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- Quantity Surveying
- Radio Engineering
- Radio Service Engineering
- Refrigeration
- Sanitary and Domestic Engineering
- Scientific Management
- Sheet-Metal Work
- Steam Engineering
- Structural Steelwork
- Surveying
- Telegraph Engineering
- Textile Designing
- Textile Engineering
- Textile Designing
- Telephone Engineering
- Textile Designing
- Woodwork Drawing
- Works Engineering
- Works Management

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Reconversion of the Radio Industry

DURING recent months the Board of Trade have been dealing with the problem of the reconversion of the radio industry, which was peacetime production. In normal times, receiving sets form the basic product of most firms in the industry, and much has been done under programmes already approved and licensed to ease the difficulties of manufacturers in the present transition period and to prepare the way for the production of normal sets.

At present the manufacture and supply of receiving sets is controlled under the Musical Instruments and Wireless Receivers Order, 1944, S.R. & O. 658145, and licences have been granted to some 70 manufacturers for the production of about 1,000,000 sets during the next 12 months. Of this quantity 400,000 are intended for export. Under-takings have been given by the industry that 50 per cent. by value of the production for the home market will be devoted to sets to be retailed at £15 or less, exclusive of Purchase Tax of 33½ per cent. on the wholesale selling price. With the cancellation of war contracts, the supply position is good at present, owing to the many important claims on the limited quantities available. During the third quarter of 1945, releases were only about 50 per cent. of the industry's requirements, but the position is improving and substantial increases will be made in the fourth quarter. This improvement, together with the supplies of plastic materials which are available for cabinets, should go a long way towards overcoming the present difficulties.

Before the war, the average annual production of radio sets in this country was about 1,4 millions. Of this quantity the average export was 650,000. It will be seen, therefore, that the present programme visualises an overall production of about 70 per cent. of the pre-war figure, but places considerable emphasis on exports. If exports actually mature on the scale licensed, the industry will, in relation to its pre-war trade, be making a noteworthy contribution to the Government's policy of increasing export business.

Production of television receivers has not yet begun. Recommendations on the future of this industry have been made by the Government Committee set up under the chairmanship of Lord Hankey.

The Lord President of the Council, Mr. Herbert Morrison, announced in the House of Commons recently that the Government had given general approval of the recommendations. The necessary action has been set in train.

Apart from sound and vision receivers, many firms are producing transmitters, communications equipment, medical and industrial electronic apparatus, and many other highly specialised products for which there is likely to be a heavy demand, both in this country and overseas. No manufacturing licences are required by firms engaged on production of this nature, but every effort is being made by the Board to assist the manufacturers concerned in the reconversion of their production programmes to peacetime needs.

House Furnishing Designs

DINING-ROOM, bedroom and nursery furniture are included in the six categories for which prizes of £100 each are announced by the Central Institute of Art and Design for the best house-furnishing designs from men and women under 30.

There are second and third prizes of £40 and £20 in each section and 108 merit awards of £5 or £1,500 in all.

The Institute wants new designs for things at present in use or new ideas altogether. Service men and women are specially invited to help in making their future homes more comfortable and labour saving.

Peacetime Reconversion

A S stated in last month's issue, the Regional Boards have been not only most useful as a machinery for the coordination of regional activity, but in linking together central policy with local opinion and in dealing with a variety of unforeseen emergencies for which no regular procedure existed. In adapting the constitution and functions of the Boards to peacetime conditions the Government is anxious to preserve these benefits, but is satisfied that to do so in peacetime the Boards must be strictly advisory in character.

The Boards will in future exercise their activity over the whole field of productive industry. Under the new constitution the Boards have been renamed "Regional Boards for Industry". Each will consist of an impartial chairman, together with three representatives each of employers and trade unions, and the senior regional representatives of the Board of Trade, Admiralty, Ministries of Supply and Aircraft Production, Labour, Transport, Fuel and Power, Food, Works and Town and Country Planning, and, in Scotland, the Scottish Office. Representatives of other Depart- ments, in matters of which they are particularly interested, will be appointed to sit on the Boards, which will cover the whole country, and which may be necessary to bring regional resources in productive capacity or labour into full use.

The new chairmen have been appointed by the President of the Board of Trade, and each Board is a constituted authority. As in the past, Boards will not be entitled to deal with wages and employment, which are matters normally handled by trade unions and employers, nor are they authorised to go beyond the sphere of productive industry into that of mining, transport, agriculture, commerce, or of public utilities, except in so far as the last named have a direct effect upon productive industry.

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The new chairmen have been appointed by the President of the Board of Trade, to whom they will be responsible and will have the right of direct access. They have been selected from industrialists, trade unionists and others who are prominent and experienced men of standing in the Region. Similarly, the industrial members of the Boards will be men who are likely to be acceptable as representatives of industry generally rather than of any industry in particular. The appointments of both chairman and members of the Regional Boards will be for a period of three years.

Fireworks

T HE Home Office and the Pharmaceutical Society state that they take a grave view of the accident rate arising from fireworks made by amateurs, and all chemists have received a circular asking them not to supply materials for such fireworks to children under 16, and the manufacturers of chemical sets for young experimenters are asked to withdraw from these sets all chlorates, nitrates, magnesium, potassium permanganate, sulphur, powdered aluminium and phosphorus.

