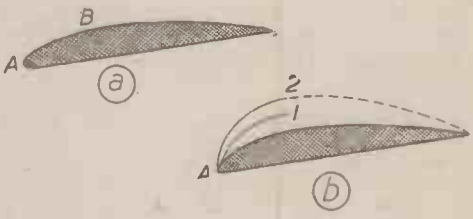


Fig. 4. The principle of the variable wing flap.

position 2, Fig. 4(b), where the basic aerofoil is now completed by the dotted line. The diagram is exaggerated somewhat to clarify it; the actual flap movement would not be as great as this.

At the intermediate position 1, Fig. 4(b), the resulting section is one of moderate lift which could be used to advantage during the take-off, where the high drag of position 2 (a high lift section has a proportionately high drag) would probably be detrimental. For landing, however, position 2 is ideal. The high lift and drag assures a low speed and fairly steep gliding angle, so that flaps could be dispensed with, and if the suspected increase in the stalling angle of the stepped wing is

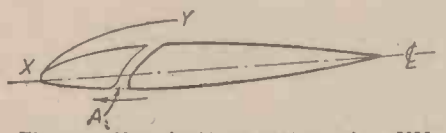


Fig. 5. Slat A closes opening, when XY raised slides forward as indicated by arrow.

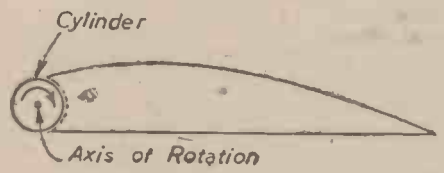


Fig. 6. Rotating cylinder device.

proved, will also replace slots to some extent.

"Floating" Flap

An alternative suggestion is to have the whole of the section AB "floating," i.e. independent of the pilot's control. It could be spring loaded so that it was normally fully open (position 2), but as forward speed increased, e.g. as in accelerating for the take-off, the increased pressure on the surface due to the velocity of the air, causes it to tend to shut, finally lying flush with the surface as high speed is approached. Employed as such, the speed range of an aeroplane would be considerably increased in a similar manner to that of a controlled step adjustment.

With a normal aeroplane a high-speed wing usually means a high landing speed, whereas the step, floating or controlled, would give all the advantages of a thin section at high speeds, that of a thick section at low speeds, and also *any intermediate section.*

The idea is worthy of development, and it is more than a pity that the present war has caused a complete abandonment of experimental work along these lines. A combination of an adjustable step and a fully slotted wing (the slot running the whole length from span to span), on which the author was working should give an extremely useful range of lift over a very large range of incidences. The layout is illustrated in Fig. 5.

Rotating Cylinder

The other "peculiar wing" which comes within the scope of this article is another type on which the author has only qualitative data, but nevertheless this does not detract from its general interest. The model tested was of normal aerofoil profile in which the nose was replaced by a cylinder—see Fig. 6. This cylinder was free to rotate about an axis parallel to the wing span, and was power driven.

It was hoped that this arrangement would preserve laminar flow over the aerofoil at angles of attack near and beyond the stalling angle, and the results more than exceeded expectations. With the cylinder rotating in the direction shown by the arrow on the diagram, the angle of attack could be increased to about 80 *degrees* without the streamlines breaking away from the aerofoil contour, as shown by experiment, conducted in a smoke tunnel Fig. 7(a) illustrates this.

At some angle of attack slightly below this, the cylinder was stopped, whereupon the flow immediately broke away in a "super stalled" pattern as in Fig. 7(b). Upon restarting, the cylinder flow was once again changed to that of 7(a).

High Drag Value

Naturally enough the drag value of the aerofoil at such a high angle of attack would be quite high, but so also would the lift. With such a wing, extremely low speeds could be obtained by utilising the cylinder effect as follows :

The 'plane is a normal high speed type, except that the front of the wing is replaced by a cylinder as above. This cylinder is normally stationary, but when for any reason the pilot wishes to fly slowly, he engages a clutch drive from the engine to the cylinder, setting it in rotation (one cylinder for each wing half). Then the pilot can approach 80 degree angles of attack without stalling his machine and, because of the high lift and drag values, low forward speed is possible.

An obvious disadvantage is at once apparent. The 'plane itself is "cocked up" at a steep angle, and to land in this attitude would demand an extremely "stilty" undercarriage. This would be bad enough on a fixed gear, where its drag would be excessive, but to retract such a gear would involve severe constructional difficulties and weight increases.

The only solution would seem to be an arrangement whereby the whole wing could change its attitude independent of the fuselage. That is, it would be pivoted about an axis perpendicular to the direction of flight and under the control of the pilot, so that whatever the incidence of the wing, the fuselage would still remain at the same attitude with respect to the horizontal.

Structural Difficulties

That is only a suggestion. The structural difficulties are great, but it is beyond the scope of this article to deal with them here. Suffice to say that with the increased use of auxiliary devices which increase the range of incidences of the wing, this problem of the attitude of the 'plane becomes more acute.

Even to-day it will be noticed that fuselage shapes tend to a straight top and upswept underside, especially on designs where attempts have been made to have a relatively low landing speed, so that a "three point" landing is possible without an excessive length of undercarriage leg. If we go on pushing the stalling angle up still further, then something in the nature of a wing with adjustable incidence will become a necessity to take advantage of such devices.

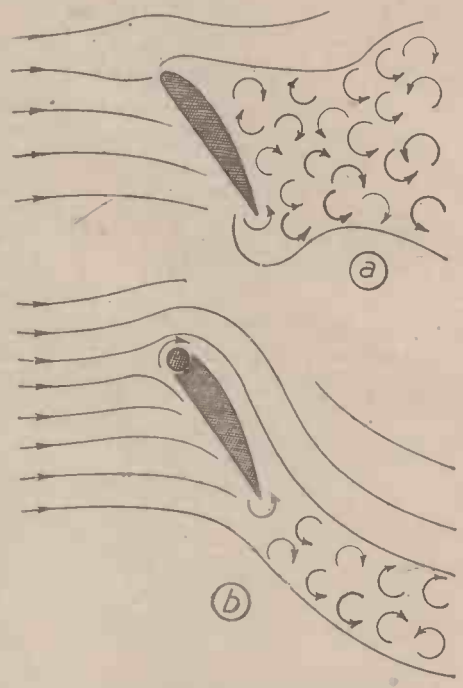


Fig. 7. Diagrams illustrating the effect of increased angle of attack.

Crazy Camera. By Claude A. Bromley. Published by The Focal Press. 98 pages. Price 6s. 0d. net.

IN this book the author, who has achieved a considerable reputation for his "crazy camera" pictures gives away, in a very entertaining manner, all the tricks and stunts of photomontage. The keen amateur photographer will find many practical and valuable hints that are disclosed for the making of the remarkable illustrations in the book. The old saying that "the camera cannot lie" seems to be a thing of the past when viewing the fantastic wonderland as presented in this book.

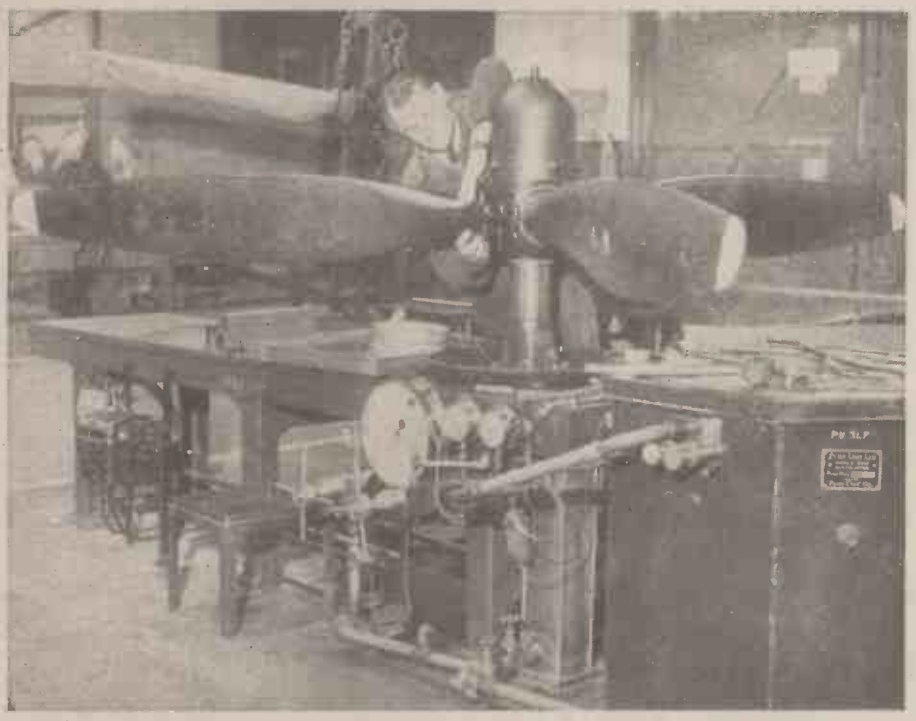
Accumulator Charging. By W. S. Ibbetson, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 166 pages. Price 6s. 0d. net.

THIS book, which is a seventh edition, is intended for the use of all interested in the charging and upkeep of accumulators for various purposes, including wireless work, motor-cars and cycles, and country house lighting. The text is divided into twelve chapters, covering, amongst other subjects, Electrical Power; Effects of Charge and Discharge; Modern Accumulators; Battery Charging on D.C. Supply; Generator Methods of Charging; Repairs and Workshop; and Country House and Private Plants. In the appendix, a list of typical questions is given, as set for the City and Guilds of London Examination, in connection with motor vehicle electrician's course. The book is well illustrated with line diagrams, and also contains an index.

The Story of Electro-magnetism. By Sir William Bragg, K.B.E., F.R.S. Published by G. Bell and Sons, Ltd. 64 pages. Price 1s. 6d. net.

SPECIALLY written for the Air Training Corps, this informative little book, by one of our leading physicists, describes in a very interesting manner the great scientific discovery on which wireless is based. The fundamental principles of electro-magnetism, and the successive contributions of the early pioneers from Volta and Oersted to Clerk—Maxwell to Faraday are briefly described. There is a peculiar interest in the study of the methods adopted by these pioneers in gradually unravelling those electrical problems which made radio possible. There are several line drawings in the book, and it is interesting to note that the sketches that illustrate Faraday's work are copied from the originals in the margin of his diary.

The World of Aviation



Aeroplane propellers receiving the final test before despatch.' The propeller is being tested in a factory which constructs these essential aircraft parts.

Automatic Recording Log

THE United States Civil Aeronautics Administration are carrying out experiments which, if successful, will eliminate the need for aeroplane pilots recording a log of their instrument readings. The principal part of this new automatic instrument log is a small light-weight high-speed camera, which is designed to photograph the many instruments of the aeroplane at regular intervals. Similar apparatus has been used before, but the new project on which American scientists are working is claimed to be much superior to any of the previous designs. The film used is sensitive to infra-red light and is several times faster than those previously used. An automatic timing device is fitted to the camera, and a special intensive type of light, flashing from an extremely short time interval, is expected to eliminate blurring caused by the vibration of the instruments. The administration is also working on another photographic device for recording other information about the performance of an aeroplane during flight.

New British Bomber

THE name of Britain's latest long-range bomber is the Lancaster. Details of the machine are secret, but it is stated to carry a very heavy bomb load. It is to be built in Canada at the request of the British Government. According to Canadian reports, the Lancaster can be equipped with four Bristol Hercules engines. It is thought that this machine is the answer to critics who have been demanding faster and lighter bombers for attacks on Germany.

Fighters Flown from America

FIGHTER aircraft from America may soon be ferried to Britain by way of Greenland and Iceland. With eight "hops," the longest ocean crossing would be about 850 miles. Auxiliary petrol tanks are being fitted to fighters manufactured in America. With these, such machines as the Lockheed Lightning, a twin-engined long-range fighter, would be able to make the 2,000-miles flight to Britain without a stop. Hitherto, ferrying has been limited to long-range bombers, which have been flown over in large numbers.

An Anti-tank Aeroplane

THE Russian Air Force are now using a new specialised anti-tank aeroplane which is said to be fitted with a 37 mm. cannon or even larger. It has been described by a British officer in Moscow as the most important invention the war has yet produced. When in operation it flies just above the ground where enemy fighters cannot easily attack it, and A.A. guns find it difficult to hit the swiftly moving target.

"Hot Air" 'Plane

THE principles used in Italy's propellerless "hot air" 'plane which flew over Rome recently have been widely known for many years, although exact details of the new 'plane are known only to a few Italian engineers. It is thought that this particular craft is a development of the jet-propelled Caproni which made a flight nearly 18 months ago. The speed reached with this type is understood to be 150 m.p.h. Air taken in at the front of the machine is heated, compressed, and expelled from the rear through a high pressure jet. It is known that its possibilities are still being investigated by Germany.

Aerial Photography

WORKING in mobile photographic units, concealed in a wood or beside a country lane, are some of the finest craftsmen of the R.A.F. They form the photographic sections of the Army Co-operation Command squadrons, and, though little may be heard of their enterprise and skill, they are doing much to keep the Army supplied with a continual flow of important photographs taken from the air. Speed is one of their watchwords. Rapid production of photographs required for information, and clear and well-defined prints are demands they always have to meet. Modern equipment is helping them to provide the Army with remarkable pictures of military value. If need be, a rough print, adequate for urgent requirements, can be produced in a few minutes.

Five years ago the time occupied by the

R.A.F. photographers working in mobile units concealed in a wood or beside a country lane, form the photographic sections of the Army Co-operational Command's Squadrons and do much to keep the Army supplied with a continual flow of important photographs taken from the air. The pilots are all keenly interested in this Army Co-operation work. The illustration shows airmen fitting a camera to an aircraft before a flight.

same procedure was at least half-an-hour. Nowadays, moreover, if finished photographs are wanted, ten of these, from ten different negatives, can be ready in nine minutes. The camera, electrically controlled by the pilot, can automatically take pictures every two seconds, and it has been adapted, with the increased speed of newer types of aircraft, to produce first-rate photographs while the reconnaissance aeroplane may be travelling at over 200 miles an hour. Such excellent pictures are now being produced by Army Co-operation and other R.A.F. squadrons, and so great an advance has been made in British photographic methods, that the Germans have been outclassed. An instance of this is to be found at one Army Co-operation Command station, where an undeveloped film from a Nazi reconnaissance 'plane, which had crashed, was discovered, after it had been developed, to be much inferior to a similar photograph of the same stretch of country taken by a British camera in an R.A.F. aircraft.

New Torpedo Plane

LESTER P. BARLOW, an American inventor, has stated that he has offered the U.S.A. Navy Department designs for a long-range aeroplane that would "sink any battleship." According to Barlow, the aeroplane would be equipped with a secret torpedo-launching device he has invented. He adds that the invention has been recommended to the Navy Department by the National Inventors' Council, and says that the Glenn L. Martin Company, of Baltimore, Maryland, builder of flying boats, is ready to produce the aeroplane.

Portable Airfield

A PORTABLE metal airfield has been put together in two weeks by U.S. Army engineers. It will allow combat planes to land safely on what was a sandy, rolling Carolina field. The 1,000-ton sectional strip designed to accommodate the fastest and biggest planes was carried in eighteen railway wagons. Smaller strips were locked together to form a metal runway 150 feet wide and 3,000 feet long. There are holes in the strips to allow the grass to grow through.

Hurricane Six Years old

THE world's best fighter, the Hurricane, celebrated its sixth birthday on November 6th. It was designed by Mr. Sydney Camm in 1934, and is still being produced in larger quantities in this country than any other fighter. No fighter, past or present, has shot down as many enemy aircraft. Pilots who, since flying Hurricanes in the Battle of Britain, have had experience of other types, declare that it is the machine from which it is easiest to shoot accurately. Its outward appearance has remained almost unchanged, though many changes have been effected, mostly in its armament.

U.S. Aero Engines

IT was recently revealed by the Office of Production Management that sufficient aero engines are now being manufactured in the United States to power 2,000 aircraft each month. Most of them are in the 1,500 to 2,000 h.p. class, and include an enormous supply for Boeing Fortress and Consolidated Liberator four-engined bombers, as well as Catalina flying boats.

Canada Building New Fighters

SPEAKING recently at Brantford, Ontario, Mr. Ralph Bell, Director of Production, said that a decision had been reached to manufacture a new secret fighter in Canada, which has been designed for Britain. Large four-engined bombers are also to be manufactured.

Ice-Pack Patrol

OF all the curious jobs that the war has brought the R.A.F., probably the strangest is the ice-pack patrol. It is flown by long-range Lockheed Hudsons of the R.A.F. Coastal Command, operating from Iceland. Among them is the "Spirit of Lockheed Vega Employees," presented to Britain by the Lockheed and Vega aircraft corporations at Burbank, California. At intervals, the aircraft take off from their northern outpost—and head north. They traverse the Arctic. The Arctic Circle, indeed, is only the start of their flight. Once they have got as far south as the Circle on the homeward journey, the pilots say they feel they are practically in the tropics.

Bombing Speedboats in Practice

A SPEEDBOAT which is built to be bombed and not answer back sounds something of a contradiction. But the armour-plated forty-footers of the R.A.F., built by a famous British constructor of racing craft, really are designed to withstand hits with light practice bombs without serious damage to the boat or injury to the crew. And they afford excellent practice to the pilots and bomb-aimers of the Royal Air Force, training for more serious work against enemy targets on the move.

To make these target-boats "bomb-proof," an ingenious compromise has been evolved. Since armouring the entire craft would make it too heavy for speedy work, if it would float at all, the crew of three and vital parts and controls are assembled closely amidships, and hooded with stout armour plate, mounted on rubber buffers. The rest of the hull is unprotected, but is packed with a special buoyant substance termed onazate, one-fifth the weight of cork. Direct hits elsewhere than on the armour-plating simply drill holes clean through the hull without affecting the seaworthiness of the boat. A special method of hull construction makes "mending the holes" a comparatively easy matter. The armour itself will resist the impact and explosion of a practice bomb dropped from a height of several miles.

Modern high-speed armoured target boats now in use by the R.A.F. are a considerable advance on the somewhat sketchy pioneer craft associated with the late Aircraftsman Shaw—better known as "Lawrence of Arabia."