It is for this reason that we have decided to give information to readers relating to experiments with fireworks and explosives in any form. Will readers, therefore, please note that they should not send us queries relating to this subject?
During the years of war in Europe, we were not aware of the weather which prevailed in parts of the country other than in our own locality, although after D-Day the blackout on weather was lifted with regard to the Straits of Dover. While residents of one district might have been enjoying dry weather, those in other parts of the country would be battling against snow storms. With the total absence of the broadcast of official weather forecasts, we could only make a rough guess of approaching weather.

In spite of this, the weather still appeared to be the opening topic of conversation between strangers, and even acquaintances of long standing. There is no doubt that everyone is to some degree interested in the weather. For example, a cyclist, motorist or hiker should obtain weather data before setting off on a tour. Now that the weather blackout is completely lifted this can be obtained by reference to the newspaper or from the radio. But how few people really understand what is meant by General Inference, Anti-cyclone, Depression, and so forth. Fewer still are able to make a weather forecast within any reasonable degree of accuracy.

Although forecasting covering a wide region over a fairly long period of time can only be made after many years of practice with the aid of special instruments in the hands of a number of expert observers stationed over a wide area, an amateur can make a reasonably accurate forecast provided he has studied and mastered the main principles of the science of weather, and has taken every opportunity of putting this book learning into practice.

Countrymen, farmers, shepherds and coastal dwellers are all weather experts to some degree. They have all made a long, but probably subconscious, study of prevailing conditions in their own localities; this without the aid of charts and instruments. In fact, most of the popular couplets and maxims have originated from such people, which is probably why so many bear relationship to the truth. Too much reliance should not, however, be placed on this weather lore, since the majority of couplets rely on one weather indication only and accuracy is often sacrificed to allow the couplet to rhyme.

Study Local Conditions
All who are interested in weather should know their own local conditions; for instance, the prevailing wind, the direction of True North from, say, the garden gate, the market square, and so forth. Surprisingly few people are aware of the direction of the main road or of the local railway lines. All of these points and many others, as will be seen later, are of direct importance in the study of weather.

The Atmosphere
The atmosphere is a belt of air surrounding the earth and rotating with it (Fig. 1). This belt is divided into two layers—an upper and a lower. The lower layer, which has a thickness or depth of approximately 11 miles at the equator and flattens off to approximately six miles at the poles, is known as the

![Diagram indicating the atmosphere](image)

**Fig. 1.**—Diagram indicating the atmosphere.

![Diagram showing weight of air](image)

**Fig. 2.**—The weight of air on top of the hill is less than that at sea level, the difference being the weight of the column of air.
troposphere. Above the troposphere and divided from it by an imaginary line called the tropopause, we get the stratosphere. In the stratosphere weather conditions, as we know them, do not exist and we are not therefore concerned with it here.

As the depth of the troposphere above Great Britain is approximately seven miles the weather conditions dealt with in these articles relate only to that distance from the earth.

Atmospheric Pressure

The average pressure, or weight of air, in Great Britain, is 14.7 lb. per square inch. This means that under average conditions, if a two shilling piece, which has an area of 1 square inch, is laid on the beach, we may assume that the weight of air on its surface is equivalent to 14.7 lb. This weight of air is not noticed because an equivalent weight of air is also pressing underneath it.

If we took our two shilling piece to the top of a hill or to any height above sea level we should find, if we could measure it, that the weight of air had now decreased. This is because there is not so much air pushing down on to the coin, Fig. 2.

If, instead of using a coin, we placed a quantity of mercury in a glass tube and turned this upside down in a vessel of the same liquid, Fig. 3, we should find that if the atmospheric pressure is 14.7 lb. per square inch, the height of the mercury in the tube would be 8 or 9 in.

If this apparatus were taken to a higher position, viz., on top of a hill, the column of mercury would then fall with the increase of height, because the lower pressure of air would then be unable to support such a high column as previously. This apparatus is thus a simple barometer and may be used for measuring changes in barometric or atmospheric pressure.

The inch is not a convenient unit of measurement to adopt for a barometer. Instead, a millibar, mb., is used; 1,000 mb. or 1 bar being equivalent to 29.53 in. In Great Britain the average barometric pressure at sea level is equivalent to 1013.2 mb.

As the height of mercury in a barometer tube changes with height and as these changes are directly proportional, the barometer may be used for measuring height. For convenience in practice, a change of 1 mb. in the height of the mercury is taken as being equivalent to 30 ft. Thus, if upon climbing a hill or ascending in an aircraft the barometer carried dropped by 3 mb., it could be assumed that a height of 90 ft. had been achieved.

Pressure Distribution

It is emphasised that the pressure of 1013.2 mb. is only the average pressure at sea level and not that necessarily found at any given time. Atmospheric pressure will vary depending upon the height, the time, the place, the weather and the air temperature. This variation in pressure, upon which the existing weather conditions largely depend, is always plotted at different places throughout the world. Identical pressures measured at different places are then plotted on a topographical map, Fig. 4. These pressure contours, which at no point cross each other, resemble the ordinary contour lines found on a topographical map. In Fig. 4 the isobars are drawn at intervals of 4 mb.

The Barometer

It has been shown that atmospheric pressure at a given point will vary considerably according to the weather. The barometer may be, and is, used for indicating weather conditions. As the mercury in the tube, Fig. 3, varies with height due to the change in pressure, it will also vary if the pressure changes for any other reason; for instance, the weather.

We have now seen that the mercury tube or barometer will indicate two factors, change of pressure due to height, or due to weather. In the former case the barometer is called an altimeter and in the latter a barometer.