New U.S.A. Bomber Tested

A TEST flight of the Ventura Vega ("Lucky Star") bomber was made recently. It was the first to leave the Lockheed Aircraft Corporation's factory at Burbank, California. Several hundred of these planes have been ordered by Britain. They are bigger, faster, and have a longer range than the well-known Hudson bombers, more than 1,000 of which have been made for this country by the same firm.

Planes of Stainless Steel

IT is reported in the *Iron Age* that a big fleet of stainless steel cargo planes are to be built for sale to South America. They will be the first all-stainless steel type to enter mass production anywhere in the world.

Giant Transport Plane

AN aeroplane which recently appeared in this country is the Curtiss-Wright C.W.20, which is claimed to be the largest twin-engined transport aircraft in the world and the only one of its type in existence. The machine has been bought in the United States by the British Government on behalf of the British Overseas Airways Corporation. A British crew flew to America, took a short course at the Curtiss-Wright works to familiarise themselves with the mechanism, and then flew the C.W.20 back to this country, crossing in 9 hours 20 minutes.

Made entirely of metal, the St. Louis, which is the name given to the new aircraft, is a low mid-wing monoplane with a length of 75 ft., a span of 108 ft., and a wing area of 1,353 sq. ft. The all-up weight is 45.000 lb., and its two Wright Cyclone engines, each of 1,700 h.p., give it a top speed of 243 m.p.h. and a cruising speed of 210 m.p.h.

The Martin XPB-2-M-1 bombing plane built for the U.S. Navy. It is the largest flying boat in the world, and details were given in last month's issue.

A "Flying Wing"

A 'PLANE that may soon be in use with the U.S.A. Army Air Corps is the Northrop "Flying Wing," an American tail-less fighter aeroplane with no fusclage.

John K. Northrop, the designer, has predicted that transport aircraft based on the Flying Wing design can be built to reach speeds of 100 m.p.h. more than the best aeroplane at present in use.

Automatic Wrapping of Bon Bons

A Short Description of an Ingenious Machine which Automatically Wraps Sweets in Fancy Coverings

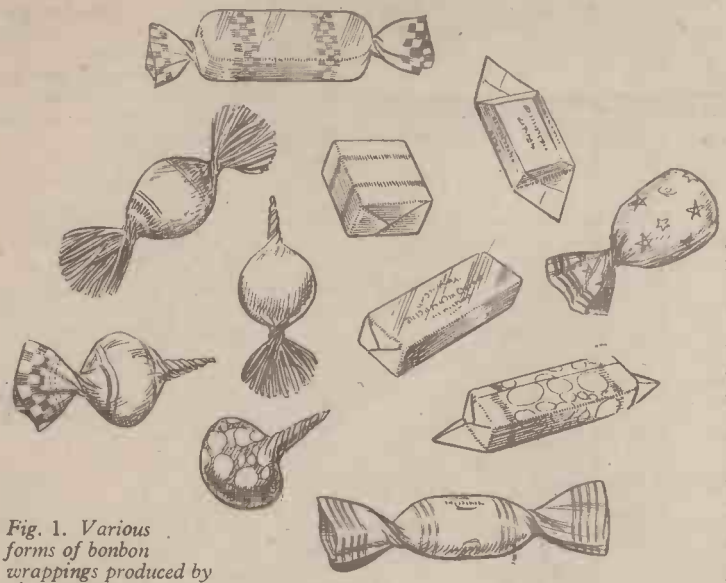


Fig. 1. Various forms of bonbon wrappings produced by automatic machinery.

EVERYBODY is familiar with the neatly wrapped pieces of toffee, caramel, etc., but few have ever given a thought to the part played by the mechanical engineer to the production of these bonbons. For the purpose of this article, only the manufacture of the "boiled sweets" will be discussed.

The raw materials are chiefly brown and white sugar, treacle, honey, crystal and liquid glucose. Butter, condensed milk and fresh cream also played an important part before the war.

The ingredients are first dissolved into a strong syrup and pumped over a steam heated surface under vacuum, the rate corresponding to that of the boiled sugar. The receiving pans are so placed that the batch, as the boiled mass is called, can be collected in quantities of a convenient size so that the vacuum is not broken.

From the operations just mentioned, it seems that there is only a small boiler required, but for modern mass production methods, a very cleverly designed machine is used. There are two vacuum heads worked independently of each other, and each pan can be placed separately under vacuum, thus the user has a machine that gives a continuous rate of production. All the parts that come into contact with the sugar and water are made of a special alloy.

After the sugar has boiled, it is poured upon a slab which is usually heated by steam. While the mass is upon this slab, or table, the colouring and flavouring materials are added.

If, however, the sweets are to be of the fruit bonbon type with jam centres, the mass is rolled out flat, and the jam centre is placed in the middle and then the sugar coating is wrapped around it.

Batch Roller

The rough cylindrical mass is then put into a machine known to the trade as a batch roller. The machine usually consists of six tapered metal rollers set at an angle and geared together. More rollers than six could be used, and the rollers can be replaced by a piece of endless webbing. The rollers are set at such an angle that the front ends of the rollers leave an orifice of about one and one-quarter inches. The sugar mass is placed at the back of the machine where the rollers are the widest apart. These rollers are positively driven and are given a reversing motion at predetermined intervals. This is done so that the mass is rolled over backwards and forwards, and so being forced to assume a cone in shape. Eventually the mass is so reduced that it can pass through the small orifice formed by the ends of the converging rollers. From here the sugar rope is passed while still warm to a rotary machine which automatically forms the shape and produces any decorative design without any waste. Fundamentally, the machine consists of two large rollers, on the periphery of which is half the thickness of the finished bonbon, so that at the centre a piece of sugar mass is firmly pressed into the required shape. These rollers or dies are made to form various designs and sizes, and can be changed in the machine in the space of very few minutes. When the formed bonbons are produced by this machine, they are joined together by means of a very small strand of sugar. The stringed bonbons then pass on to a cooling band usually about twenty feet long or, if space is limited, into a rotary cooling device. While the bonbons are travelling in one or the other of these devices, they are subjected to a current of cold air, and upon their arrival at the end of the conveyor they are almost cold and drop into a tray.

In some factorie the sweets are allowed to stand for a while before being taken to the wrapping room.

Automatic Wrapping Machine

In the case of the confectionery works, as well as in all modern production processes, the constant demand has been for a machine that will give the greatest possible output per day, and, of course, surpass the product as produced by the human element. So with this in view, modern wrapping has slowly but surely been gradually developed during the past thirty years.

It is to such a machine that the bonbons are then brought and deposited upon the feeding counter, an integral part of the machine.

The working of a toffee wrapping machine is extremely fascinating. At the first glance, the machine seems to be alive with a complicated mass of quickly moving parts, which on closer observation are seen to have a particular and individual motion for each operation.

The various moving parts are usually cam operated, and so made to actuate at exactly the right moment. The designing of these various movements calls for a close study of motion and time, so that the different motions are made to follow one another, and the whole of them to operate in less than half of a second.

The general operation of these wrapping machines does not resemble the human hands in any manner, a principle upon which most light automatic machinery is built.

The wrapping machine is usually fed by hand, and the speed is about one to two hundred wrapped packages per minute.

The day has not yet arrived when a batch of goods can be thrown upon the feed tray, mechanically sorted and fed to the wrapping machine.

In America, such a machine exists for wrapping the familiar sugar-coated chewing gum pieces, but a very different question would arise if soft centred goods, such as chocolates, were to be wrapped.

Figure 2 shows diagrammatically the principles usually adopted for the machine that is used for the wrapping of small irregular shaped pieces. The machine can also produce the various styles of packages such as those depicted in Fig. 1, by throwing the various mechanisms out of gear.

Principle of Operation

Referring once more to Fig. 2, we will follow the steps in the folding and completing of the packet.

The wrapping material is usually fed from a reel W. The free edge of the web is gripped by the tong-like grippers G, and drawn through the web cutting knives K into a predetermined

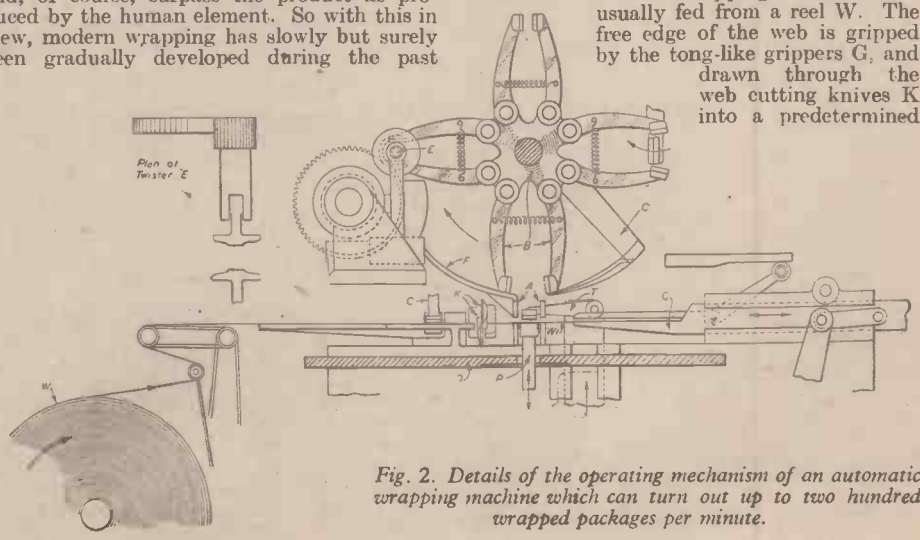


Fig. 2. Details of the operating mechanism of an automatic wrapping machine which can turn out up to two hundred wrapped packages per minute.

position, as depicted. The wrapper is then severed by closing the two knives K, and the wrapper is left as marked, W1.

The clamp finger C also actuates at this moment, so that the paper does not spring back out of control. This finger is placed a little way back from the severed edge so that the tongs have enough to grip at the next sequence of operations.

Beneath the paper line there is placed the intermittent rotary feeding wheel D. In its periphery are a series of holes, the size of which is slightly larger than the goods to be wrapped.

Passing through these holes is a vertically operated plunger P, which has two prongs to support the wrapper.

As the plunger rises, it carries the bonbon to the underside of the wrapper. Upon its arrival here, the finger F has also taken up its position at the top of wrapper. These two now give a little nip to the wrapper and bonbon so that there is no fear of the wrapper becoming displaced. The plunger and finger move vertically and together, carrying the wrapper and bonbon through the stationary folders A. By this movement the wrapper is forced down three sides of the bonbon in the manner of the letter U.

The wrapper and tablet is carried as far as the confection holders B, which in turn are moved inwards and so grip the tablet with its wrapper. The plunger then withdraws, and the finger T moves further upwards to be clear of the fingers as they move round.

As the plunger withdraws, a swinging folder C moves inwards and folds one of the projecting ends of the wrapper against the under side of the bonbon.

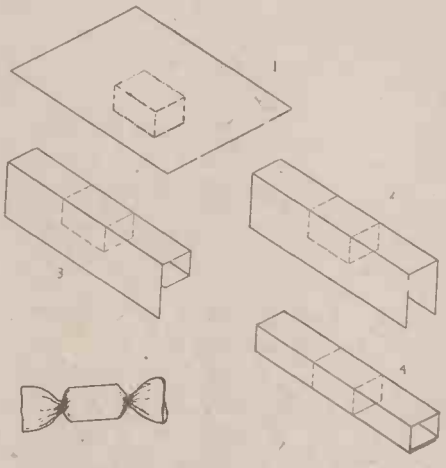
The confection holder wheel then moves in the direction of the arrow, this bringing the remaining edge of the wrapper into contact with the stationary folder F. The bonbon is now enclosed in a complete paper tube.

The holder wheel having moved ninety degrees, again comes to rest, and the folding or twisting mechanism is brought into action.

Assuming the finished packet has to be of the twisted type, it is at this stage that this is usually done.

The twisting grippers E seize the open ends of the tube and by their rotary motion twist the familiar fantail ends of the packet. As the twisting action is taking place, the wrapper, of course, becomes shorter, and so the twisters are moved inwards to compensate for this.

The completed package is then moved another ninety degrees, and perhaps here a label may be stuck on, or the seam of the fold sealed by means of a movable heater. After the remaining ninety degrees has been traversed, the package is ejected by the push-out finger into the receiving receptacle.



Various stages in the wrapping of a bonbon.

Adaptable to Different Shapes

This class of machine is very versatile, and can be readily adapted to wrap any of a large variety of different shapes and sizes of tablets by the very simplest of adjustments, and on some machines this means only the turning of a screw.

It may be interesting to know that there is always a device fitted so that the wrapper feed, or a label feed if one is used, is thrown out of gear if there is no tablet or an imperfect article presents itself to be wrapped. The cutting knives are also spragged against cutting if these difficulties are present. A device may also be fitted that fringes the ends of the wrapper, and gives the package a cracker effect.

Some people may have noticed that on some packets the manufacturers names may have been printed at regular intervals, and at all times have been at the same position on the finished packages. This is also taken care of by the machine.

At regular intervals along the whole length of the web there may be holes, or in some cases these may be replaced by opaque printed marks. As can be understood, the printer cannot print and recoil the paper to such a degree of accuracy as to secure correct synchronism over any appreciable length of time without some form of register control. For instance, if an error of one-thousandsth part of an inch occurs and is allowed to accumulate, all would be completely lost running at the slow speed of one hundred and fifty per minute for the whole of an eight-hour shift.

The punching of holes certainly adds to the cost of the paper, but the registering device is rather cheap, as this may be purely mechanical or may operate by pneumatic or electro-magnetic means.

If the wrapper is printed with the opaque spots the web feed is then controlled by the photo-electric method. Before the war this system was rapidly coming to the fore, even though it is more costly than the rest. Against this it may be said that owing to the registering mark being a part of the wrapper, the cost of printing is correspondingly reduced.

There are some machines that are fitted with a safety device if the operator puts her hands too near the mechanism. When pills and similar articles are to be wrapped, the machine is fitted with an attachment that counts and collects them before they are presented to the machine.

As will be readily understood, this survey hardly covers the fringe of this fascinating branch of automatic machinery, but it may serve to enlighten a number of interested people.

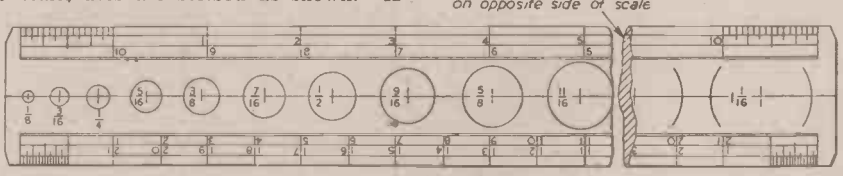
Useful Kink for Draughtsmen

A Speedy and Accurate Method of Setting Compasses

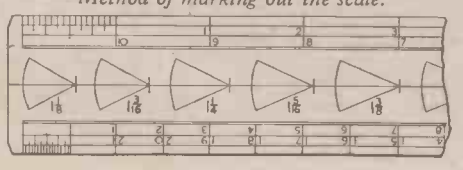
AS a means to the speedy and accurate setting of compasses, a series of circles scribed on the back of a scale or favourite set-square in the manner illustrated will prove of inestimable value.

The circles commence at $\frac{1}{8}$ in. diameter, and rising in sixteenths the range is extended to the full length of the scale. When the diameter of the circles becomes greater than the width of the scale, arcs are scribed as shown. A space of about $\frac{1}{8}$ in. is left between circumferences of the circles, which are arranged symmetrically to blend with existing markings, and using both sides of a 12-in. scale, circles up to a diameter of $1\frac{5}{8}$ are covered. By using the diameters as radii, circles of double size can, of course, be described.

The markings are made with a pair of spring-bow dividers and needle scriber; being afterwards made clearly visible by rubbing finely powdered lead from a pencil over the surface, so filling the scribed lines.



Method of marking out the scale.



The dead-true radius setting of the dividers is easily accomplished by registering the divider points into the machined incisions of a steel rule at the correct distance. Advantages which will be readily appreciated are:—

1. Markings on the scale are not marred by the constant penetration of the compas needle.

2. Mistakes in setting are eliminated, as diameters are clearly marked.

3. Strain on the eyesight is reduced to a minimum as only one line is seen and used.

4. Intermediate dimensions are set by approximation, taking a midway setting and using two adjacent circles.

5. Uniform centring of screws, studs, bolts, etc., can most easily be obtained by setting the compasses and marking dot on either side of centre line.

The writer, having applied this simple idea, can vouch for its utility.

In order to extend the range, some may prefer to mark out radii instead of diameters, and a suitable form of marking is shown in the smaller illustration.

Whilst reference has been made to draughtsmen, this kink would prove equally useful to shop-men as a means whereby to set their dividers for quick and accurate marking out. instead of setting the circles on scale or set-square they could apply the idea to some tool in constant use by waxing the surface, scribing the circles and dimensions and penetrating as deep as required with some suitable acid.

D. H. D.

The Story of Chemical Discovery

No. 11. The Advent of Aniline Dyestuffs

WILLIAM HENRY PERKIN was a strange and an earnest lad. He was far more interested in chemistry than he was in eating. Many a time he would readily go without his lunch in order to attend a chemistry lecture, or to be present at a scientific demonstration. At the still tender age of thirteen years he was attending an extra course of chemical lectures which were given at the City of London School, and when, afterwards, he heard that a college of Chemistry had been founded in London, he forthwith enrolled himself as one of its first students.

The fortunes of this new chemical College were in the hands of another earnest and fervid chemical enthusiast, one August Wilhelm Hofmann, a German, who had been brought over to England from his post of Lecture Assistant in the University of Bonn, by the Prince Consort, himself a German, and placed in charge of the new enterprise in London.

Hofmann was undoubtedly a brilliant man. He had been recommended by no less a personage than the renowned Justus von Liebig, one of the "fathers" of the then infantile science of organic chemistry, and, under his direction, the new Royal College of Chemistry in Oxford Street, London, soon attracted to itself a large number of promising pupils.