It will now be seen that this instrument can be unreliable for use as either, since it possesses at least two varying factors, height and pressure. As an altimeter the readings may not indicate true height, for the weather conditions and barometric pressure at a different place, or at the same place at a different time, may have altered and upset the altimeter readings. As a barometer, unless it is calibrated in accordance with the position of the place above sea level, the readings will again be inaccurate.

The barometer as a weather indication instrument is considerably overrated. Though its face is usually graduated from Fair, Rain, Stormy and so forth, rarely do these markings indicate the actual weather conditions. On the other hand, as an aid, and an aid only, to weather forecasting, the barometer is quite useful. For example, when a front or stormy and unsettled conditions are expected the "glass" will be unsteady, due to rapid changes in pressure during such periods. Settled weather is indicated by a steady glass, and when the glass is rising the approach of an anti-cyclone and fine weather is indicated.

Barometers should be sensitive to small changes in pressure and mercury barometers are sensitive, but the usual household type is of the aneroid principle which, although not very sensitive, is cheap and meets the requirements of the amateur.

Fig. 5 illustrates a barograph, or recording barometer, which shows variation of barometric pressure by an inked plot on a seven-day chart.

Temperature

As the earth receives its heat from the sun by means of radiation, or insolation, as the meteorologist calls it. That is, the heat of the sun passes through the air to the earth. Energy in this form is released by raising the temperature of the air through which it passes. Temperature is of the highest importance to the meteorologist.
for the heating of the earth is responsible to a large measure for the varying weather conditions in the troposphere. It is also responsible for the seasons as we know them, viz., Spring, Summer, Autumn and Winter.

Increase of temperature in the atmosphere of the earth's surface at different places depends not only upon the seasons of the year and upon the latitude of the particular place (Great Britain being situated in the temperate zone of the Northern hemisphere), but upon the heat capacity of the surface layers.

Heat is constantly received from the sun at the earth's surface. At the same time the heat is being dissipated, otherwise the temperature at the earth's crust would become so hot that everything would burn up and the lakes and sea would boil.

The surface of the earth, owing to the variation of heat capacity, does not heat up evenly where the sun's rays are equally radiated upon it. For example, sand and ploughed fields heat up very quickly, woodlands and grasslands heat up more slowly owing to the absorption of the heat by the plants to give them life, and large areas of water such as the sea heat up even more slowly. This happens because the sands are often very hot when the water is comparatively cold. On the other hand, water gives up its heat more slowly than land. This will be noticed by a person going into the sea after a sunny day. The water is often very hot when the water is comparatively slow.

Water such as the sea heat up even more slowly than large areas of land, for example, ploughed fields heat up very quickly, woodlands and grasslands heat up more slowly owing to the absorption of the heat by the plants to give them life. Large areas of the sea have a higher temperature than the outside air. Upon release, therefore, it will rise still further.

These are known as unstable conditions, and when they exist there is a considerable movement of air.

As will be shown later, such unstable conditions do not exist for long, since changes in weather, viz., the development of thunderstorms, restore the atmosphere to conditions which are stable.

When the air is saturated, viz., below dew point, the lapse rate is then 2.7 deg. F. per 1,000ft. altitude, conditions which are termed the saturated adiabatic lapse rate.

The normal adiabatic lapse rate in the British Isles is approximately 3 deg. F. per 1,000ft. and most calculations are made with these figures.

Temperature Inversion

Under certain conditions, often when an anti-cyclone is stationed over an area, the change in temperature with height increases for the first few hundred feet, after which it decreases in the usual way, Fig. 6(d). This is known as a temperature inversion.

Humidity

Air, unless it is completely dry, contains a quantity of water. Air which has passed over large tracts of land, such as deserts, will be very dry.

The amount of moisture contained in a given volume of air is known as its relative humidity, usually expressed as a percentage.

The relative humidity of the air over Great Britain is approximately 70 per cent; that is, it contains 70 per cent, of the moisture of saturated air under similar conditions.

Saturation of Air

When warm air comes into contact with water of a lower temperature the warm air will cause the water to evaporate. This moisture then mixes with the air and increases its relative humidity. The amount of water which will be evaporated in this manner will depend upon the amount of moisture the air can hold before it is saturated. The point, which depends upon the temperature of the air, is reached when the air can contain no more water and has then a relative humidity of 100 per cent.

The higher the temperature of a given
of refrigeration. Therefore, the dryer the air the greater the rate of evaporation and therefore the greater the cooling of the bulb inside the muslin. This coolness will register on the thermometer by a drop in temperature.

The result is that while the dry bulb will register the air temperature, the reading on the wet bulb will be low, depending upon the rate of evaporation.

Using the two readings, the dryness of the air, or its relative humidity, is at once determined. No simple formula for this is as yet devised, owing to complications, but charts are available from which relative humidity can be derived directly.

When the air is saturated (relative humidity of 100 per cent.) there is no evaporation from the muslin, and the temperatures recorded by the two bulbs are identical.

Maximum and minimum temperature thermometers are often placed in a Stevenson Screen. These readings are taken at regular intervals and the instruments then have to be reset.

Other devices are used for measuring relative humidity, though many of them are hardly accurate, and indicate only the moisture content of the air.

Cagot is known to expand when it absorbs moisture, hence violin strings slacken. Ingenious "weather gadgets" are based on this principle. One type comprises a model house, in the doorways of which are positioned figures of a man and woman. These are controlled by a "lever" of cagit which, as it expands or contracts, changes the relative positions of the figures in the doorway.

People collect seaweed, which absorbs moisture and indicates the relative humidity of the atmosphere, but not necessarily the weather conditions, viz., fine or wet.

For instance, a ground fog at night during a spell of good weather, when the air is saturated, would also saturate the seaweed and expand the cagot, but it certainly does not, in these circumstances indicate the approach of rain.

If other conditions favorable to the formation of radiation fog exist, but there is no wind, dew instead will form. This is, of course, a particular characteristic of fine weather.

When a warm front is approaching and low stratus cloud is expected (Fig. 8), very great importance is attached to the relative humidity, particularly on aerodromes. Each hour, and often at more frequent intervals, readings of the wet and dry bulb thermometers are taken. Once the relative humidity (R.H.) reaches a high figure or ascends rapidly, pilots are notified and flying arranged to ensure that pilots can return to their bases or be diverted to others at short notice.

Relative humidity is only one additional item of knowledge which the meteorologist uses to complete his weather picture.

(To be continued.)

Within a short time the Council intend to approach the various representative trade associations concerned, to seek their help and discuss ways and means with them. The exhibition would cover clothing and accessories; furniture, glass and pottery; heating, lighting, cooling and other domestic equipment; hand and garden tools; radio and television; office equipment; toys, cameras, watches and clocks; pens and stationery; leather and travel goods; musical instruments; packaging and printing and transport.

Besides peace-time goods, the Council wanted, with industry's help, to show the public as much as possible of the achievements in war production of industries normally making consumer goods, and the way in which wartime developments in manufacturing technique and processing had led on to the new designs and types of goods which post-war industry would produce. In fact, the keynote of the exhibition would be the changeover from war to peace: its title would be "Swords into Ploughshares: British goods for the new age."

### National Exhibition of Design

**THE President of the Board of Trade (Sir Stafford Cripps) announced recently that the Government had accepted a proposal from the Council of Industrial Design to hold in the summer of next year a national exhibition of design in all the main ranges of consumer goods—clothing, household furnishings and equipment, office equipment and civil transport. The exhibition would be held in London, would open not later than July 1st, and would be on a considerable scale.**

"It will not be anything so vast or all-inclusive as a commercial exhibition or Trade Fair, and space will not be sold," said Sir S. Cripps. "It will represent the best and only the best that modern British industry can produce, largely the new post-war designs, but not excluding those good designs of the years immediately before the war which will be going into production again."

"This exhibition will be British industry's first great post-war gesture to the British people and to the world. I confidently believe that it will demonstrate the vigour, freshness, originality and skill with which our manufacturers are setting about their task of serving the home consumer and capturing a great share of the export trade. The British public will see what industry has planned for the living rooms, bedrooms, and kitchens of the post-war home: the world overseas will discover that the brains, ingenuity and taste which long gave Britain her place as a leader of world industry have not deserted her, and that her lead will be kept.

One main purpose of the exhibition is to enable our industries to give a lead at home and abroad: it would be a mistake to wait too long. In 1947 the British Industries Fair will take up the running, performing its normal function as a trade exhibition."

A panoramic view of the Ladybower reservoir, of the Derwent Valley Water Board, recently opened by the King and Queen. The huge earthwork dam is 1,270ft. long, and 665ft. thick at the base.
Fluorescent Lighting

Its Operation and Adaptability for Commercial and Domestic Uses

By P. SEYMOUR

O

NE of the latest forms of commercial lighting to become available for public use is fluorescent lighting. Many readers will no doubt be familiar with the daylight effect given by this lighting, and with the return of more normal supply conditions we can expect a great increase in the numbers of users of these lights.

What is Fluorescent Lighting?

First of all, what do we mean when we speak of fluorescent lighting? The dictionary definition of fluorescence is "a coloured luminosity which certain substances exhibit when the sun's rays fall on them." To use the sun's rays for fluorescent lighting is obviously impracticable, so we have to produce artificially those of the sun's rays which have the greatest effect on fluorescent materials.

The rays which we use are ultra-violet rays, which cannot be seen by the human eye, and are therefore of no use to us as a source of illumination. The ultra-violet rays being of a shorter wavelength than visible light, we need a frequency changer which will bring the emissions within the visible spectrum. For this purpose we use materials which exhibit fluorescence when excited by ultra-violet rays. The principle of the frequency changer is that all of which have a different colour content.

It is very important that these powders should be entirely free from impurities, and this brings about a number of manufacturing difficulties, especially as the powder has to be fused. As ultra-violet radiation has a shorter wavelength than that of the visible spectrum, it is natural to assume that fluorescent radiation will fall within the visible spectrum.

The Ultra-violet Source

Many readers will be familiar with the green-blue light given by mercury arc street lighting. These lamps are of the high-pressure mercury vapour discharge lamp type, and are designed to give the maximum amount of light obtainable from the arc itself. They are, however, only about 10 per cent. efficient, as only 10 per cent. of the total input energy is converted into light in the visible spectrum and 1 per cent. of energy into ultra-violet radiation.

If the pressure of mercury vapour inside a discharge lamp is reduced to less than 0.1 lb. per square inch, the visible radiation from the arc falls to about 1.5 per cent. of the total input energy, but the ultra-violet radiation increases to 60 per cent.

This is the reason for low-pressure mercury vapour in the 80-watt fluorescent tube, whose mercury vapour pressure when cold is less than 0.1 lb. per square inch, and which remains almost constant at this value, with a very small increase in pressure, while the lamp is burning.

The 80-watt Tube

The 80-watt tube itself consists of a glass envelope, 5½ ft. long, 1½ in. in diameter, sealed at both ends, and having two electrodes, each consisting of a coiled filament and two metal fins, supported in a glass pinch, one at each end of the tube.