Student Days

Among these students was to be found the aforesaid William Henry Perkin, son of a London builder and contractor, who, it was said, had "got chemistry on the brain." The College's Director, August Hofmann, to his credit, quickly recognised the ability of Perkin, for, after the latter had passed through his ordinary course at the College, he was made an honorary assistant to Hofmann, a job which carried with it the duty of prosecuting various lines of chemical research suggested by the renowned professor.

Hofmann was interested in coal tar, the black, viscid, evil-smelling oily liquid obtained by the distillation of coal. So, too, was his young assistant, Perkin. Hofmann set Perkin to work on an investigation of anthracite, but this problem, it would seem, hardly filled the chemical needs of the enthusiastic research student. Perkin had a miniature laboratory at home, an entirely private sanctum in which he carried out his own special "private lines" of chemical investigational work, such tasks being achieved mainly during weekends, and vacations.

Hofmann, it appears, at one time threw out the suggestion that it would be a very desirable and profitable feat to be able to make quinine artificially, since this valuable drug was entirely a natural product, and had to be imported into England from the tropics.

Perkin was eighteen years old at the time. If he had been of a more mature age he might, perhaps, have regarded the problem of bringing into being synthetic quinine as one of too formidable a nature for him to tackle. Being young and inexperienced, however, Perkin took the problem home and tried to solve it in his household laboratory.

Discovery of "Mauve"

It was during his Easter vacation of 1856 that young Perkin first began to wrestle with the engrossing problem of artificial quinine production. In his home laboratory he made the attempt at oxidising crude aniline oil (then a new product) with bichromate of potash in the hopes of converting some of the aniline into quinine. But no signs of quinine did the youthful experimenter get. Instead, he managed to convert the contents of his aniline flask into a black, tarry, sticky mass which

Sir W. H. Perkin

seemed to defy all further treatment. In disgust, he began to wash the flask out with methylated spirit in an attempt to clean it for the next experiment. To his surprise, the spirit was coloured an intense violet, which colouring-matter Perkin soon found to have strong staining properties.

The quest for quinine was now forgotten, or, at least, side-tracked. Perkin's enthusiasm was stirred up by the accidental production of the violet colouring-matter. He tried the same experiment again, this time using purer aniline. To his surprise the second experiment failed. He then found that the aniline must contain a little of what is now called toluidine before the experiment would work, this toluidine being contained in the crude aniline manufactured from coal-tar benzene.

The third and subsequent batches of the new violet colour which Perkin prepared in his home laboratory during the Eastertide of 1856 dyed silk remarkably well. The experimenter sent specimens of his dyed silk to Messrs. Pullars, of Perth, and asked their opinion of it. Pullars were cautious yet promising in their reply. "If your discovery does not make the process too expensive," they said, "it is decidedly one of the most valuable that has come out for a long time."

Perkin, young as he was, saw vast possibilities in his new dye, which afterwards was named "Mauve." With the aid of his brother, he made a few ounces of the dyestuff during the summer vacation of the same year (1856) and then took out his first patent on the 26th of August of that year.

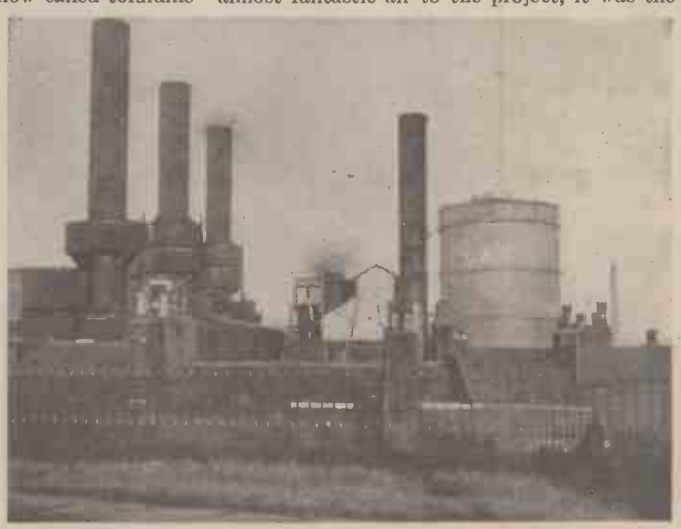
In the following October, to his former teacher's great annoyance and disgust, Perkin resigned his position as Assistant at the Royal College of Chemistry, and from henceforth devoted the whole of his energies to the commercialisation of his new chemical discovery.

First of all, he prepared a fresh supply of the new dye and took it up to Scotland with him on a visit to Messrs. Pullars. Pullars were interested in the stuff, but they were rather doubtful as to the advisability of erecting plant for the industrial manufacture of the dye. So back to London came the determined William Henry to seek fresh opinions on the subject of his new product.

As a Manufacturer

Towards the end of the year, he persuaded one Thomas Keith, a silk dyer, of Bethnal Green, London, to try out a batch of his dye. Keith was quite pleased with the results, so much so that Perkin definitely decided to embark on the manufacture of the new colouring-matter.

Putting his decision into action was a different thing from merely making it. In the first place, Perkin had never seen the inside of a chemical works. He had no experience in chemical production, no experience in engineering, no business experience, and, to cap all, no money. Yet such drawbacks failed to damp the ardour of the young enthusiast. Somehow or other, he managed to persuade his father and his brother of the almost certain success of his proposals. So successful were his arguments that Perkin senior invested nearly the whole of the family savings in his son's enterprise. In June, 1857, the Perkins began the erection of a small factory to manufacture "Mauve" at Greenford Green on the outskirts of London. It was the first synthetic dye factory the world had ever seen. And, to lend an almost fantastic air to the project, it was the



It is in the modern gas works that every aniline dye begins. From coal tar, it is possible to synthesise hundreds of the most brilliant colours.

creation of men who had no experience whatever in chemical manufacture and who had very little money to lose in useless trials.

Raw materials were a source of anxiety to Perkin during his first working of his "Mauve" process. There was practically no crude aniline oil available. Perkin had to devise plant for making it from nitrobenzene, which product was then very little known except by one or two soap manufacturers who had used it in small quantities for scenting their products. Nitrobenzene, therefore, had to be made by the action of nitric acid on benzene which, even in the mid-fifties of the last century, was little available. Nevertheless, by his indomitable energy, Perkin overcame all these difficulties of raw materials and in the December of 1857 he was turning out his "Aniline Purple" (it only afterwards became "Mauve") and supplying it for use in the silk dyehouse of Thomas Keith and Sons, of Bethnal Green.

The Greenford Factory

Two whole years of "educating" British dyers in the use of the new colouring matter followed. But Perkin carried out such a task with courage and energy. By the time 1859 arrived, the Greenford Green factory was fully established, and was working to its fullest capacity.

Even the great Hofmann became enthusiastic over his former pupil's success. "England," he wrote, "will, beyond question, at no distant date, become, herself, the greatest colour-producing country in the world; nay, by the strangest of revolutions, she may, ere long, send her coal-derived blues to indigo-growing India; her tar-distilled crimson to cochineal-producing Mexico, and her fossil substitutes of quercitron and safflower to China, Japan and other countries, whence these articles are now derived."

Many New Colours

So, too, the rest of the civilised world thought, for artificial dyes had originated in England and before long, more of them began to be made in the same country.

Another Englishman, Greville Williams, patented the discovery of Quinoline Blue or Cyanine in 1859. Then were discovered Aniline Blue, Soluble Blue, Allaki Blue, Fuchsine or Magenta, Aldehyde Green, Aniline Black, Induline, Manchester Yellow, Iodine Green, and numerous other artificial colouring matters. Even Hofmann went in for colour-producing. He synthesised the dyes known as the Hofmann Violets. Perkin, of course, extended his discoveries in this realm. He introduced Dahlia, Aniline Pink or Safranine, Britannia Violet, Perkin's Green, as well as other dyes for the manufacture of printing inks.

The final achievement of Perkin in the domain of dyestuffs comprised his introduction of a process for making alizarin (the dyestuff of natural madder) artificially. He made this dye starting from anthracene, a constituent of coal tar. On 26th June, 1869, W. H. Perkin applied for a patent for his alizarine process, only to find that a similar patent had been applied for on the previous day by two Germans, Graebe and Liebermann, who had worked in London on the same problem.

Graebe and Liebermann took their patent to Germany and sold it to the *Badische Aniline und Soda-Fabrik*, which was to become the great dyestuff-producing concern of that country. On the death of the Prince Consort, too, Hofmann had given up his post and returned to his Fatherland, his head full of the new synthetic dyes which his student, Perkin, had shown to be possible of manufacture.

In this country synthetic dyestuff making got into a bad rut. Perkin, ever a theoretical experimenter at heart, tired at last of the decidedly narrow views of the English dyers and chemical firms. He sold his factory, which then covered about 6 acres, in 1874 to Messrs. Brooke, Simpson and Spiller, and retired for the remainder of his long life to carry out original researches in pure Chemistry. Eventually, Messrs. Brooke, Simpson and Spiller moved to a new works at Silvertown, London, from which nucleus the well-known British Alizarine Company finally developed.

After Perkin left the dyestuff world, English dye makers and dye users got at sixes and sevens among themselves. The dye makers would not spend the necessary money for research. The dye users were absurdly conservative, and would not favour or even give consideration to any product which was of an experimental nature. The British patent laws, moreover, put unfair restrictions upon British chemical discoverers, so much so that, eventually, dyestuff production came to a virtual standstill in our country.

The interior of a modern chemical laboratory devoted solely to the task of creating new dyes for industry.

German Dye Industry

Across the German Ocean, the tale was very different. Universities and industrial firms built up large technical staffs to ferret out new dyes, fresh colours which could be manufactured for an endless variety of purposes, and sent all over the world. New companies with ample wealth came into existence for the exploitation of the young German dye industry. From dyes, these organisations subsequently branched out into the manufacture of drugs, perfumes and other synthetic chemicals, yet they ever kept dyestuff production to the fore, since that industry was the one upon which their success had been reared.

A multiplicity of new dyes and synthetic colours were discovered in Germany. Their chemical constitutions were investigated by an army of chemists. Economic methods for their manufacture were rapidly worked out in almost every case. Even the traditional dyestuff, indigo, was at last made artificially. The *Badische Anilin und Soda-Fabrik* spent more than a million pounds and seventeen years of continuous chemical research before they successfully made synthetic indigo for the first time towards the end of the last century. But this achievement made Germany master of the world's indigo industry, and it put most of the native Indian indigo producers out of business.

At the outbreak of the 1914-18 War, our dependence upon Germany in the matter of dyestuffs was more or less complete. In 1914, the German dyestuff industry was manufacturing more than three-quarters of the world's coal-tar products. In the whole of the British dyestuff factories there were only 35 trained chemists, whilst in one German factory alone, no fewer than 307 of these highly-trained and expert individuals were employed.

It is perhaps fortunate that Perkin did not live to see this sad state of affairs, for he died in 1907, full of honours and in possession of a Knighthood, which, to say the least, had been richly deserved by him.

Hofmann's curious attempt at prophesying the status of England as mistress of the world's dyestuff industry had gone woefully astray. Perhaps, however, Hofmann had some inkling of what he inwardly hoped might transpire, and was thereby constrained to predict ironically?

Dyestuff Prices Soar

After the commencement of the last war, dyestuffs rocketed sky-high in price. Factories were put down for their manufacture. Herculean efforts were made on all sides by scientists to recover the lost industry, but it was, of course, impossible to achieve in a few months, or even years, the colossal standard of Germany's then nearly fifty-year-old industry.

After the War, the British Government subsidised dyestuff production to some extent. A new spirit came over officialdom. The industrial chemist attained a new status, one which had formerly been denied him. As a result, more dyestuffs discoveries were made, the first important British discoveries in this department of Science for many years. Entire new classes of dyestuffs, vastly improved upon the old standards, came into existence, and not merely into theoretical cognisence, but into actual industrial production. Some of the most resistant, fadeless and brilliant of the artificial dyes began to be made in enormous quantities in England. We even exported some of them. A new fashion set in. The fashion for English dyes. The money which had been spent on research rapidly bore fruit, and the British dyestuff industry once again regained its feet.

How well this resurrected industry has stood us in the present national emergency has yet to be revealed and related. At the opening of the present war, however, there was no dyestuff or synthetic chemical famine. To a large extent, England had gained and held her self-supporting status in this respect.

The story of synthetic dyestuffs is one which is based upon the history of Sir W. H. Perkin and his youthful energies, both as a chemical scientist and as a manufacturer. It is a narrative which has its sad and disappointing chapters, but the end of the complete story has not yet been reached. Only our innate ingenuity as a scientific nation can impart to this history the final termination which we desire.

PHOTOGRAPHY

Shading and Finishing Enlargements

Subduing Backgrounds and Mounting Prints

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

IT is hoped that many will try their hand at the combination printing suggested in the last article, for it does not take a lot of practice to get quite excellent results, and it is also possible to extend the work by the insertion of figures and other objects into landscapes or general views.

" Shading "

Sometimes it is necessary when making a picture to hold back the printing of a certain part of the negative, and for this we have recourse to a method known as " shading." Taking a simple example for our illustration, we will consider a negative taken on a bright day when every detail of the landscape is sharply defined. The contact print shows that the line of trees at the back of the picture is too heavy and too dark; those trees look as clear as the gate and cottages in the foreground of the picture, in fact, the more it is examined, the worse it appears, because there is no distance represented in the print.

The background of this print has been shaded to give the effect of distance

It is likely that you want to make a print in a hurry and cannot devote the time to improving the negative by the application of Johnsons negative dye, so here is a method which will help you.

Place the negative in the enlarger, focus, and make your trial test strip to get the accurate exposure time for the cottages and general foreground. Now make another test strip of the background row of trees, remembering, of course, that the exposure for this part is to be considerably cut down; having developed the two strips place them together and see which of the exposures of both strips combine to give the best effect of distance. Be sure you do not reduce the exposure too much as it will then look as if the background is too far distant.

Exposures

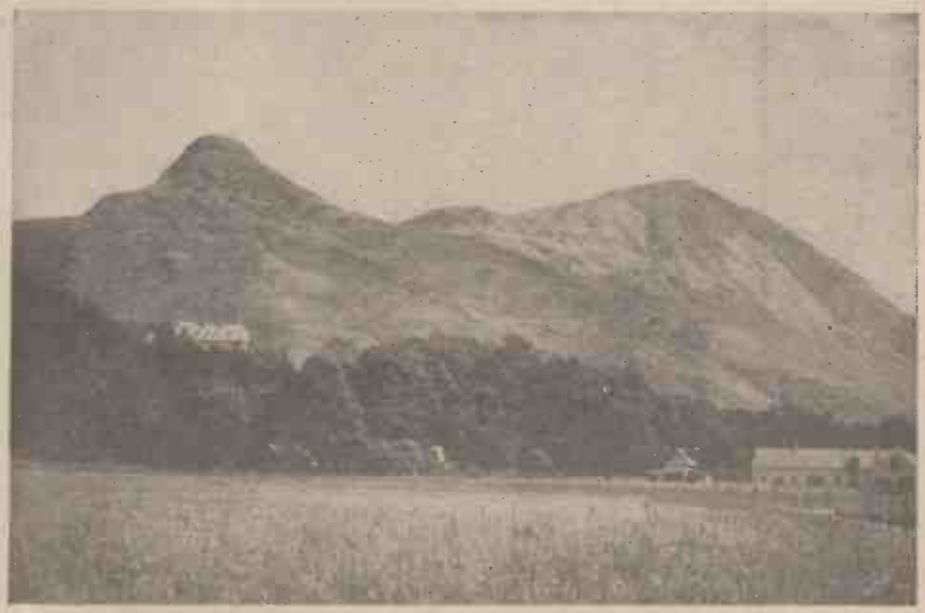
Let us assume that the exposure required for the foreground is 20 seconds, and that for the background only 10 seconds; do not place the bromide in position until you have had a chance of experimenting as follows. Take a piece of card in your hand and hold it midway between the projector, and the easel on which you can plainly see the picture; you will notice that the card causes a shadow on the easel and this shadow can be regulated so that it covers that part of the image which requires holding back. You know what exposure this wants as compared to the cottages, so try and move the card about in such a way as to leave the foreground completely exposed for the 20 seconds, and yet only allow the other to receive 10 seconds; it does not sound easy, but it is actually quite simple. There is a dividing line between the two sections of the picture, and below this your shadow must not go; you must move the card slowly until the shadow comes down to this line, and then move it upwards. If this movement is regular, you will find that that part to be held back is only covered for part of the 20 seconds, and when the print is developed, you will find that the gradation is such that the centre line is not so dark as the foreground, and yet it is not so grey as the trees on the skyline.

In another example it may be that a certain object in the foreground is in shadow, and its details are lost when you come to print; obviously, this requires rather more skilful handling if you intend to shade. Take a piece of card, focus your negative on to the screen, and to the size of your bromide paper and ascertain, in the usual way, the correct exposure. Now with the card try to shadow the image of the object you want to hold back; it may be your hand will be in the way, in that case suspend the card by means of a thin wire. Remember that you must keep the shadow card slightly and continuously moving so as to avoid any sharp lines around or close to the part being shadowed.

" Spot-lighting "

Finally, there is the example of a negative where it seems almost impossible to print some of the details. It may be a building on which the sun is shining and it is consequently over-exposed, and is much too dense. In this case take the card, but this time cut a little hole in it; proceed with the focussing and then hold the card between the lens and the screen in such a way that whatever light reaches the easel must pass through the hole in the card. You will find that it is possible to so adjust the card that only the building is seen on the easel, and all the other parts of the image are not showing. This will enable you to give the building the extra exposure after which remove the card, and expose the whole of the picture, and when the result is developed you should find that you have secured some detail where previously it was not apparent.

We have now reached the stage where the print is to be developed, and I must urge the necessity for cleanliness in this part of the work; your dishes and bench cannot be kept too clean, and this also applies to your fingers. A chemically stained measure or dish will



The background in this print is too heavy, and requires shading, or holding back in the printing to give the effect of distance

waste both the paper and your time, and what is more, will cause you a nasty disappointment.

Developing and Fixing

If you are using paper of a size of 10 by 8 or larger, get into the habit of soaking it in clean water before pouring on the developer; this is the surest means of preventing air-bells, and it gets the emulsion of the paper into a uniform degree of softness for absorbing the developer generally, and not on the edges first, and the centre later. I think I have already told you that Amidol is the best developer for bromide papers, and I would like to give you a word or two about the time of development. Amidol seems to go on with its work until there is nothing left to be done, and when it reaches this point it does not start staining as some developers do, and this is a great advantage. It normally finishes its work in from 1½ to 2 minutes according to the paper, and it therefore indicates whether you have over or under exposed. If correctly exposed, you are sure of correct development, and so will get the best possible result.

Do not be too anxious to examine the developed print, but pass it quickly into the acid-fixing solution. If you are wise you will have a "stop" bath into which it is placed immediately development is complete; this stop bath is simple to make, by dissolving one ounce of potassium meta-bisulphite in 20 ounces of water, or you can buy a tin of a special powder all ready for dissolving—it is called Stop Bath. The advantage of this bath is that it kills the action of the developer immediately the print is placed in it, thus completely overcoming any tendency to stain. Leave the print for about five minutes in this before placing it in the fixing bath.

I never advocate plain hypo for fixing papers; it is far better to use the acid-fixing bath as it does not stain or discolour, and it lasts longer than the plain bath, but on this point care must be taken not to use it to exhaustion. Unfortunately, it is not possible to see when a print is fixed, therefore it is better to be extravagant rather than mean with the fixing bath.

Washing has a very important bearing on the life of a print, its primary object being to wash out the free silver made soluble by the fixing bath, and unless this is effectively done, the print will in a few months or years show metallic stains, and these cannot be removed. Some of my enlargements are over 30 years old, and are as clean as on the day they were made, and this is due to efficient washing.

The picture is now dry and ready for any final work. Place it under a sheet of glass and examine it for any blemishes such as pin-holes, black spots, or scratches, and get these removed as already suggested. What about the edges? Are they quite free from any discoloration, and do you think that side wants trimming? The trunk of that tree is void of detail and makes that side look overloaded. Why not cut half-an-inch off? Do you feel satisfied that there is not too much sky? Don't cut for the sake of cutting, but do not hesitate to use the knife if it will improve the general composition of your picture.

Having finished spotting, trimming and any other final item, make sure that the print is rectangularly accurate before you attempt to mount it.

Mounting

Now for your white card mount; no colours, please, and no intermediate papers; they only detract from the picture. Do not use gum or an ordinary office paste, and if you have not the opportunity of using dry mounting, then insist on a photographic mountant, and have a good make.

The size of mount is to a certain extent a personal matter, but here are a few examples which I know are good; for a 12 by 10 print, allow 3 inches of mount at top, and 2½ to 3 inches each side. Below the print allow 7 inches, and for a 10 by 8 print allow 2½ at top, 2 to 2½ inches at sides, and 5 to 6 inches at the base.

Finally, unless you are exceptionally good at handwriting or doing "printed" lettering, always place your titles, if any, at the back of the mount. A title is at times necessary, and helpful, but quite frequently one sees a picture that is spoilt by poor attempts at lettering. It sometimes helps, but only seldom, to rule a thin line round the print about ¼ inch from the edge of the bromide paper, but the day has passed when fancy borders were the vogue.

Items of Interest

An Omnibus Raft

THE raft de luxe has hove in sight. To style it a miniature floating palace and to talk of its amenities would be an exaggeration; but it certainly appears to be a paragon.

This substitute for a lifeboat belongs to the family of rafts intended to be carried on a ship and thrown overboard in an emergency. Such rafts must be strong enough to withstand damage when dropped on to the water from a considerable height; for instance, a rapid descent of 60 feet. They should also be reversible; When they reach the water, it should be immaterial which side is uppermost. And these features characterise the new raft in question, for which a patent in this country has been applied for.

The raft is square in plan and qualified to seat 12 persons. The length of its side is about 6 ft. 6 ins. It comprises three vertically spaced side wall battens at each side, secured together at their ends to form the corners of the raft. These corners are strengthened with metal.

Compartments for storage of food and water containers can be provided. These may be constructed in such a manner that they are accessible either way up, having hinged lids fastened down by hasps or pins.

Underneath the planking spaces are packed with buoyant material such as slabs of cork. This substance may consist of certain patent gas-filled rubber blocks. Triangular extensions may be fixed to the ends of the raft to increase the space available for the buoyant material and for the storage of food, water, etc.

Light on the Water

THIS super-raft may be fitted with lamps deriving power of illumination from an electric battery built into the raft. In order to indicate the position of the raft, the lamps should be adapted to light automatically upon making contact with the water.

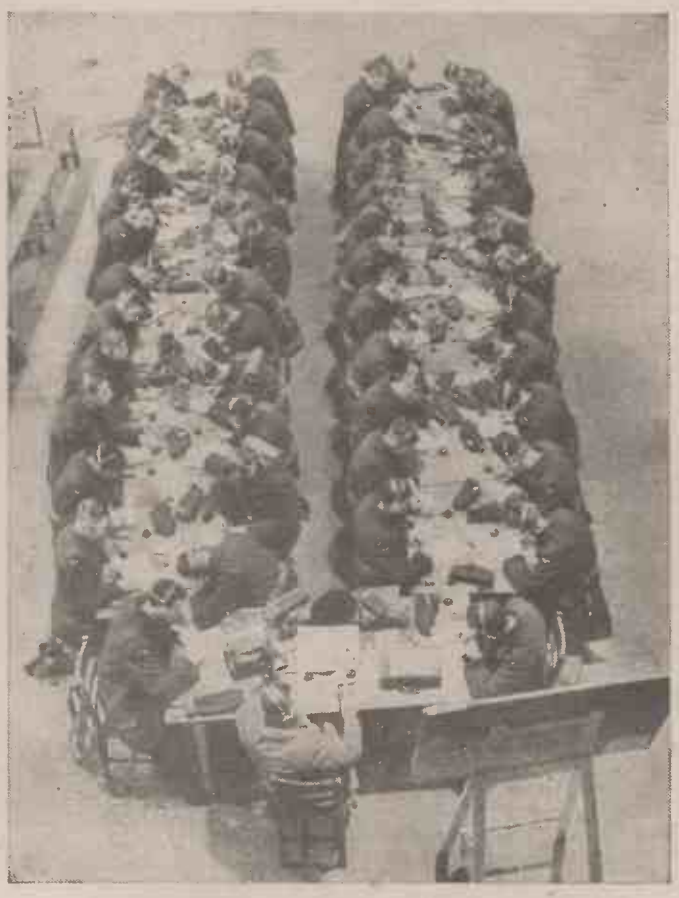
The raft may be furnished with rope grips for the shipwrecked passengers and mariners to grasp.

Gas Mask for Horses

GAS masks for horses have already been proposed, but a French citizen, dissatisfied with those previously devised, has submitted to the British Patent Office what he maintains is an improvement. He asserts that hitherto protection of horses from gas has been furnished by means of nosebags made of filtering fabric, which he states is difficult to fit in a gas-tight manner and hinders the breathing of the animal. He further affirms that such a mask quickly tires the horse.

His improved design comprises a cylindrical or a truncated cone-shaped arrangement capable of being hermetically fixed round the horse's head, by tightening an outer thong on an inner sponge rubber or resilient joint.

The mask carries a bit, made of one or a number of parts which, in a gas-tight manner, passes through the mask.



A group of aircraftsmen undergoing Morse instruction at one of the R.A.F.'s training stations

Our Busy Inventors

By "Dynamo"

Light Walking Stick

I NOTE that incorporation of a torch and battery with various objects forms the subject of more than one recent application for a patent in this country. For example, an improved walking stick has been devised with means to provide a lamp for the feet, and also to throw light upon the body of the walker, so that he is visible to an approaching person.

This stick has a crooked handle with a lamp mounted in a recess in the stock of the stick. The lamp shines through an opening in the rear side of the stock—that is, on the side to which the handle is bent. The result is that, when the walking stick is held naturally and with its lower extremity at an angle forwards, rays of light will be thrown rearwards and downwards.

In order to protect the lamp in daylight or at any time when it is not required, there is a closing arrangement which rotates and covers or uncovers the aperture.

For Fire Watchers

DEMONSTRATIONS are frequently given to show fire watchers and others how to deal with an incendiary bomb. Recently the British Patent Office received an application relating to an incendiary bomb specially designed for the purpose of demonstration. The inventor points out that with the customary demonstration bomb, the intense heat produced by an actual bomb usually is not present. Consequently, it is a primary object of his device to provide an article which, when ignited, burns with the fierceness of a real incendiary bomb. And its cost is less than that of the actual bomb.

This practice bomb has an outer casing of paper, cardboard or similar sheet material. The lower portion contains particles of the incendiary metal or mixture, while in the upper part is an igniting material. The container is closed by means of a puncturable or removable cover, whereby the igniting material can be fired. As a consequence, the effect of various fire-fighting appliances can be clearly demonstrated.

The bomb is cheap to manufacture, and it can be handled and transported with safety.

This demonstrating device may contribute its quota towards preventing a replica of the Great Fire of London.

Long Life for Stockings

THE stocking is subject to more than one peril. If it be of silk, its besetting sin is laddering. Compared with the constricting Victorian garter, the suspender is hygienically preferable, but the tension imposed by the fastening undermines the constitution of the fabric. And a further strain is caused to the upper part by the varying circumference of the limb of the wearer.

To obviate these disadvantages, an inventor has devised a method for improving the elasticity of stockings. He furnishes a stocking with an elastic inset in the upper part more capable of being stretched than the main fabric. This inset extends from the upper edge downwards. Tapering almost to a point at its lower end, it is secured to selvedge edges formed during the knitting of the stocking.

In these days when the hosier's stock and his customer's coupons are equally limited, any method which prolongs the life of the stocking will come as a boon to women.

Two-Legged Nails

AN inventor calls attention to the fact that some boot protectors at present in use do not always get a firm and secure grip of the leather. The result is that, after a little wear, they become loose and fall from the sole or heel.

To remedy this defect, he has conceived the idea of a protector that, once hammered into the leather, remains a fixture until completely worn away.

Two views of the new M-3A1—the first American medium tank with a cast steel hull. In the top illustration workmen are putting guns aboard the first completed tank, and below is a broadside view of the new tank. The top hull is not rivetted, and has rounded contours, which will deflect shells and bullets better than flat surfaces.

His protector consists of a metal plate with a hole for the insertion of a nail having a head and at least two legs. When this nail is driven through the hole into the leather, the legs spread apart. The nail is the sole means of fixing the protector in position.

The sides of the hole in the plate and the head of the nail may both be tapered. In that case, when the nail is driven home, the head is countersunk and more or less flush with the plate.

Concert Pitch

A SHAH of Persia, when on a visit to this country, is said to have attended the Handel Festival at the Crystal Palace. He stated that the piece which delighted him most was the opening number. As a matter of fact, this was the tuning of the instruments!

Generally speaking, such tuning applies principally to the stringed instruments of the violin family, which have a vicious habit of frequently lapsing from the pitch. However, there are other stringed instruments which occasionally need pulling up—in other words, to be braced up to concert pitch. Among these is the harp, the "sole-remaining joy" of Sir Walter Scott's Last Minstrel.

I observe that an application for a patent concerning a tuning device for the harp has recently been accepted by the British Patent Office.

There are in this country a number of harpists to whom this invention would be useful.

Comfort for Casualties

WHEN an injured person has to be lifted from the ground on to a stretcher, according to the current method adopted by first-aid authorities, four men customarily use their hands and arms for this purpose.

The main object of a newly conceived device is to facilitate this lifting operation. It comprises a strip of webbing or other flexible material having at each end a handle or loop of rigid material, such as metal.

The handle at one end of the strip is pushed from one side under the injured person until it can be grasped at the other side and drawn so that the webbing lies under his body. If four of these strips were provided and there were four attendants—two at each side—the casualty could be easily and gently laid on the stretcher.

Accommodating Seats

THE leading characteristics of an improved collapsible seat, concerning which a patent in this country has been applied for, are asserted to be facility in folding, and compactness when collapsed. The inventor has aimed at making a seat of this description which is also simple and cheap to manufacture, rigid and stable when in use, and ready for prompt collapse when vacated.

The invention comprises a column pivoted at its lower extremity to a support block or bracket. It is adapted to be fixed to the floor near a counter, or, if preferred, to the face of the counter near the floor. The seat proper is pivotally attached to the upper end of the column and there is a stop arrangement limiting the extent to which the column may be inclined outwardly from the face of the counter.

This seat is not only suitable for restaurants and milk bars; it is also useful in connection with work benches.

THE WORLD

Realism in Miniature

View of the forward part of the French Liner "Champlain"

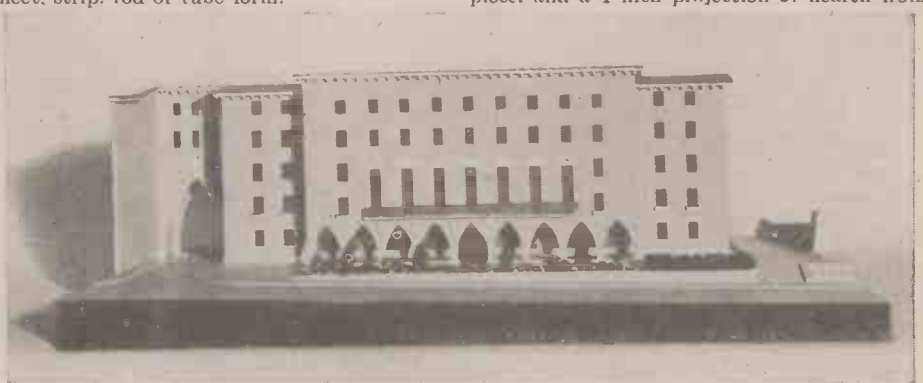
Popular Liners

THOSE who travel by sea in peacetime on some of the world's famous ships often wonder what fate has befallen, or will befall the ships they knew and loved.

Here is a portion of a model of probably the most popular of French liners that ever crossed the Western Ocean—the S.S. Champlain, with her peculiar shaped funnel and rather unusual lines. As is well-known to many, she was sunk near Bordeaux soon after the fall of France. Then there is the Georgic, most familiar of all Cunard-White Star liners, sailing from Liverpool to New York. Of medium speed ships she claimed the patronage of those travellers who were not anxious to speed across the Atlantic in four and a half days, but inclined to more leisurely sea travel. She was set on fire by the enemy in the Red Sea, and I believe is a total wreck. Last, but not least, is the famous E.S. Normandie, most spectacular of all luxury liners that ever sailed the seas, and built as a first-class ship catering for film stars, politicians, authors and writers, and millionaires. She is a tribute in speed to the turbo-electric method of propulsion, and the rival of the Queen Mary. As will be seen from the illustration, she has a counter stern, and her distinctive tiered decks show up to advantage. Will she eventually become an aircraft carrier by the time these lines are in print, or will she remain in New York Harbour, awaiting her complement of gay passengers when the piping days of peace return?

Model Furniture

I find many model makers who used to work in metal and wood are having to turn their energies entirely to woodwork owing to the difficulty in obtaining essential metals in sheet, strip, rod or tube form.



Re-building Britain—a suggestion for Coventry. This illustration shows one of the main buildings of the town centre with its arcade of shops and offices above

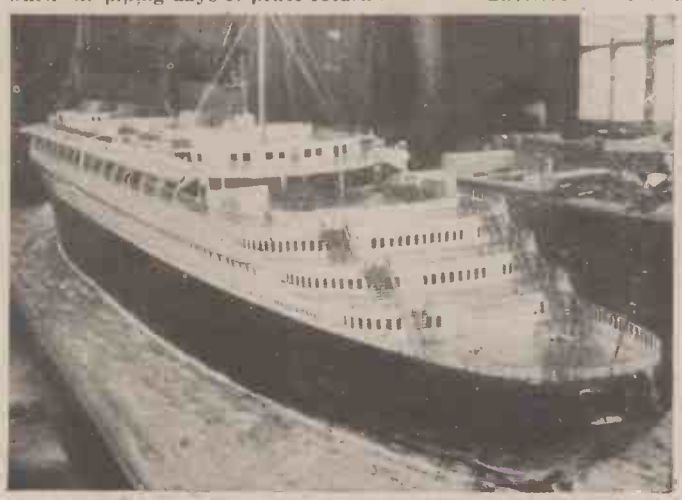
But there is no need for them to give up the hobby—model furniture is quite simply made without the use of metal. Some ladies, too, are quite expert in small woodwork, and here is a model sideboard to a scale of 2 inches to the foot, made by Miss Judith Hughes of Tavistock, who is also a maker and designer of full-size furniture.

The model is 7½ inches long by 2¾ inches wide and 5 inches high. The doors, which open, are without hinges, but are pivoted on pins. The drawers are properly constructed to open and the beauty of the piece is in its fine proportions, enhanced by the use of a walnut base and legs and walnut handles to the doors and drawers. It is a real wartime product, because there is no metal in it at all with the exception of the two small pins to support the doors.

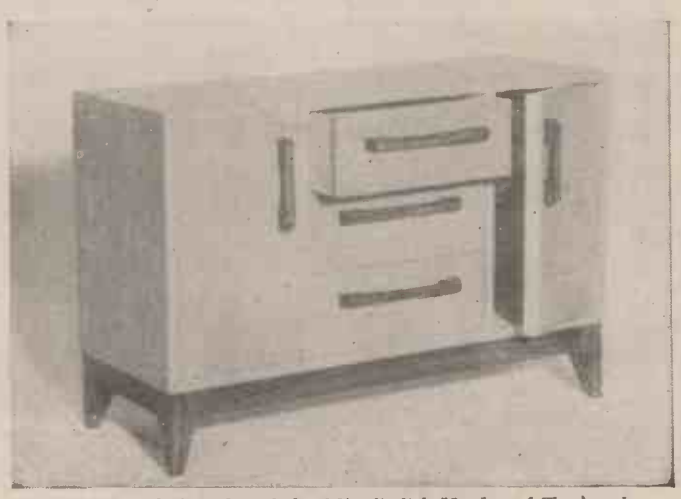
In Bassett-Lowke's London shop I chanced to come across another attractive piece of dolls-house furniture, which is a pre-war product. This is a scale model fireplace and mantelpiece to a scale of 1 inch to 1 foot, which is an exact replica of the well-known Bell grate with Dutch tile surrounds and hearth. It is cast in white metal and fitted with imitation fire illuminated with an electric bulb when connected with a pocket battery. The dimensions are 3½ inches to top of mantelpiece, and a 4 inch projection of hearth from wall. While the supply lasts they can be obtained free of Purchase Tax for 4s. 6d. (postage 4d).