The filament projects about 1½ in. into the tube, and the metal fins, which act as anodes for the arc, so reducing volt drop, are placed on each side of the filament, and in the same plane, i.e., at right-angles to the axis of the tube. The two filament leads are sealed in the end of the tube and go out to a standard bayonet cap, one at each end of the tube.

The Fluorescent Powder

The whole of the inside of the glass envelope is coated with a white powder that produces the fluorescent effect. This powder consists of a mixture of compounds, each of which exhibits fluorescence on its own, but all of which have a different colour content.

Apparatus Needed for 80-watt Lamp

In order to run the 80-watt lamp from a normal supply voltage, say, 200 volts 50 cycle/sec. alternating current, we require, in addition to the lamp, a stabilising choke to drop the line voltage to the correct level, a starter switch, and a 8 mfd. condenser for P.F. correction.

Lamp Characteristic

One of the peculiarities of the fluorescent lamp is that it has a negative resistance characteristic, i.e., when the current in the lamp increases, the voltage across the lamp decreases. This is due to the increased ionisation of the mercury vapour due to the increase in current, causing the arc to have a lower resistance. The extent of this effect can be seen on the accompanying curve (Fig. 2).

The average current in the lamp itself is 0.85 amps., and may vary between the limits of 0.6 amps. and 1.2 amps. Another thing that has an effect on the lamp is the ambient air temperature. As can be seen from Fig. 3, a working range of temperature from 50 deg. C. to 30 deg. C. produces a change of plus or minus 15 per cent. in the average lamp voltage. The current range due to the variations in ambient air temperature will be seen to be from 0.68 amps. to 1 amp., and the remaining part of the permissible current range down to 0.6 amps, and up to 1.2 amps., is taken up by variations in the supply voltage, characteristics of the choke coil and the lamp.

It is clear, therefore, that the careful adjustment of the choke is of great importance, and manufacturers supply chokes with a series of tappings which will accommodate any line voltage from 190 volts to 250 volts. The effect of ambient air temperature has been taken into account in the selection of these tappings.

Starting

These fluorescent lamps for use on 50 c.p.s. A.C. require a special method of starting. When the supply voltage to the lamp is switched on, the filaments must be made to glow at red heat in order to ionise the vapour in the tube, and then a voltage surge produced across the lamp to strike the arc from one filament to the other.

The heating of the filaments is achieved by shorting the lamp out, i.e., closing the switch S. (Fig. 1). When the supply is switched on, a current flows through the filaments, causing them to glow. The switch S is then opened after an interval of about two seconds, and a voltage surge of approximately 1,000 volts is produced across the lamp by the collapsing flux in the stabilising choke. This strikes the arc between the filaments and causes the current to flow through the tube, giving rise to the ultra-violet emissions which create the light.

This complete switching operation is done...
obtained when an object is moved rapidly in
against length of tube.

When the supply voltage is switched on, the current flowing through the lamp filament is about 1.5 amps., and there will be 750 volts across the lamp and 12 watts for the choke, making the total wattage 92 watts. The efficiency is therefore $\eta = \frac{120}{92} \times 100 = 87$ per cent.

**Efficiency of D.C.-operated Lamps**

The efficiency of lamps operated from D.C. is greatly reduced, the input watts being greatly increased for the same light output as on an A.C. operated lamp.

For example, the 80-watt lamp equipped for 500 c.p.s. working, has connected across it a 2.5 mfd. condenser. When the supply is switched on, the current flowing through the lamp filament is about 1.5 amps., and there will be 750 volts across the condenser. This produces a much greater amount of heat—about 200 deg. C.

To combat this flicker, luminous powders are introduced into the fluorescent compound, but the amount used is limited by the colour content of these powders. The luminous powders tend to spread and give a more continuous light output.

High-frequency Operation

In the previous paragraph we discussed the stroboscopic flicker effect and the method used to combat it. Another, but more unusual way of eliminating flicker, is to operate the lamps from a high frequency supply. This has the effect of increasing the frequency of the flicker, which is twice the frequency of the fundamental supply frequency, to such an extent as to make it unnoticeable. The frequency of the supply should be at least 500 c.p.s. in order to eliminate the flicker.

At increased frequencies the size of the stabilising choke is greatly reduced owing to the reaction of the choke increasing with the frequency. This characteristic of the lamp is made slightly more steep at high frequencies, but this does not affect the working range of current, limiting only the voltage.

With a 500 c.p.s. supply, the value of the P.F. correction condenser would become about 2 mfd., thus creating a saving in size on that component.

High-frequency Starting

When operating lamps from high frequencies, the normal method of starting can be used, making use of the same starter switch as is used for 50 c.p.s. operation. It can be seen from Fig. 6 that the lamp voltage at 500 c.p.s. becomes much more sinusoidal, that is, much less distorted, and the absence of high current peaks due to higher harmonics in a relatively large condenser connected across the lamp makes a different form of starting available.

A condenser of fairly large capacity may be placed across the lamp in place of the starting switch (Fig. 7). The value of the condenser is chosen to give partial resonance with the stabilising choke at the supply frequency and to produce a high voltage across the condenser.

Let us say, for example, that an 80-watt lamp equipped for 500 c.p.s. working, has connected across it a 2.5 mfd. condenser. When the supply is switched on, the current flowing through the lamp filament is about 1.5 amps., and there will be 750 volts across the condenser. This produces a much greater amount of heat within the lamp, and is therefore very suitable for traction work.