Re-building Britain

If books and lectures and Cabinet Ministers statements came true, what wonderful citie



A stern view of the model "Normandie" showing the yachtlike "counter" stern and gracefully terraced decks



Model side-board made by Miss Judith Hughes of Tavistock —scale 2 in. to 1 foot

OF MODELS—By "MOTILUS"

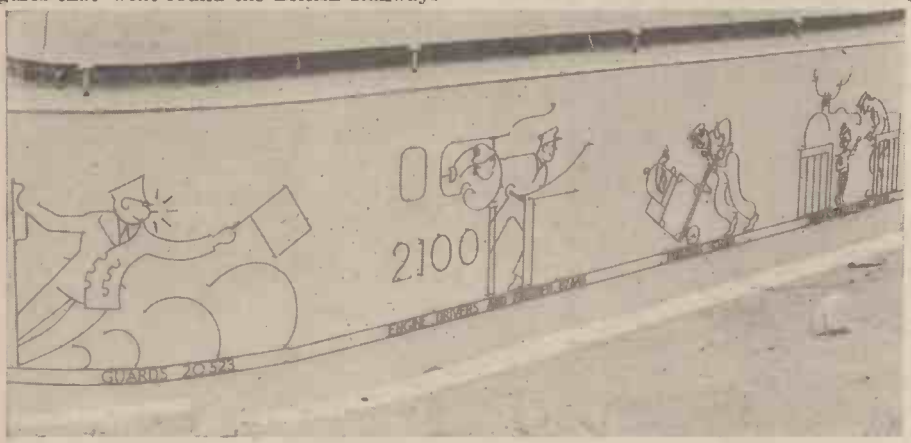
Model Liners and Railways

we shall have in the future. Certainly those which have been badly blitzed will *have* to be entirely re-built in the centre, and Coventry is certainly the most forward of all cities in plans for re-building. Mr. D. E. E. Gibson, M.A., A.R.I.B.A., A.M.T.P.I., the City Architect, has been busily engaged in putting several schemes before the City Council, and the matter has now been sufficiently finalised for a model to be made, putting a more concrete and visible proposal to the City Fathers and the people of the city. The model is being made to a scale of 24 feet to the inch, and here is a portion of the new design for a shopping centre, which will probably be revised before the plans are finally agreed. The photograph shows one of the main buildings of the town centre with its arcade of shops and offices above.

View amidships of the White Star Liner "Georgic"

An Amusing Frieze

It seems a far cry back to the Glasgow Exhibition, but the other day a friend was asking me about the humorous railway figures that went round the British Railways



Humorous railway figures of metal wire which formed a frieze round the British Railway Pavilion at the Glasgow Empire Exhibition in 1938.

Pavilion at this Empire Exhibition. They certainly were unique designs, and were done in metal wire in the form of a frieze, and here is a photograph of a portion of the design, showing a guard, engine driver, fireman, porter with truck, and ticket collector with his small prospective passenger !

A Realistic Scenic Model Railway

I find more of the Trix fans are endeavouring to make their railways as realistic as their "O" gauge colleagues, and gauge I contemporaries. Here is a photograph of part of the railway of R. Watson, of Burnley, showing the L.M.S. 4-4-0 complete with "painted in" smoke, crossing the bridge by-road into the village.

Despite the difficulties in obtaining Trix goods, there is still a limited quantity but there is no limit to the amount of scenic work that can be done by an owner to make his railway more attractive, until he is able to renew his interest in the extension of his line, in locomotive and rolling stock, and other peacetime developments, which will come with the cessation of hostilities.

The owner of the railway illustrated tells me of an interesting experiment which he carried out recently with good success.

An Interesing Conversi on

"Taking a 4-4-0 Compound," he said, "I dissembled the mechanism from the body. Next, I took off the cylinders and valve gear, leaving just the plain body. Next, I took off the motor, the two front driving wheels, which have no boss for the coupling rod screws. These were replaced by two bossed wheels from a spare motor, and straight coupling rods were made and attached to the four driving wheels. The whole unit was re-assembled and the engine ran beautifully, and if painted black, would approximate as near as possible to the "2P class." The only fault which the discriminating owner could see was a little too much space between top of bogie and engine footplate, but he considers a little higher bogie would cure this. Mr. Watson features the L.M.S. 4-4-0 Compound, of which he runs three, and considers it the finest value for money in the "OO" field to-day.

Model fireplace and mantelpiece; built to a scale of 1 *in. to* 1 *ft.*

Realism on a T.T.R. railway. Ingenuity and careful work will do as much for realism as anything you can buy with money. This is part of the model railway of Mr. Reginald Watson of Burnley

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 159 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.

Artificial Fire Extinguishers

I HAVE been told that when dealing with incendiary bombs, artificial fire extinguishers as used in cars should never be used, as these, when in contact with the incendiary bomb, generate the poisonous gas known as phosgene.

Could you please tell me whether this is so, and if it is correct, what is the reason for it? I would also like to know the composition and mode of action of an "oil bomb."—E. H. Magee (Bournemouth).

IT is perfectly true that the fire-extinguishing liquid, carbon tetrachloride, which is contained in some fire-extinguishers as used in cars, may evolve the poisonous gas, phosgene, in contact with hot surfaces, but this gas is seldom generated in quantity. Hence, the risk from phosgene poisoning is far less than the certainty of damage which will be caused by the fire if it is not quickly checked.

The reason underlying the generation of phosgene (carbonyl chloride) from carbon tetrachloride is purely a chemical one. When this liquid (carbon tetrachloride) is suddenly heated by contact with red-hot surfaces, a portion of its atoms rearrange themselves into a new configuration and they form molecules of carbonyl chloride (phosgene), abstracting oxygen atoms from the air. In a sense, the carbon tetrachloride (or, more accurately, a small part of it) "burns" to carbonyl chloride.

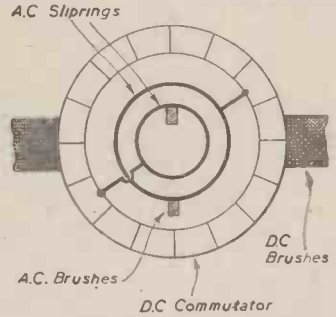
You need not be afraid of phosgene poisoning, however, as a result of the use of a carbon tetrachloride fire-extinguisher, but, to be absolutely on the safe side, it is always best to operate such an extinguisher from the open air if possible, or, at least, not in too confined a space, for, quite apart from any possible generation of phosgene, there will, of course, arise clouds of carbon tetrachloride vapour, which in itself is poisonous, to say nothing of being suffocating.

(2.) An "oil bomb" is merely a sort of strong steel drum containing highly inflammable petroleum liquids which are sprayed in a burning condition over an area as a result of the bursting of the drum caused by the detonation of a small charge of explosive in the drum. "Oil bombs" or "oil shells" were used in the last war, and there is nothing radically new about them, except that they are made on a larger scale in the present war.

A.C. from D.C. Generator

WILL you please inform me how I can convert my 6-volt D.C. generating set to A.C.? It has two self-energised field coils. Would these need an external exciter, or could the generator also energise them as in the present case?—E. Pestett (Grantham).

A DIRECT current 6-volt generator can be converted to deliver alternating current by adding two insulated slip-rings to the shaft with an additional pair of brushes, leaving the rest unaltered. On opposite segments of the present commutator connect two wires, one from each slip-ring in such a way that they do not interfere with the existing d.c. brushes. This can best be done by mounting the insulated slip-rings on the opposite end of the shaft if the design admits of sufficient room, and carrying the wire connections back from the commutator to the slip-rings along the slots in the armature. The generator will still work as a self-exciting dynamo if shunt wound, as the field current will be supplied from the ordinary commutator and brushes. On the slip-rings alternating current only will be available, at a voltage about 60 per cent. that of the d.c. voltage.



Converting a 6-volt generator to supply D.C. by adding slip-rings

Infra-red Camera

I WOULD be very grateful if you will give me the information required by the following queries:—

1. What material could be used on the mosaic screen of a television camera for use with infra-red rays? Where can I obtain it?

2. What transparent material could be used for the backing plate of the mosaic screen to permit of scanning from the rear? Where can I obtain it?

3. What is the best type of infra-red filter to use with an infra-red television camera, and where can I obtain one?

4. Is it necessary to use any special type of lenses for infra-red rays?

5. Where can I obtain about 2 ozs. of No. 48 or 47 enamelled copper wire?—L. A. Lee (Southsea).

1. Caesium on Silver is a suitable screen for infra-red cameras. Caesium is obtainable at British Drug Houses Ltd. Its preparation and application is an extremely difficult operation and requires apparatus and experience.

2. Transparent to what? Light or electrons? A rear-scanned mosaic would have to be a built-up affair of many thousands of conducting links between front and rear surfaces, all insulated from each other.

3. Wratten Infra-red Filter, from Kodak Ltd.

4. No, provided a filter is used.

5. We suggest Leslie Dixon & Co.

Thermo Couples

CAN you inform me what pair of metals or alloys would constitute the most satisfactory electric couple under the action of infra-red rays. I wish to construct a sensitive galvanometer; could you give me any suggestions regarding this with particular reference to size of coil, number of turns and gauge of wire?—F. H. Shawcroft (Southport).

THE four types of thermo-couples usually employed in pyrometry consist of (1) Chromel-Alumel, (2) Chromel-Constantan, (3) Iron-Constantan, and (4) Platinum and Platinum-Rhodium, the latter for high temperatures. These pairs will give approximately the following equivalents in millivolts per 100 deg. C.:—Chromel-Alumel—4.1 m/v. Chromel-Constantan—6.3 m/v. Iron-Constantan—5.25 m/v. Platinum v. Pt-Rhodium—0.64 m/v. Even with the most sensitive of the above couples it would require an exceedingly sensitive galvanometer to detect the presence of infra-red rays, and a reflecting mirror type galvanometer would probably be necessary, such as described and illustrated in Thompson's "Elementary Lessons in Electricity and Magnetism," pp. 202-205. It is scarcely an instrument for amateur construction. Thermo-couples with fused wire joints are obtainable from The Foster Instrument Co. Ltd., Letchworth, Herts.

Freezing Process

CAN you give me some information as to the process of freezing with compressed air and ammonia?

1. What kind of cylinder do I require to contain the ammonia?

2. What air pressure is required?

3. What kind of solution is suitable for cooling?

4. Also the strength of the ammonia?—K. A. Varey (York).

WE think that you have been misinformed, for there exists no direct mode of freezing by means of compressed air and ammonia. A number of mechanical refrigeration plants operate by virtue of the continuous forced evaporation of liquid ammonia and by its

subsequent automatic compression, but this is a very different thing from "freezing with compressed air and ammonia."

For this reason, it is, therefore, not possible for us to reply to the specific questions which you put. We feel that before proceeding further in the matter, you should peruse one or two reliable books on the subject of mechanical refrigeration. These will give you a clear notion of the entire subject, and, from them, you will see that it is a very difficult matter (particularly in these days) for an amateur to build for himself a really satisfactory refrigeration plant.

Books suitable for your needs would be:—

A. M. Green: Elements of Refrigeration.
F. E. Matthews: Elementary Mechanical Refrigeration.
H. B. Hull: Household Refrigeration.
J. A. Ewing: The Mechanical Production of Cold.

These books are expensive, but you will probably be able to find some of them in your nearest County Libraty at York. If not, the Librarian will be able to obtain them for you.

You may also be able to purchase second hand copies from a firm of booksellers such as Messrs. W. & G. Foyle, Ltd., Charing Cross Road, London, W.C.2.

Liquid Hydrogen

CAN you please give me information on the following subjects:

1. How is liquid hydrogen and oxygen stored?

2. From whom can the same be obtained, and what is the price?

3. How can the velocity of a steam jet in a turbine be found, knowing the pressure in the boiler?

LIQUID hydrogen and oxygen can only be stored indefinitely by retaining them at their low temperatures by surrounding them with similar liquified gases. Actually, these liquified gases are never stored for any length of time. Liquid oxygen, for instance, is usually stored and handled in double-walled glass flasks, the space between the glass walls being evacuated on the principle of the "thermos" flask. Indeed, it was for this purpose of keeping liquid cold that the thermos flask principle was invented by the scientist, Dewar. Stored in such flasks, liquid oxygen can often be kept for nearly a week at ordinary room temperatures and at normal atmospheric pressure. Liquid hydrogen is similarly handled in like containers, but, owing to its extraordinary low temperature, it is difficult to retain it in the liquid state for long.

2. Liquid oxygen (and, also, liquid air) can be obtained to order from your nearest branch of The British Oxygen Company, Ltd., Wembley. The pre-war price of these liquids was about 6s. per quart. Special containers can be hired at a small fee. It is possible to send liquid air by passenger train. No doubt the above-mentioned firm will be pleased to give you full particulars of its service in this respect.

Liquid hydrogen is not commercially obtainable.

3. It is impossible to calculate the velocity of a turbine steam jet from the details you supply. You must also know the cross-sectional area of the jet orifice, the temperature of the steam at the jet, together with its jet pressure.

Making Vinegar

CAN you please tell me how to make vinegar for the table, pickling, etc., from pure acetic acid?—F. Crisp (Normanby).

ALTHOUGH genuine vinegar is merely a dilute solution of acetic acid (containing from 5-8 per cent. of acetic acid) together with natural colouring matter and traces of other fermentative substances, no good grade vinegar is ever produced simply by diluting pure acetic acid to the requisite strength.

However, if you wish to make a *substitute* vinegar you may do so by adding 5 or 6 parts of glacial acetic acid to 93 or 94 parts of distilled water. To this liquid must be added sufficient "liquid caramel" (i.e., burnt sugar) to impart to the liquid a desirable brown colour. A trace of black pepper and, also, ginger, will improve the flavour of this substitute or artificial vinegar, but it is quite impossible to impart to it the full flavour of the genuine fermented article.

"KULOBONS"

Dominoes without Spots

THIS recently patented new game is a revolutionary improvement upon the standard and exceedingly popular old one. The central feature of the game of Dominoes has always been the distinctive dots or pips, but in Kulobons the pips are eliminated, and their place taken by various *colours*—thus, for example, the dangerous six is represented by red, the three by yellow, the four by blue, and so on.

Colour being its main feature, this new game has many advantages—it makes the game possible for those with failing sight, and it can be played with accuracy in poor light, e.g., in shelters, wardens' posts, camps, etc.

The generous use of colour transports it from the cold zone of black and white (of ordinary Dominoes) into a new region of warmth and colour.

OUR ADVICE BUREAU **COUPON**

This coupon is available until February 28th, 1942, and must be attached to all letters containing queries, together with 3 penny stamps. A stamped addressed envelope must also be enclosed.

PRACTICAL MECHANICS, February 1942.

THE Cyclist
Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

Traffic Signs

FROM their inception we have been opposed to automatic traffic lights except at multi-road junctions. It has been our view that traffic lights have been a prolific cause of accidents, in that they cause traffic to conglomerate and to pack the roads instead of keeping it free-flowing. They act as dams and there can be little wonder that the traffic stream overflows its banks when such dams are erected every hundred yards or so along busy thoroughfares. They cause traffic to proceed in chunks, and leave little room for cyclists or pedestrians. They have reduced the speed of traffic in London to an average of about seven miles an hour according to official statistics. Erected in the name of road safety and as part of an effort to reduce the number of accidents, they have contributed something less than nothing to that cause. On the other hand they have increased transport costs, caused delays, and packed police courts. One of the peculiar reasons given in support of their erection was that it would release the police for other duties and it was said that there was insufficient police to control the evergrowing volume of traffic.

It is, therefore, somewhat strange to see so many police in London walking about in pairs inspecting motor cars. In some cases two of them will wait beside a parked car for an hour or more until the driver returns. This, of course, ensures a case, and a comfortable morning or afternoon in court for the officer.

Automatic Control of Lights

IT is not an uncommon occurrence for two streams of traffic proceeding in opposite directions to be held up for several minutes at a junction for no other purpose than that the lights are red. Traffic on such occasions is not proceeding at right-angles to the traffic brought to a stop. The automatic control of these lights by the traffic itself is a failure. Such signs are quite insensible to the needs of the moment, and in these days of shortage of metal they should be sent the same way as the Belisha Beacons. They should be uprooted and put in the melting pot to make munitions. Both are a relic of a Minister of Transport who signally failed in his object to reduce road accidents. It is true that such experiments must be tried, but there is no need to continue with them when they have been proved costly failures. There is no evidence that they have saved any money for the expenditure on the Police Force has steadily risen since they were introduced. If it is necessary to have a policeman waiting near traffic signs for motorists to pass the Red, that policeman would be far better employed directing the traffic, for it is unlikely that motorists will pass the arm of a policeman. If the lights are erected in the interests of safety and are ignored (and the large number of prosecutions for traffic light offences indicate that most road users ignore them when it is safe to do so) they are a failure. A policeman's arm under such circumstances contributes more to road safety than an electric light. We admit that there are some hundreds of instances where traffic lights can safely be ignored. There are several erected apparently for the use of pedestrians—not at road junctions, but on some straight stretch of road without a turning. Traffic is held up for some minutes until the Green light reappears, even though no one is crossing at that particular point. A good example of this exists along the Chiswick High Road, approaching the junction with the Great West Road, but there are many others. We have every sympathy with road users who pass such Red lights, when it is quite apparent that there are no foot passengers waiting to cross. Indeed, it would be wise, if such lights are not removed, to permit motorists to pass the Red if pedestrians are not waiting to cross. In days when we are being urged to keep at it, and stick to it, when every minute wasted at our desks or our benches costs lives, we should remove all devices which waste public time, and are merely traps to swell the coffers of the police court. They are additional revenue raisers. However, it is interesting now to observe that our voice no longer cries out in the wilderness. We have severely criticised our traffic light system for a number of years, in print and in speeches.

Now our call is being taken up in other quarters, we are glad to note. What we think to-day, others think some months later !

The Rule of the Rude

WE welcome the gesture mutually made by the Royal Automobile Club and the National Cyclists' Union in issuing joint appeals to the road users they respectively represent. Their most recent joint appeal concerns lighting. Cyclists are urged to comply with the law and to see that their head and rear lights are switched on during all periods of blackout, and motorists are to see that their headlamps do not dazzle. In the past, cyclists and motorists have been accustomed to regard themselves as natural enemies. No doubt this has been sponsored by the attitude of the organisations themselves. We are glad to see that cyclists and motorists are co-operating in this way. No doubt this is due to the enthusiasm of the Secretary of the National Cyclists' Union, Mr. A. P. Chamberlin, who since he took over the job has worked untiringly and successfully for the interests of cyclists. We understand that the membership of the N.C.U. has increased enormously as a result of his energetic recruiting campaign.

We hope that the present policy will be continued in the post-war period and thus end a situation which has militated against the interests of motorists and cyclists, and prevented meetings of an exploratory nature.

The New Season

WITHIN a few weeks the Racing Season will open, and now that various date-fixing conferences have taken place, it is apparent that the calendar will not be so full as it was last year. This is to be expected, for the ranks of cyclists under recent call-ups and de-reservation, have still further depleted their ranks. Naturally, the fit go first, and so it is fair to assume that times this year will be slower.

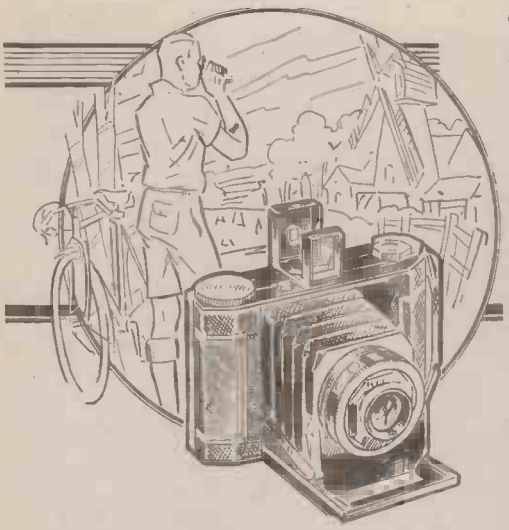
There are many of the older men associated with clubs and who now occupy positions as Presidents or Vice-presidents, who firmly believe that all road racing should be cancelled for the duration of the war. We have discussed this matter with those associated with many prominent clubs, and whilst we cannot say that we have taken, to use modern parlance, a "cross section of the movement," we have been astonished at the number who have supported this view. Apparently, however, they do not preponderate in their own clubs, or at least, they have not been able to sway their annual general meetings. If road sport is to be abandoned, we think the lead should come from the Government itself. The fact that the Government has not seen fit to take this lead at present suggests that they are in favour of its continuance.

Trade Assistance

THE suggestion has been made that we should drop the style of strict amateurism and allow riders to be trade assisted so that they can compete on equal terms with the amateur more fortunately possessed of this world's goods. We must admit that a sport need not necessarily be unclean because riders receive cash instead of pots or goods suitable for engraving. A man who receives a reward whether in cash or kind is just as much an amateur as one who does not receive such reward. A professional can be simply defined as one who earns his living from the sport and who is occupied for the greater part of his time so earning his living.

If we are genuinely interested in the sport and its continuance, we should encourage the young man of promise who cannot afford the equipment and the spares necessary for training and an intensive season of competitive sport; nor must we blind ourselves to the fact that there are many well-known amateurs to-day who receive tyres, saddles, chains, etc., "free of charge," but who are not denied their amateur status. The sooner those responsible for controlling cycle sport drop their long-continued attitude of suspicion towards the trade, the better. If they are so genuinely interested in maintaining strict amateur status, they might usefully investigate, and we think with somewhat surprising results, some of the complaints which have been made against certain riders who have been consistently accused of shamateurism. Some of those prominently associated with the sport will hold up their hands in horror at the mere suggestion that any amateur rider has received some cycle accessory free of charge, but they are not sincere in their expression of horror. They all know that it takes place, and most of them know the guilty parties.

We see no reason why, under certain conditions, amateur riders should not receive trade support, as they do in other spheres of sport. There needs to be a new definition of what constitutes an amateur. We all know what constitutes a professional. Somewhere midway between the present definitions should be found an amateur status which would be agreeable to all the parties concerned.



Domestic Cycling Club

REGARDED at first as a venture hardly likely to prosper, the Domestic Cycling Club—for maids and menservant's—has gone from strength to strength, and has now a flourishing membership.

Club Records Broken

K. J. LEE, Oak C.C., has broken club records at 10, 25 and 30 miles and, in company with N. Edis, broke the club's 30-mile tandem record.

Club 30-mile Record

V. A. GIBBONS, Brentwood Road Club star, holder of club records at 25, 50, 100 miles and 12-hours, closed his season by taking the club's 30-mile record with 1.16.49.

Death of Young Rider

AN enthusiastic and promising rider, Ken Farley, 18-year-old member of Redditch Road and Path Club died after a short illness.

Well-Known Clubmen in Forces

A. C. HOBBS and F. W. Pearce, two keen racing members of the Brentwood Road Club, have been called up in the Army and Tank Corps respectively

More N.C.U. Enrollers Wanted

MANY members of the N.C.U. have passed the 25-badge of merit mark, while quite a number of them have attained the fiftieth. The Union appeals for more club-folk to act as enrollers under the Associate Scheme.

Club Champion a Prisoner

SGT. PILOT J. MORGAN, former club champion of the Steelopolis C.C., is a prisoner of war in Germany.

Clubmen in the Services

BRYAN ERLEBACH, Southgate C.C., is a Sub-Lt. in the R.N.V.R., and three other members, Eddie Moll R. W. Steel and E. G. Thomas are training as pilots.

Three popular members of West Kent C.C., S. G. Lynes, J. Rowden and I. Silliprandi, are among the latest members of that club to join the Forces.

Shortly after riding in one of the last important open road events of the season (the Comet C.C. "25"), P. F. Fairweather, Goodmayes C.C., signed up with the R.A.F.

Albert Watson, famed Edinburgh crack tricyclist is serving with a Balloon Barrage Unit.

Veteran Timekeeper Keeping Fit

G. R. HERD, the noted Scottish timekeeper, keeps fit in retirement by consistent cycling. He often visits Langhaugh Hostel where he is always certain of congenial company.

Road Time-Trial Hold-up

ONE of the few road time-trials to be seriously interfered with towards the close of the season by Home Guard exercises was in the Liverpool area. All traffic was held up over a wide area.

Club's Prize Distribution

OVER 200 members and friends attended the University C.C. prize distribution, one of the first of the season, when vice-president Albert Richards presided.

Fifty Miles a Day at 84

MR. A. U. COLLEYPRIEST, who claims to have completed 70 years of cycling at the age of 84, is stated to still be capable of fifty miles in a day!

Club Sec. Joins R.A.F.

ALTHOUGH in his 40th year, Arthur Cook, secretary of the East London R.T.T.C., and hard worker for the Eastern Counties Cycling Association, and the Comet C.C., has volunteered—and been accepted—for service in the R.A.F.

Clubman Dies on Active Service

THE death is announced on active service of Sgt. Pilot William Booth, who, as a time-trialist, won numerous awards with the Pyramid C.C. He was also a committee member of his club.

Clyde Clubman in Russia

BESIDES having many members serving with the Forces in all parts of the Empire, Clyde C.C. now have one with the R.A.F. in Russia.

B.B.C. Man to Attend Club's Dance

RAYMOND GLENDINNING, famed B.B.C. commentator, has accepted an invitation to attend the dance of the North Midds. and Herts. Cycling Association, at which the season's awards will be distributed.

Time-Trial Sec. as Sergeant-Pilot

JACK KEEN, former time-trial sec. of the Finsbury Park C.C., has completed his training in Canada as a Sergeant Pilot, and is now back in this country.

Southport R.C.'s Woman Secretary

VERA DUFOUR, wife of the hon. secretary of Southport Road Club, is carrying on with the club secretarial work until her husband returns from military service.

Paragrams

Star Rider in R.A.

B. V. WEEKS, star rider of the Clyde C.C., who has had one of the most successful London short-marker seasons in which he won many road time-trials, including the Comet C.C., is now with the Royal Artillery.

R.A.F. Cycling Club

THE R.A.F. Hereford C.C., one of the first to be formed in the R.A.F., has nearly 80 members, all of whom are keen riders and tourists. Week-end leave is usually spent at Youth Hostels.

Girl Rider Breaks Club's Record

MISS ALICE SHERIFF, Skipton C.C., has broken her club's Skipton-York-Skipton record with a creditable time of 4 hrs. 46 mins. for the 88 miles. The record has stood for two years and defied attempts on it by mere males

North Road Clubman Marries

ERIC POVEY, massed-start expert of the Marlborough C.C., and member of the North Road C.C., who is serving in the Royal Navy, was married while home on leave to Miss Esme Hewis.

Another Rider Killed in Action

W BOOTH, a member of the Pyramid, who was a Sgt.-Pilot in the R.A.F., has been killed in action.

Crack Tricyclist Weds

GEORGE LAWRIE, crack tricyclist and holder of the 1,000 mile and London-Bath-London tricycle records, has married Miss W. McNeill. Lawrie, is a member of the Viking Road Club, and also time-trials sec. of the Tricycle Association.

Scottish Rider's Ordeal

PAT McCABE, Glasgow Wheelers, and a track rider of repute, now serving with the Merchant Navy, was one of five survivors who reached Canada, after days in an open boat, following the torpedoing of the ship miles from land.

"Early Birds" in Forces

MEMBERS of the Early Birds C.C. serving with H.M. Forces include Phil Wears, an R.A.F pilot in the Far East, Eddie Laidler, with H.M. Submarines and Barney McGill, who is with the Army overseas.

Club Rider a Marine Engineer

ERIC FLYNN, East Liverpool Wheelers, has not been home for over two years but, as a sea-going Engineer, has seen much of the world and experienced thrilling adventures.

Doncaster Club's Monthly Run

DONCASTER Wheelers have hit upon the bright idea, which other clubs might follow, of "starring" one run per month in their fixture list for support from less active riders. The scheme is a great success.

Woman Caterer Retires

AFTER catering for cyclists—and racing men in particular—for the past thirty years, Mrs. Wood, Siddington Bank Farm, in the Manchester area, is retiring.

T.T. Rider in R.A.F

DONALD MORRISON, Glasgow Wheelers, "King of the Mountain" in the 1939 Bicycle T.T. in the Isle of Man, is a sergeant in the R.A.F.

Scottish Club's Champion

AYR Roads C.C. champion is John Smith, with David Wilson as runner-up.

Young Rider's Success

WYNN CUNION, 20-year-old time-trials secretary of the Coventry C.C., is club champion in his first year of racing. He is also the third best all-rounder in the Birmingham Time Trials League.

Open Road T.T. for 1942

TWENTY-SIX open road time-trials are scheduled for 1942 in the East London area.

Club's Annual Prize Giving

WHEN Crouch Hill Cycling Club held its 61st annual prize distribution, a silver salver, suitably engraved, was presented to Mr. H. G. Hayward, life president, in recognition of his attaining fifty years' unbroken membership.

George Olley at Club Dinner

GEORGE OLLEY, famous record-breaker and holder of the End-to-End record over thirty years ago, was accompanied by his son, a Sergeant Pilot in the R.A.F., when he presided at the annual dinner of the Southampton Wheelers.

Retford Club Disbanding

RETFORD Broadstone C.C., never a large club, have decided to disband for duration, as most of their members are with H.M. Forces.

Cyclist Survivors from Ark Royal

PETTY Officer Jack Milton and Stoker Alec Saunders, members of the Hitchin Nomads C.C., were among the survivors from the Ark Royal. They have since made an appearance on club runs.

Club Champion in Indian Army

G. E. THOMAS, reigning champion of Southgate C.C., and former best-all-round tricyclist of the country, is now a Second Lt. in the Indian Army.

Bath Rider's Wedding

A. G. L. SARGEANT, Bath C.C, has married Miss Nancy Wilson, an N.C.U. member.

Young Rider Wins Championship

CYRIL CUMMINGS, 17-year-old Londoner, has won the 1941 championship of the Clarion C.C., with an average of 21.466 for 25. 50 and 100 miles.

Fast Novice

THE fastest Clarion C.C. novice of the year is E. E. Cleveland, another Londoner, whose average for the same distances was 21.041.

Club's Membership of 100

BROAD Oak C.C. is one of the few clubs whose membership totals 100.

1942 Cummock Rally

THE 1942 Cummock Rally has been fixed for the last week-end in June.

Star Rider as P.T. Instructor

M. G. RICHARDSON, the Galena star rider, is now a physical training instructor in the R.A.F.

Club Members in Forces

OVER 40 members of the Wisbech Wheelers are now serving with H.M. Forces.

N.C.U. Enroller Wins Badge

CHARLES JONES, Birmingham Centre, N.C.U., is the first Associate Enroller in the Birmingham Centre to win the Badge of Merit under the N.C.U. scheme. He has enrolled over 50 members.

Antrim C.C.

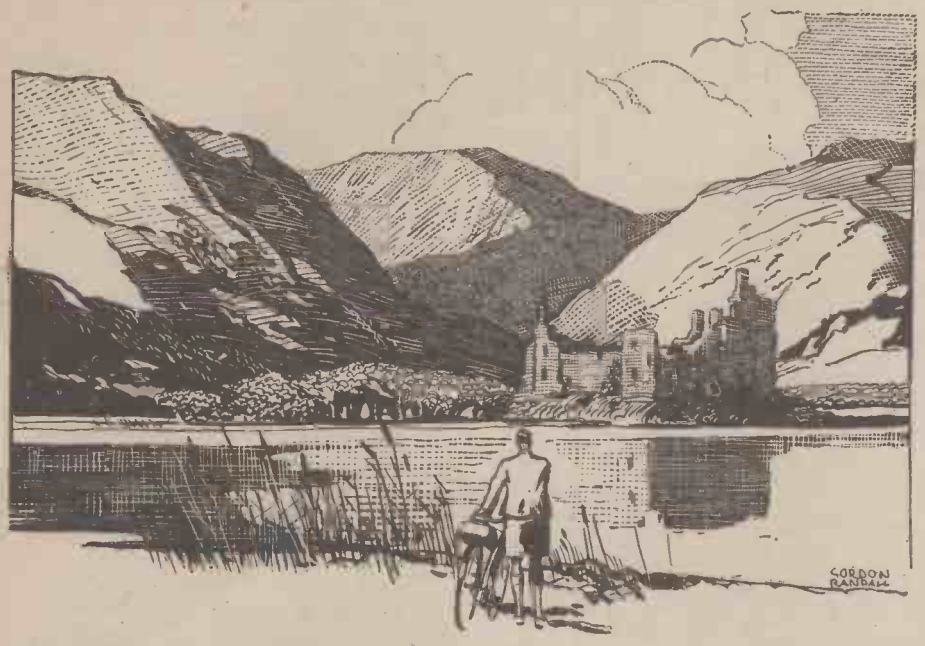
THE Antrim C.C. is the name of a new cycling club formed in Northern Ireland.

Crack Tandemists in Army

C. MELHUISH and H. Chapman, the crack tandemists, are both in the Army. They are still together!

Brighton Club's 37th Birthday

BRIGHTON Mitre C.C. is celebrating its 37th birthday. Sixty of its members are serving with H.M. Forces.



Quietude at Loch Arne—in Scotland

Around the Wheelworld

By ICARUS

The Railway was First

THE first real development in connection with the bicycle was when Kirkpatrick MacMillan, in 1839, produced his rear-driven bone shaker. Two-wheelers prior to that time had merely been glorified Velocipedes. It seemed an obvious thing to apply some form of drive to the rear wheel, and yet the hobby-horse had been in existence for several decades before MacMillan conceived the idea of propelling it mechanically. Looking back on this important fact it is remarkable that it had not been done before. There was no lack of inventive genius at the time, for we must remember that Stevenson had invented the Rocket and that the first railway—the Darlington to Stockton—had been opened with Stevenson as Chairman in 1825, fourteen years before MacMillan's idea for a rear driver. The public evidently did not take any more kindly to the railway than it did to the bicycle or the motor car in the early stages.

For example, this is what John Ruskin wrote in "The Seven Lamps of Architecture," which was published in 1855:

"Another of the strange and evil tendencies of the present day is the decoration of the railroad station. Now, if there be any place in the world in which people are deprived of that portion of temper and discretion which are necessary to the contemplation of beauty, it is there. It is the very temple of discomfort, and the only charity that the builder can extend to us is to show us plainly as may be how soonest to escape from it. The whole system of railroad travelling is addressed to people being in a hurry, and therefore for the time being miserable. No one would travel in that manner who could help it—who had time to go leisurely over hills, and between hedges, instead of through tunnels and between banks; at least, those who would have no sense of duty so acute as that we need consult it at the station. The railroad is in all its relations a matter of earnest business to be got through with as soon as possible. It transmutes a man from a traveller into a living parcel; for the time he has parted with the nobler characteristics of his humanity for the sake of a planetary power of locomotion. Do not ask him to admire anything; you might as well ask the wind. Carry him safely, dismiss him soon: he will thank you for nothing else. All attempts to please him in any other way are mere mockery, and insults to the things by which you endeavour to do so. There never was more flagrant nor impertinent folly than the smallest portion of ornament in anything concerned with railroads or near them. Keep them out of the way, take them through the ugliest country you can find, confess them the miserable things they are, and spend nothing upon them but for safety and speed.

Give large salaries to efficient servants, large prices to goods manufacturers, large wages to able workmen; let the iron be tough and the brickwork solid, and the carriages strong."