This method is only practicable where a high frequency alternator is available, and any intending users of the H.F. scheme are recommended to submit their plans to the lamp manufacturers.

Vibrators have been experimented with, but it has been found that even a small ripple or modulation of the vibrator output is sufficient to cause the lamp to display a flicker.

D.C. Operation

Fluorescent lamps may be successfully operated on direct current after some changes have been made to the control gear, but there is one big objection. This is, that after several hours' running on D.C., the positive end of the tube begins to blacken and cuts down the light output quite considerably. The blackening may extend up to quarter way along the tube, and is caused by the diffusion of mercury at the cathode end of the tube. This is known as electrophoresis.

This blackening may be overcome by reversing the polarity of the tube every three or four hours, but this is very inconvenient in a commercial installation.

Instead of using a choke for lamp stabilisation on D.C. operated units, a resistance of about 140 ohms is placed in series with the lamp. This resistance is suitable for a 200-volt supply, and must be altered according to variations in the supply voltage.

D.C. Starting

Lamps operated from D.C. supplies still need a high voltage surge across the lamp in order to strike the arc, and for this purpose a small choke is placed in series with the stabilising resistance. The same automatic starting switch can then be used, as the collapsing flux in the choke will produce a high voltage surge across the lamp when the starting switch opens.

**Efficiency**

The efficiency of lamps operated from D.C. is greatly reduced, the input watts being greatly increased for the same light output as on an A.C. operated lamp.

For example, the 80-watt lamp run on 500 c.p.s. uses 80 watts for the lamp and 12 watts for the choke, making the total wattage 92 watts. The efficiency is therefore $\eta = \frac{80}{92} = 87$ per cent.

**Flicker**

Another noticeable feature of fluorescent lighting when operated from 50 c.p.s. A.C. supplies is that a stroboscopic flicker is obtained when an object is moved rapidly in the light of the lamp.

This is due to the almost complete absence of thermal inertia in the lamp, i.e., ability to store energy in the form of heat. When the A.C. voltage falls near its zero level, as it does 100 times/sec, the light output falls very low and the lamp nearly goes out.

A fluorescent lamp reaches an outside temperature of about 35 deg. C., but an incandescent filament lamp of similar wattage produces a much greater amount of heat—about 200 deg. C.

To combat this flicker, luminous powders are introduced into the fluorescent compound, but the amount used is limited by the colour content of these powders. The luminous powders tend to spread and give a more continuous light output.
The D.C. lamp with resistance stabilisation takes 80 watts on the lamp, and 53 watts on the resistance, making a total of 133 watts.

The efficiency is therefore \( \frac{80}{133} \times 100 = 60 \) per cent.

This means that the input for the same amount of light is, for D.C. operated lamps, 45 per cent greater than for A.C. operated lamps.

Lamps may be used for A.C. and D.C. operation alternatively, but this would lead to unnecessary complications.

**Choice of Lamps**

As readers will be aware, 5ft. fluorescent lamps are now available in two distinct colours, one of these being "daylight" and the other, and more recent, is called "warm white." The choice of these lamps is important.

The "daylight" lamp has for its fluorescent coating inside the tube, a mixture of powders, the light from which contains the primary colours in almost the exact proportions as does noon sunlight. This tube is therefore best used when daylight conditions are required when artificial light is in use.

The "warm white" tubes emit a rather pink shade of light, which, after a few hundred hours of burning, resolves into a pleasantly warm light. This tube is most suitable for domestic lighting.

Fittings of various types have been designed for use with 5ft. tubes. The industrial fitting may consist merely of a long reflector, housing the lamp and the control gear and making one separate unit, or several may be joined together to form a continuous trough. These reflectors may contain more than one lamp placed side by side.

For domestic lighting various fittings have been evolved, some types having a decorative reflector and others concealing the tube by means of frosted glass.

The initial cost of fitting fluorescent lamps is high, many times higher than for incandescent filament lamps in fact, but they are economical to run and have a long life, which may be as long as 4,000 hours or more.

The life of the lamp is reduced by excessive switching, such as on flashing signs, but for domestic use switching has a very small effect on the life.

**Conclusion**

We may in the future hope to see fluorescent lamps of various sizes and colours used in many forms. Some residents in London have already had a glimpse into the future of fluorescent lighting when they saw the District Line railway car fitted with an experimental set-up of 2ft. lamps.

This is only one direction in which the fluorescent lighting experts are turning their energies in order to turn our nights into a simulation of day.

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**Jap Bomb-carrying Balloons**

During the latter part of the war with Japan many Americans were aware that certain V-weapons were reaching some of the Western States, but news of this development was withheld until comparatively recently. According to a report received from America the balloons travelled at a great height on wind currents moving at a speed of 80 m.p.h.: these high-speed currents always travel from west to east. The balloons were grey-white, or greenish-blue in colour, and were made of oiled paper.

Our illustration shows a Jap bomb-carrying balloon, fully loaded, and details of high-explosive and incendiary bombs, and bomb-releasing device.
The Foundations of Thermodynamics—2
The Mechanical Equivalent of Heat, and Conservation of Energy

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

(Continued from page 46, November issue)

parts of the apparatus. (Denoted by F.)

(4) In the production of heat in the churned water. The greater part of this heat (denoted by W) was recorded by the temperature rise of the churn and its contents. A smaller part (denoted by Q) was lost to the surroundings by radiation, convection, and conduction, in the process of cooling.

If it is assumed that the energy is conserved in its quantity when it changes its form, the following relation must exist between the above quantities:

\[ J = W = \text{heat generated in the churn,} \]

\[ Q = \text{heat dissipated to the surroundings.} \]

The quantity Q was calculated in the standard manner by plotting a cooling curve for the water in the churn, and W was then found from the equation

\[ W = n.g.(m_1 + m_2).v^2 \]

\[ -\frac{1}{2}J.I.w^2 = -n.g.h. - Q \]

The amount of heat H generated in the churn and its contents and causing a temperature rise of \( t \) degree centigrade, is found from the standard relation \( H = M.t \), where \( M \) represents the water equivalent of the churn and its contents. But \( H \) is defined by the equation

\[ W = J.H \]

and thus it can be calculated from the relation

\[ W = n.g.(m_1 + m_2).v^2 + \frac{1}{2}J.I.w^2 - Q \]

Joule found in his carefully conducted tests that by giving \( W \) different values and measuring the corresponding yields of \( H \), their ratio \( J \) remained always the same. This discovery was of major significance. It indicated that the initial assumption made in the above calculation that a given amount of mechanical energy could be totally converted into heat was justified, and, furthermore, that the conversion rate was universally constant. For otherwise, if \( W \) and \( H \) were only partly and haphazardly measurable quantities, it would have been the extreme case, not related at all, a series of different values of \( W \) would be obtained from a series of experiments in which \( W \) was assigned different values.

The value obtained by Joule as the constant \( J \) has since been confirmed by many other investigators. Some repeated the experiments and used apparatus similar to that used by Joule himself, others used devices designed to work on a different principle. In 1858 Gustave Hirn, an Alsatian engineer, whose steam engine tests at a later date made a useful contribution to the advancement of thermodynamics, carried out a series of measurements of \( W \) with a piece of apparatus in which heat was generated by the impact of heavy solids. When a moving body is suddenly halted, its kinetic energy goes out of existence and an equivalent amount of energy in various other forms comes into existence. Some of this energy is acoustic if the impact is audible; some is mechanical (both kinetic and potential); if the colliding bodies rebound to new levels, some is electrical if charge is developed on the bodies (as, for example, when silk strikes glass), some is luminous if the shock produces sparks or a glow, and some, and as a rule the majority, is heat energy because of the extra agitation conveyed to the atoms or molecules at the atomic subatomic level. The fact that the water in a pool at the base of a waterfall is a little warmer than the water passing over the top of the fall.

The apparatus built by Joule to make his measurements involved the principle that water can be warmed by shaking or stirring it. It is illustrated in Fig. 3. Water was stirred in a churn consisting of a cylindrical copper vessel fitted with a brass paddle wheel having eight sets of blades which worked between four sets of stationary vanes rigidly attached to the inside wall of the vessel. A doubled cord passing horizontally over pulleys, and kept in tension by means of slabs of lead suspended from the axles of the pulleys, was wound upon a vertical shaft which carried the paddle wheel at its base. The uncoiling of this cord as the masses descended under the force of gravity set the churn into motion by turning shaft and paddle. Continued rotation was maintained by making repeated descents of the masses through a measured height of about 5 ft. At the end of each fall the paddle was disconnected from the shaft by withdrawing the taper-pin C and the taper-pinion D, connected from the shaft by withdrawing the taper-pin C and the taper-pinion D, and the system rewound in the direction. The Foundations of Thermodynamics—2

The mechanical energy spent in friction with the water, and discovered the relation between them by evaluating the quantity J.

Calculation of Quantity J of the masses \( M_1 \) and \( M_2 \) through a measured distance \( h \), released for a consumption in the apparatus a quantity of potential energy \( (m_1 + m_2).g.h \), where \( g \) represents the acceleration due to gravity.

A total of \( n \) successive descents, where \( n \) is some integer, therefore made available an amount of potential energy \( n.(m_1 + m_2).g.h \).

This energy could be consumed by the apparatus in the following ways:

(1) As kinetic energy of translation of the moving parts in linear directions. (Denoted by T.)

(2) As kinetic energy of rotation of the pulleys, shaft and paddle. (Denoted by F.)

(3) In overcoming frictional resistance in the pulley bearings, and viscous drag of the surrounding air on the moving

Thus F = n.b.g.h.
Hirn's Impact Apparatus

Hirn selected the metal lead as the material to receive the impact, since the properties of this substance are such that most of the lost kinetic energy reappears in it as heat. Its softness makes a blow almost inaudible, its small elasticity produces little friction in hammer and anvils, and its low specific heat gives a large temperature increase from the heat developed by the friction of its molecules while it is being deformed. Hirn's apparatus is illustrated in Fig. 4. A massive rectangular block of stone serving as anvil and a heavy solid cylinder of iron acting as hammer were suspended by means of parallel ropes from the cross-beams of a rigid wooden frame. A cylindrical vessel of lead was held with its base against an iron plate at the end of the tube to be impacted. The iron hammer released from its position 1 to swing down through a measured height $h_1$ into its position 2. In the recoil the hammer and anvil rose through small measured heights $h_2$ and $h_3$, respectively. The lead cup, released by cords immediately after impact, was then partly filled with a measured amount of ice-water and the rise in temperature of the water in the warm lead cup recorded.