Progress has always been opposed in this way, but the above paragraph according to some critics is most appropriate to-day as applied to motorists and motoring. Whether we like motorists or not, we must square up to the fact that the motor car is here to stay. Opposition to motoring merely because it *is* motoring defeats the object. I fear that there are many whose minds still live in the past and oppose changes and progress merely because their minds cannot accustom themselves to changing conditions.

Joint Appeal

HOWEVER, there are signs that the old animosity between motorists and cyclists is going. For whereas formerly it was customary when accidents were discussed for cyclists to blame motorists and *vice versa*, there is now a tendency for each to see the other's point of view. For example, a joint appeal is made by the R.A.C. and the National Cyclists' Union to car owners and cyclists to adhere faithfully to the lighting regulations. Cyclists are urged to light up both their front and rear lamps at all times during the blackout. The law, of course, insists that they should do so, but as the N.C.U. and R.A.C. point out, there is a tendency amongst some cyclists who have a short journey to make in the morning when it is still dark, or in the evening when it is just growing dark, not to trouble to put their lights on. Car owners are asked to see that their headlamps are properly adjusted. Not all of them are complying with the law.

Coupons and Capes

THE following new coupon values are now operating in connection with cycling clothing. An unlined cycle cape of single texture requires six coupons for a man's cape, and six for a woman's (nine were formerly required), four for a child's; a lined cycling cape or one of double texture requires ten coupons (formerly 16) for a man's, and ten for a woman's (formerly 15), and six for a child's; woollen lined breeches or trousers require eleven coupons (formerly eight), and eight for a child's; non-woollen but lined breeches or trousers remain unchanged for eight coupons for man or woman, six for a child's; lined woollen shorts and non-woollen lined shorts require six coupons and five coupons each respectively for man or woman, and four and three respectively for a child. Those who only have five-and-ten coupon vouchers may, should their purchase not require the full number of coupons shown on the unit, receive back loose coupons from the trader.

Cycle Tyres

CYCLE tyres are exempt from the recent Order which made it illegal for any person before February 13th to acquire or dispose of any new rubber tyre except cycle, motor cycle, side-car, or motorised bicycle tyres, etc.

Mounting a Bicycle

I WAS interested to listen to the Brains Trust's exposition of the reason why cyclists mount their bicycles from the left or nearside. They gave as the reason the fact that we are compelled in this country to ride on the left-hand side of the road, and cyclists, therefore, naturally interpose their bicycle between themselves and danger! They said that abroad, where the rule of the road was reversed, that is to say, the traffic drove on the right-hand side, cyclists mounted from the right or offside of the machine. That may be so, but it seems to be a perfectly natural thing, rather an instinctive movement, to mount the bicycle from the left-hand side. It is more difficult to mount from the right-hand side, whatever the rule of the road. It was an interesting answer, however, to the question, but up to the moment I have not been very well satisfied with some of the answers given by the Brains Trust. Perhaps it should be termed the "Brine" Trust, because it is necessary to take a large grain of salt with some of their facetious remarks.

Hill Climbs

I SEE that a correspondent in a contemporary suggests that a new form of hill climb should be arranged. Someone it is said should find an "unclimable gradient," the winner of such hill climb should be the one who most nearly approaches the top. It was seriously suggested that some years ago when a similar suggestion was promoted, an attempt was made to find an unclimbable gradient, but that Maurice G. Selbach was unable to find such a gradient, and that he was easily able to climb by use of a suitable gear any of the hills suggested.

Quite frankly, I find it difficult to swallow this statement. I am prepared to guarantee that none of the moguls of cycling sport could climb Beggar's Roost, or Blue Hills Mine on a bicycle, irrespective of the gear they use.

And whilst we are talking of hill climbing contests, why not a hill descending contest? Why should riders not be started from the top of a very steep hill and told to bring their machines to a standstill at some point halfway down it to test the brakes? And why should they not be started from the top of hill to see how many can descend to the bottom without falling off?

Cyclists' Pilgrimage No. 2

There is little doubt that the first man to fit pedals to a bicycle was Kirkpatrick MacMillan, a blacksmith of Courthill, Keir, Dumfriesshire, round about 1840. MacMillan drove his rear wheel by cranks and swinging levers, and steered his front wheel by direct sloping forks. No doubt the method of propulsion was to start by the old hobby-horse method of striking each foot in turn on the ground. MacMillan paid the penalty which inevitably attaches to the pioneer. In the course of his experiments he mounted the footpath, thereby knocking down a child, and was fined 5/- at Gorbals Police Court, Glasgow, on June 8th, 1842.

THE BIRTHPLACE OF THE DUNLOP TYRE . . .

The plaque marks the house at 26 May Street, Belfast, where in 1887-8 John Boyd DUNLOP carried out the experiments which led to his epoch-making invention of the first practicable pneumatic tyre, thereby revolutionising road mechanical transport.

IH/320

The Marquis of Queensbury and C. A. Smith on a tandem in the 'nineties.

More About Bicycle Transmission

By C. A. (Bath Road) SMITH

IN my article, "Wanted — Better Bicycle Transmission," which appeared in *Practical Mechanics* for September last year, I referred to B.S.I. Now it is amusing to be able to state that I have received some enquiries as to what these capital letters stand for! British Standard Institution has a standard specification for "Steel Roller Chains and Chain Wheels." Let me tell you a bit more about B.S.I. It was formed in 1901 as the Engineering Standards Committee and incorporated in 1918 as the British Engineering Standards Association. This specification on Chains and Chain Wheels was prepared under the supervision of the Mechanical Industry Commission, consisting of representatives from the Admiralty, Crown Agents for the Colonies, Ministry of Transport, Office of Works, War Office, Institution of Automobile Engineers, Railway Companies of Great Britain, British Cycle and Motor Cycle Manufacturers and Traders Union, Makers of Roller Chains, etc. This specification having been approved by the Mechanical Industrial Commission, and endorsed by the Chairman of the Engineering Divisional Council was published by the authority of the General Council as a British Standard on 16th April, 1934. Now I must explain that the B.S.I. is carried on by means of grants received from the Government, Professional Institutions, and Industrial and Trade Organisations, as well as by the sale of its publications. The amount derived from these sources is however not sufficient, so the Institution has to look to industry as a whole for the further funds necessary to enable it to meet the increasing demands upon its organisation. Membership of the Institution is open to British subjects, companies, technical and trade associations, and local and public authorities. The Institution is not a profit-making concern—its only expenses being staff salaries, office expenses and printing. By the way, the publications department address is 28 Victoria Street, S.W.1.

B.S.I. sets it out that British Standard Steel Roller Chains and Chain-wheels shall comply with the requirements and dimensions laid down in the specification. The chains shall be of two types, short pitch and long pitch. All chains shall be measured in their finished condition ready for use before oiling. Elaborate tables are given showing the breaking loads for roller chains and the dimensions for chain-wheel teeth. The metric equivalents are given in a separate table. A page of manufacturing information for British Standard Chain-wheels, cutting sizes and tolerances, sets out very clearly the pitch diameter, measurements over pins, etc.

B.S.I. Booklet

Every cycle manufacturer should get a copy of this interesting little book from B.S.I. The price is 2s. 2d., post free. It is to be hoped that in the contract of the future, when large orders for cycles are being given, a clause be inserted in the contract stating that chains and chain-wheels shall conform to B.S.I. specifications, otherwise the contract is cancelled. The Post Office, for instance, gives orders for thousands of cycles every year—the officials therein should note the facts I have given out in these columns and insist on B.S.I. specifications. Hundreds of pounds would be saved, as hundreds of chain-wheels are scrapped, simply because many manufacturers are ignorant of Renold tooth form.

I again point out that the cycle trade years ago adopted Renold's tooth form as the best. The B.S.I. says so, too! Surely the cycle manufacturers who support the B.S.I. will wake up and insist upon their chain-wheels being turned out in conformity with B.S.I. recommendations? If not, why not? A chain-wheel producer recently wrote me: "We do not usually cut our chain-wheels to Renolds form, *which is unsuitable for bicycle work!*" Stampings and notched chain-wheels must go if the cycle manufacturers wish to put an end to all the gear troubles, which at the present moment disturb the cycle repairer's trade, and cause such a lot of worry to the cyclist. He, poor fellow, blames the chain, which we all know is turned out with such care and skill. Surely the directors of the cycle companies and the managers of the concerns will wake up and see that they get chain-wheels built up as per the B.S.I. specifications. They cannot continue building cycles and fitting gears which ignore engineering methods. Perhaps the contracts for 1942 are already made. But it is possible to amend them now. Anyhow, these facts can be dealt with in time for 1943, unless the trade decide to ignore the B.S.I. ruling! It is to be hoped that they will not, as the B.S.I. is their own creation. It is refreshing to remember that manufacturers of free-wheel sprockets like Messrs. Cross & Co., the Villiers Engineering Co.; and many others, follow the B.S.I. ruling, and let us hope, since the cycle manufacturers cannot supply their own gear-wheels that they will insist upon the chain-wheel suppliers adopting B.S.I. specifications.

No reference in this booklet is made by the B.S.I. to the quality of the steel to be used for cutting the chain-wheels, and a P.S. in the next edition might be useful. Certainly the trade has had enough of the inferior stuff in use to-day. Tool steel, chromium, what you will, but let us have something which will stand hard work, and have correct teeth.

Stamper Gears

I have already pointed out that it is the gear which is wrong with the present-day cycle. This gear, i.e., the sprocket and the gear-wheel, is an engineering job. Neither should be stamped or notched out. They should be "cut" with gear-cutters. At present I don't suppose there are half-a-dozen cycle manufacturers cutting their teeth. They don't even attempt the job! It is so easy to buy something which one can call a chain-wheel! And look how cheap it will be. So the manager of the works says to himself, Won't the directors be pleased. But this manager forgets that imperfect gears have to be replaced, and that his company has to pay out money for these replacements. The owner of the cycle has to pay for this the same as the manufacturer, and the gear supplier says to himself, This really is good business! B.S.I. stuff would never do any trade if I followed their advice!

So let us hope that the manufacturers will wake up and recognise that it is in their own interests that they should provide correctly cut gear-wheels and sprockets. These will wear longer—make cycle riding a pleasure instead of a "grind," the chain will last longer (unfortunately, nothing yet has been invented to stop them from stretching), and the manufacturers will be able to congratulate themselves on following the advice of their own B.S.I.

The Humber Trike

Tale of a Trike and a Tandem

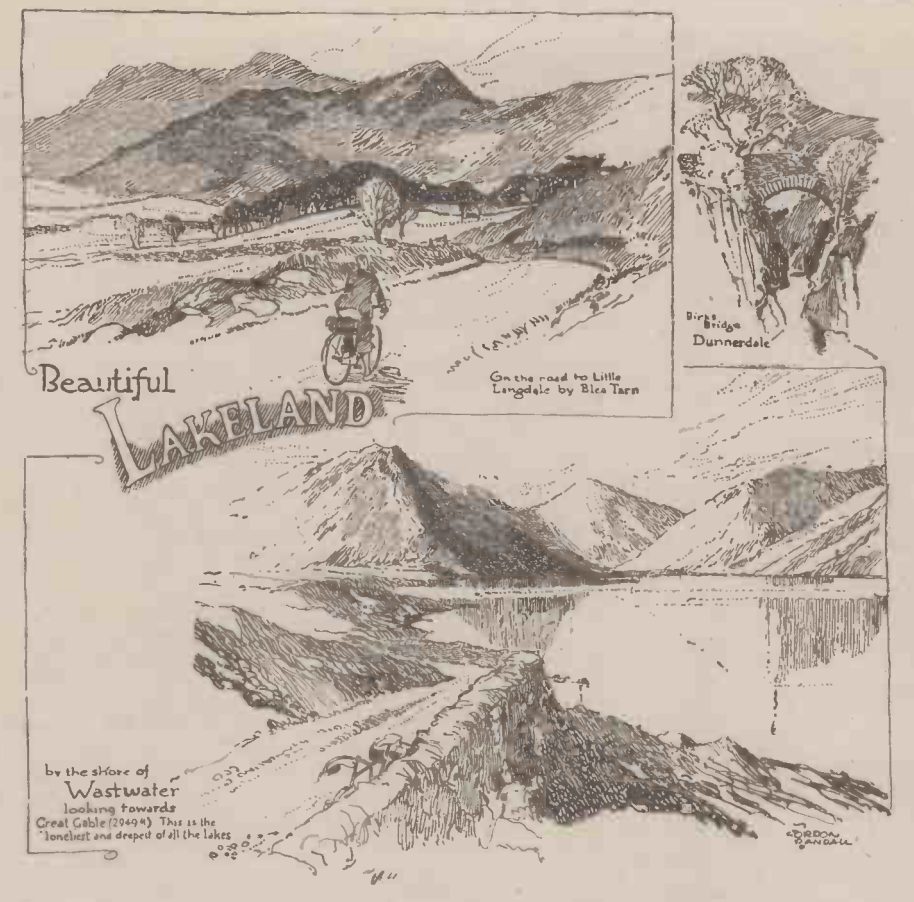
REVERTING once more to the Beeston Humber tricycle I possessed, I remember that it had a spoon brake on the front wheel. An unsatisfactory makeshift! In the first place, it wasn't strong enough, and it caused an unnecessary strain on the head and front forks. In October 1899, R. U. Trevor (Editor of the *Bath Road News* at the time) borrowed my tricycle to go for the Bath-and-back tricycle record. Motor pacing had not been forbidden at that period, so S. F. Edge, M. S. Napier, and myself on a motor quad rendered what assistance we could in the shape of pacing, but I am afraid my quad wasn't half fast enough for the trikist, and I have the recollection that he waved goodbye when nearing Hounslow!

I expect Edge and Napier on their cars took him along fast enough, but coming back Trevor fortunately saw in time that the front forks were parting, so he hopped off quick and saved the crash! Martin D. Rucker was managing director of Humber Ltd. at the time, and he was living then at Woodlands, close to the Cobhams. He was not pleased when he heard from me what had happened. The head and forks were replaced, but some years after I had A. & P.s fitted to my three cycles. And these have stood up well up to now.

I found the trike most useful during winter time when the roads were covered with slimy grease which was most dangerous to the "safety" bicycle.

And in the snow, well, you got along on the three-wheeler, which you cannot do on the other machine. I can assure you that the trike is an ideal touring instrument, for one can carry heaps of things on the machine, which one can't find room for on a bike. The only snag is a head-wind. That does seem to delay one. But still, with a low gear (mine was sixty) one got through alright. Punctures were uncommon, and the chaps who wanted a bit of fun on the road found that a trike can move at times.

The Humber Tandem



WAYSIDE THOUGHTS

By F. J. URRY

Experience!

THE daily press does not pay numerous compliments to cycling, so I was pleased to read a letter appearing in a recent issue of the *News Chronicle* suggesting that the nation is more healthy because it is using its legs! The writer affirmed that though he was 84 he could still ride 50 miles in the day and enjoy it. Obviously, such an individual is an exception, for anyone of that age who is decently active is lucky. Yet there is much truth in the statement that we remain healthy if we use our legs, because that means we also use our lungs, and I have always believed the reason for my sound health mainly resides in the fact that my respiratory organs are in good condition because they are frequently in action to their full capacity. Deep breathing, the doctors tell us, is one of the secrets for the preservation of a clean internal condition; and cycling, the doctors too seldom tell us, is a simple and enjoyable method of acting on the advice. At heart we are a lazy people; we like things done for us, even though we instinctively know such service is against the best interests of our health; but all the talking in the world does not appear to alter the inherent habits of the multitude. Nevertheless, I shall keep on advocating the virtues of a pastime that, to me, goes much further than the acquisition of health, for I look upon it as an avenue leading to the perfection of action, kindly leisure, and the high attainment of a sense of beauty, with which a man can decorate the mundane moments of existence. This to me is not praise of the pastime, but experience.

Good Tradition

THE C.T.C. have been encouraged to compile a war-time Year Book of Club accommodation appointments, and hope to be in a position to publish it to their members very shortly. During their investigations the officials have been agreeably surprised at the considerable number of catering places still willing to do their best for wandering cyclists. Naturally, in these times, no certainty can exist that beds and food await every casual caller, nor can prices be printed for the obvious reasons that no prices can be taken as stable; but it is rather remarkable that the wayside hotel, farm, cafe, and cottage folk, should still welcome the tourist and tacitly promise, by allowing their names to appear in the Club handbook, to do the best they can to provide for the needs of Club members. As a cyclist who finds the highest expression of the pleasures of the pastime in touring, I feel it incumbent on me to give this information in advance, as it were, with the advice that if you have the luck of a few days holiday this year, make a cycle tour of them, join the C.T.C., and obtain the handbook, and then you are equipped with the best opportunity of finding an unworried holiday. It has been my good fortune during many years to accompany numerous people on their first cycling tour, youngsters and oldsters, and I do not recollect an occasion when the individuals concerned did not thoroughly enjoy the adventure with one exception: when on a Scottish trip the rain seldom ceased, and two of the party grew so weary of grey days and mackintoshes they cut the journey short. I was younger then, and probably my desire to seek a dry valley pushed my friends rather further on the day's journey than was good for them; but to-day, the philosophy of travel would limit my search for the brave days of sunshine and fair winds to the places of comfort not too many miles distant from each other.

Valuable Things

I HAVE warned you to take care of your bicycles, and I do so again at the risk of becoming a bore. Some people who have been seeking to buy machines or have found repair and replacement necessary, will now know what I mean, for the shortage of the former, and the difficulties attending the latter are quickly discoverable. Keep the bicycle well lubricated and adjusted, and if you do need replacements, tyres, chains, brake-blocks, pedal rubbers, etc., don't wait until the last minute before making enquiries from your dealer, or you may be disappointed. Give him a chance to obtain the goods, or if he has them in stock, book and pay for them on the nail, and take the first opportunity he can give you to have them fitted. I do not know how you feel about your bicycle, but I do know that I look upon mine as among the most useful articles I possess, and therefore something worthy of the slight attention it needs to keep it in perfect running condition. For too often the loose adjusting cone of a wheel or a pedal (particularly the latter) needs attention, it will wait until tomorrow, and tomorrow never comes, and today a new pedal is not easily acquired. If you do not want to undertake these jobs, or have neither time nor patience to spare for them, then go to your dealer and ask him to do the little service in exchange for his moderate charge. It will be cheap in the long run, saving you time, trouble and worry. But the great thing is to keep on friendly travel terms with your bicycle: it is precious now.

War Skimps

ANOTHER item of equipment that is becoming short in supply is capes. You can still buy them in exchange for much money and eight coupons, but they are skimpy garments, ill-fitted for broad shoulders, and lack the roomy comfort to which most of us are used. Leggings cannot be cut to the point of discomfort in quite the same manner as capes, so the war-time edition of these garments is not too bad. If, therefore, you have a decent cape, take care of it. Don't leave it rolled up in the bag when you are not using the machine, but hang it loosely in a dry cool place until you want it. It is no use criticising the cape manufacturers; they have to cut according to the cloth allowed them, and as there are not enough to go round in any case, it is natural they should make the material at disposal provide as many capes as possible. As an every-day rider, my macks never get fair treatment for the only time they are hung up is for the purpose of drying out. Fortunately, I have two sets, and the worst worn of them is now doing duty for the daily journey, while the newer ones await the touring time.

Not So Easy

THE Royal Society for the Prevention of Accidents (Safety First Assn.) recently issued a circular appealing to cyclists to obey the lighting laws, and I want to back that request. But it isn't as easy as it seems on paper, for electric lamps, whether battery or dynamo, do not always act as expected of them, and since 90 per cent. of us use those forms of illumination, and also since the reliability of some has not improved with the war, the request of the Royal Society to always be sure our lamps are functioning calls for something more than ordinary care. I have no desire to excuse wayward cyclists by putting all the blame for non-observance of the lighting laws on the lamps they use (and, indeed, about the only kind of lamps they can buy), but certainly some of it must be placed there. I spent half-an hour the other day getting my rear lamp to work properly instead of intermittently, and finally succeeded; but I must confess had I been on the road and the night was dirty, I should have risked its irritating ditheriness which made and un-made battery connection with every wave of vibration. I do take care of my lamps, yet occasionally get into a mess of this kind; ask any regular user of bicycle electric lamps, and he will tell you the same. The fact is, the ideal electric light for bicycles has not yet been made, though I'm sure it can be if a little more thought, care and sturdiness goes to its make-up, which means of course an addition in price. But I do not think cost would much matter to regular riders, if they could be assured of reliability. What do the makers say? Not until after the war I expect, if then.

The Changed Outlook

BY this time everyone knows the retail price of bicycles has been advanced by 17½ per cent. This, with the original 12½ per cent. increase, and the Purchase Tax, approximately 25 per cent., brings the old basic price of £3 19s. 0d. to approximately £6 5s. 0d.: a big advance, but not an inordinate one when nearly half of it is the result of the Purchase Tax. What is of interest is the knowledge that the Government have at last recognised the bicycle is a war-time transport necessity. They—the Government—have been a long time making up their minds, but the fact that they have now increased the allocation of raw material for cycle construction and repair and presumably are going to make arrangement for the necessary skilled labour to supply the needs of war workers, is all to the good. The best thing they can do now is to make the trade an essential industry, in order to satisfy the cycle worker that he or she is on an essential job. The increased numbers of new bicycles to be made will be sent into those areas of the country where the demand for machines for munition workers is greatest. Even in the eyes of a reluctant Government far too absorbed with the motor car, the bicycle has at last justified itself. It was bound to happen, for the voice of the people always prevails in the long run.

Wartime Cycle Lamps

"WAYFARER" writes: It may interest "Icarus" to learn that I recently "had words" with a policeman—or he with me—on the subject of my front lamp. He and a colleague were stopping all traffic on one of the main roads into Birmingham, and he at once pronounced my lamp to be out of order, because the lower half of the reflector was not blacked. (His colleague flashed an electric torch in my face, and I promptly told him that he had better not do that again.) I set about No. 1 interferer by assuring him that he evidently did not know the Regulations, and that the lamp was quite in order, provision having been made for the reflector to be "otherwise" rendered non-effective. I said that it was hardly likely that the largest firm of cycle lamp manufacturers in the world would put on the market a masking device which did not comply with the law, and he replied that hundreds of cyclists were prosecuted in Birmingham every week because the same device was deemed non-effective. I told him, with emphasis, that I didn't believe him, and that I *knew* the device complied with the law: further, that he would never convince me I was wrong—because I knew I was right! I added that I was not altogether a nonentity in the cycling world, and that I had some knowledge of these matters. Evidently I shook his faith. Then we parted, I leaving with him the information that I would be passing that way again on the following Saturday night and on other Saturday nights to come, and that the same lamp (without any alteration) would be in constant use.

My Point of View

BY "WAYFARER"

The Week-end Habit

FOR many years now I have been a persistent exponent of what the preachers used to call "the week-end habit," and it is curious to look back upon one's early cycling career and view it from the present-day standpoint. Then—thanks mainly to road conditions—many of us allowed the seasons to govern our cycling. Now—thanks again to road conditions, and also to improved bicycles, a wider knowledge, and a saner outlook—the cycling season is spread over exactly 12 months of every year. Then, indulgence in the week-end habit was hardly to be thought of in the off-season. Now, we week-end in December and February with much the same delight—and with equal benefit—as characterises our similar jaunts in May and August.

At one time, it would have been classed as a Great Adventure—invoking the displeasure of elders and the suspicion (as to our sanity) of friends—to spend a November Saturday night at some distant spot which was acceptable enough and proper enough in June. But nowadays I, for one, look to every month of the year to provide me with opportunities for getting farther afield than the ordinary half-day or day out-and-home jaunt permits. Nor do I—nor do those who think with me—look in vain. Moreover, I can faithfully say (and I believe that hundreds of cyclists will agree with me) that some of my best week-ends have been carried out in the depth of the winter season.

"Total" Leisure

AT this point let me instance two outstanding examples, though neither of the trips concerned was carried out at a normal week-end. In my period of leisure—"total" leisure, as one might say—which the war interrupted, I was in the habit of taking some of my week-ends in mid-week! That, however, does not affect the argument. The principle, i.e., demonstrating the possibility and the delight of spending a mid-winter night away from home in connection with our pastime—is just the same. Here are the two examples to which reference has been made:—(*a*) A two-day February jaunt into Wales, which took me by road over the Berwyns in the dark and brought me back by hill-track in the light—a journey which seemed full of thrills, and which is joyously remembered as a "purple patch." (*b*) A 200-odd-mile ride achieved on the last two days of a recent December, taking me to Bettws-y-coed and back, the return journey being made difficult with snow and ice, and there being, of course, several hours of riding in the dark on each day. A rather strenuous outing! But did I enjoy it? Rather!

It must be admitted in my case that one of the great charms of the winter week-end jaunt—and, indeed, of all winter cycling—resides in the circumstance that part of the journey must be done in the dark . . . and it would take a lot to assuage my appetite for night-riding! Then, as regards winter week-ending, if "they" know you are coming (and it is just as well to send along word a few days before), there is the hot meal you have earned, the pleasantly warm room and the glowing wood fire, and the hanging paraffin lamp which sheds its soft light in the centre of the table, making seductive shadows in the corners of the room . . . and the welcome. And then, again, there is that delightful stroll just before going to bed, with the splash of stars overhead and the silence of the countryside all around, the sense of remoteness from what we call Civilisation, and the comforting knowledge that the miles achieved stand to our personal credit—"all my own work," as the pavement-artists have it—and not to any mechanical device. If I, personally, am a slave of the week-end habit—and this is not denied!—there is ample justification.

Mid Week "Week-Ends"

I FANCY it has been stated in this place that, owing to Sunday duties, week-ends are now hard to come by, while mid-week "week-ends" are beyond imagining. But in the late autumn of 1941 there came to me three consecutive week-ends when, having delegated my Sunday duties, I was able to indulge in my ancient habit. What gorgeous week-ends they turned out to be, despite the fact that the weather conditions were not entirely favourable! On each of the three Saturday afternoons I set me forth and cycled to the same spot, just 50 miles from home, having warned the people of my coming by letter or telegram. What a delight it was to arrive at a favourite cottage in Shropshire and to receive a hearty welcome—and to be plied with food in plenty! The three Sunday mornings I devoted to wandering about the district, filling in some of the gaps in my knowledge, and returning to the cottage for lunch—and such a lunch! My mileages on these mornings were 21, 28, and 31, respectively. Then, soon afterwards, I set forth for home, not by the shortest route, and my total respective mileages for those three Sundays were 76½, 82½, and 90. They were red-letter days, on which I shall look back with profound delight for many moons, and I am conscious that my affection for the week-end habit, especially during the winter season, has been strengthened through the medium of those experiences.

Rubber Solution

ADVERTING to our reference to rubber solution in a recent issue, T.C.R., of Totteridge, reminds us that a bottle of benzine is useful for repairing punctures. Certain grades of rubber can be dissolved in benzine to provide a useful alternative to rubber solution. The rubber bands obtainable at stationers may be dissolved in this way.

Bicycle Shortage

ONLY one bicycle in four of the number made before the war will be available to the public during the next eight months.

"The total would be even lower but for the fact that the bicycle is now recognised as the ready substitute for the motor car," states Mr. H. R. Watling, director of the Manufacturers' Union.

"To-day, the British bicycle industry is almost entirely concentrated on further war production. The material now being allocated for the current year will be used to a considerable extent to produce the necessary spares and replacement parts to enable our millions of cyclists to keep on the roads."

Prince Edward's Cycle "Record"

ALONG the smooth gravel drive of a Berkshire country house, a small fair-haired boy cycles breathlessly. Several yards behind a smaller, golden-haired girl, her dimpled cheeks flushed, tries in vain to overtake him on her tricycle. Smiling, their father, in the blue uniform of an R.A.F. Air Commodore, awards the race to the boy, and Prince Edward and Princess Alexandra of Kent wheeling their machines carefully to the side of the wall, go into tea with the Duke and Duchess of Kent. That is a scene you might see any day at Coppins, the Duke's home at Iver.

Six years old Prince Edward is the youngest male member of the Royal Family, and, next to his bicycle, aeroplanes are his greatest joy.

Notes of a Highwayman

By Leonard Ellis

Rolling Stones

AS the editor once said to the reporter, "If a dog bites a man it is commonplace; if a man bites a dog, that's news." In these stirring times stories of prodigious feats of gallantry and endurance by young Naval officers are almost commonplace. It is, however, rare to find a story of a youngster getting himself disgraced because of an extraordinary feat of skill. And yet such a story exists, and it is closely connected with a spot in Cornwall beloved of all tourists. Almost at the extreme south-west corner of this island, in fact, only three miles or so from Land's End, there is a tiny village called Treen. A few hundred yards' walk towards and along the cliffs brings us to a point where a magnificent view is obtained of some of the finest cliff and coast scenery in the country. We are overlooking Porthcurnow Cove and away to the left there is a headland composed of jagged upright stones. On this headland is the Logan Stone. The word logan has no Cornish significance, in fact, there are several logan stones in England. The word means "logging" or "rolling," and all the stones so called are more or less balanced on a pivot, and have a certain amount of movement, if one knows the knack. It is quite an easily explained natural phenomenon—merely a heap of stones cast up by some earth disturbance, soft parts weathering away and leaving one stone nicely resting upon another. It is obvious, of course, that many millions of "one-upon-anothers" must have happened, but perhaps only one in a million would be sufficiently balanced to avoid crashing.

Valour Unrewarded

HOWEVER, the antiquarian, Doctor Borlase, inspected the Logan Rock and foolishly gave it as his opinion that it was quite impossible to move it. A nephew of the poet, Oliver Goldsmith, a young Naval lieutenant, heard the statement, and in 1824 set out to disprove it. He was supposed to be engaged upon the task of suppressing smuggling in the neighbourhood. He enlisted the services of some of the crew of his vessel, and they set off to move the immovable—the 65-ton Logan Stone. In a short space of time the stone was debunked, and young Goldsmith proudly surveyed his handiwork. Perhaps he expected a medal from a grateful country, but he certainly did not expect the furious outburst of indignation that his action evoked. The people of the countryside felt as we might feel if someone diverted the course of the Thames. At any rate, the storm of protest made itself felt in the Admiralty, and young Goldsmith was ordered to put the stone back. He succeeded finally, but he discovered that it was a very easy matter with properly applied levers to shove one stone off another, but to lift 65 tons ruined him financially. Even after this second great triumph, he met with no reward, as the locals swore that the stone never logged afterwards as it did before the disturbance.

The Logan Rock, near Land's End

The Delectable Duchy

THERE is sufficient material hereabouts to satisfy the tourist for a considerable time, but it is a regrettable fact that most of them are in such a tearing hurry to reach Land's End, because it is better known—well, one remembers the story of the substance and the shadow. The headland on which the Logan Rock is situated is called Treryn Dinas and contains the remains of an old cliff castle, complete with a triple vallum and fosse. Porthcurnow Cove is well known for its shells and the little sun-trapped bay under the Logan is one of the most delightful places imaginable for a bathe. Still within walking distance is St. Levan, and in the churchyard is St. Levan's Stone. It is said that when a packhorse can pass through the hole in this stone the Day of Judgment is at hand. The rock scenery is amazing and awe-inspiring. At Porthgwarra two tunnels connect the beach with the village, and naturally great tales of smuggling, probably with considerable truth, are woven around the spot. The Chair Ladder and Tol-Pedn-Penwith, two huge rock formations in grotesque shape, are quite close. In fact, from Treen, around the route suggested, and back to the village is probably not more than five miles or so, but nevertheless hard miles.

John Murdoch—Inventor of the Bicycle

According to an Ayrshire Historian, the Bicycle was Invented Seventy Years before Kirkpatrick Macmillan's Day

THE cycling world has for so long regarded Kirkpatrick Macmillan, a Courthill, Dumfriesshire, blacksmith, as the inventor of the bicycle, that any claims made on behalf of earlier inventors must be regarded with some suspicion. But matter to be found in a town history by an Ayrshire clergyman throws fresh light on the origin of the bicycle, and if substantiated, must lead to much early cycling history being written anew.

According to this new source of information, an Ayrshire man, John Murdoch, used a two-wheeled machine in the Auchinleck district some seventy years before 1840, when Macmillan made his machine.

History of Cumnock

The text of this information is to be found in the "History of Cumnock," by the Reverend John Warrick, M.A., of the Free Church, Old Cumnock, published by Alex. Gardner, of Paisley, in 1899. The book has much local lore, but the data regarding the bicycle made by Murdoch is to be found on pages 340-42, chapter XVIII, entitled, "The Father of the Cycle." The chapter first of all makes note of the inventions of Dalzell and Macmillan, and then goes on to state that more than sixty years before Macmillan's day, there was often seen in Cumnock a cycle which can fairly claim to be the first ever made. This machine was invented by an Auchinleck man, John Murdoch, the tenant of Bello Mill, near Lugar. His fame has been eclipsed by that of his son, William, who, born in 1754, was "the first maker of a model locomotive in this country, the inventor of lighting by gas, and the inventor of many valuable parts of the working steam engine."

Continuing with references to the bicycle, John Warrick writes: "Young William, who had a hand in making it, rode about on it, too. The date on which it was first used is difficult to detect, but, as William went to England in 1771, it must have been earlier than that year. There are persons still in Cumnock whose fathers were accustomed in their boyhood to go to Bello Mill and ride Murdoch's horse."

Propelling Poles

In support of this oral tradition, the Reverend Warrick quotes a descriptive poem, "A Tour in Ayrshire," by H. Campbell, written in 1829, who thus writes of the inventions of the two Murdochs:—

"And Murdoch (pass the author without blame,
The world should know of thy scientific fame),
Sprang from a curious deep-seated sire,
Who rode a horse no mortal could tire."

Warrick hastens to add that, lest there should be any doubt as to the meaning of the words, Campbell added a note (page 150), in which he says that William Murdoch's father, "The honest and scientific proprietor of Bellamiln, made a wooden horse on wheels, on which *by the assistance of poles*, he used to visit Cumnock."

Warrick continues: "Now it is certain that whatever the 'propelling poles' may have been, Campbell means to represent Murdoch, whose son William was alive at the time Campbell wrote, as riding upon his tireless horse without touching the ground with his feet. He propelled the poles and thereby gave movement to his machine by acting upon the pedals. Accordingly, we may fairly claim for Murdoch the proud distinction of being the first of whom we know to use the mechanical contrivance for locomotion, which in a splendidly perfect form is seen in the bicycle of to-day. It seems hardly too much to say that he is the 'Father of the Modern Cycle.'"

In one part of his description, Warrick says of Murdoch, the elder, that it is stated that he made a wonder horse on which he would ride to Cumnock, a distance of two miles, in a very short time.

If the Reverend John Warrick's evidence is to be believed, and one cannot turn the findings of a clergyman down very readily, then Murdoch made his machine well ahead of Macmillan. Moreover, he was not only the first maker of a bicycle, but also one of the pioneers of the hobby horse.

So far as his being the inventor of the first bicycle is concerned, much depends on what the "propelling poles" were. If these worked levers which turned one wheel or the other, then Murdoch's claim is a real one. Such a claim cannot, of course, be accepted without further confirmation from other sources, but the information in the "History" throws a fresh light on the early history of the bicycle, and if substantiated, marks an important step forward in our knowledge of wheeled vehicles.

Our correspondent is looking further into the matter, and in due course may be able to add something to the findings of the Cumnock historian.

BUY, EXCHANGE OR SELL

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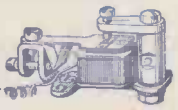

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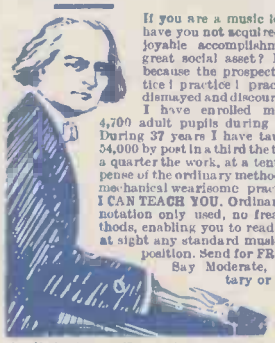

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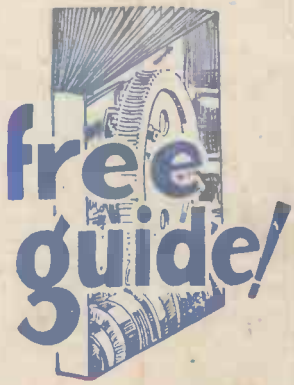

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