Let the masses of iron hammer, stone anvil and lead cup be denoted by $m_1$, $m_2$, $m_3$, respectively. Then the potential energy $m_1g(h_1 - h_2)$ of the poised hammer is converted into kinetic energy during its downward swing, and as such is delivered to the lead cup by impact. A small part of this energy is used up mechanically as the hammer and anvil recoil through small heights $h_2$ and $h_3$. At their recoil peaks their potential energies are $m_2g(h_2 - h_1)$ and $m_3g(h_3 - h_2)$, respectively, so that a balance of energy $m_1g(h_1 - h_2) - (m_2g(h_2 - h_1) + m_3g(h_3 - h_2))$ is left to reappear in the lead as heat, if small energy losses due to noise of impact, viscous drag of air, friction of supports and so forth are disregarded. If $t_1$ deg. C. is the temperature of the lead immediately before the collision, $t_2$ deg. C. the final temperature after pouring in a mass $m_3$ of ice-water, and $S$ the specific heat of lead, then the heat developed in the lead is given by $m_3S(t_1 - t_2) + m_3t_2$. A value of $J$ may then be estimated from the ratio $m_1g(h_1 - h_2)/(m_2g(h_2 - h_1) + m_3g(h_3 - h_2))$.

Searle's Friction-cone Apparatus

A modern form of laboratory instrument designed by Dr. G. F. C. Searle for the measurement of the mechanical equivalent of heat is illustrated in Fig. 5. In this apparatus heat is developed by friction between the slightly lubricated surfaces of two closely fitting, hollow conical cups of brass which turn, one within the other, about a common axis of rotation. By means of pins protruding from its base, the outer cup is fitted to an ebonite seat in a brass holder which is mounted on a vertical spindle set in bearings in the base of the apparatus. The spindle is turned by means of a belt which passes round the spindle-wheel, over a pair of guide pulleys to the hand-wheel used by the operator to set the apparatus in motion. The inner conical cup carries two vertical pins on its lip which fit into a broad wooden disc. A cord with one end attached to the rim of this disc passes over a pulley and holds a mass in suspension at a fixed level when the apparatus is in operation. A heavy iron ring pinned to the top surface of the disc presses the cups together and provides a suitable rate of friction when they rotate. In performing the experiment the hand-wheel is turned at such a rate that the friction between the inner and outer cups is just sufficient to prevent the former from rotating under the tension in the cord which carries the suspended weight. Careful control of the turning of the hand-wheel is needed to keep the weight suspended at a constant level. The heat developed by friction distributes itself throughout the brass of the two cups and the water in the inner cup, and the rise in temperature produced is measured by a thermometer in the water. A value of the number of revolutions is registered by the revolutions counter so as to leave the sum total of energy unaltered.

Conservation of Energy

The proof that heat and mechanical work were two different aspects of the same thing was but one link in a wide chain of experiment and reasoning which led to the founding of the doctrine of the conservation of energy. This doctrine was not the outcome of the work of any single individual, nor was it a discovery made suddenly at a certain time. In the history of physical science there are to be found many instances of discoveries of outstanding principles and phenomena which have received their first definite name of a discoverer. Notable examples are Clerk Maxwell's electromagnetic theory of light (1865), Planck's quantum hypothesis (1900), Einstein's relativity principle (1905), and Rutherford's nuclear theory of the atom.
High-power Short-circuit Testing

Measuring and Computing the Power Factor

BY S. STATON

(Continued from page 57, November issue)

Now time constant for the circuit \( L = R \):

\[
\text{Time constant} = \frac{L}{R}
\]

where \( L \) is the circuit inductance and \( R \) is the circuit resistance.

This is done by calculating the time constant of the D.C. component curve from one of the phases in which the current is constant of the D.C. component curve from the known circuit constants for the particular test set up.

Thus, the resistance of the test circuit and \( X \) is the reactance, then the power factor may be obtained by the formula:

\[
\text{Power Factor} = \frac{R}{\sqrt{R^2 + X^2}} 
\]

where \( \phi \) = the angle of lag or lead of the current vector with respect to the voltage.

The value of power factor as calculated above can be checked from the oscillograph record of the phase currents.

This is done by calculating the time constant of the D.C. component curve from one of the phases in which the current is constant. The method is as follows:

- The current wave is split up into two equal portions by drawing in vertical ordinates as shown numbered 0 to 10 inclusive.
- The asymmetrical R.M.S. value of the current is calculated by the formula:

\[
I_{\text{R.M.S.}} = \sqrt{\frac{1}{10} (I_0^2 + I_1^2 + I_2^2 + I_3^2 + I_4^2)}
\]

where \( I_0, I_1, I_2, I_3, I_4 \) are the asymmetrical current components.

The asymmetrical current wave is shown in Fig. 21.

The current is then, by equation 11, obtained by the formula:

\[
I = I_0 + I_1 + I_2 + I_3 + I_4
\]

Reference to the short time current carrying test was made in Article 1. It was stated that for a given test the short-circuit current was passed through the circuit breaker for intervals of five seconds. It was continued that the arcing times are reasonable as compared with those of breaker tests made in this country.

Power Factor

The power factor limit set out in Article 1, is 0.15 for a breaker of this capacity.

The values of 0.06 and 0.058 for this test are a very good indication of the margin of severity of the test circuit. These low values have a bearing on the recovery voltage as explained in Article 1.
Table: Tabulated Record of Short-Circuit Test on Oil Circuit Breaker

<table>
<thead>
<tr>
<th>Test Duty</th>
<th>Phase</th>
<th>Making Current in Kilo Amps</th>
<th>Breaking Current</th>
<th>Recovery Voltage</th>
<th>M.V.A. Broken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Symmetrical Kilo Amps</td>
<td>Recovery Value</td>
<td>Per Phase</td>
<td>Total Power</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of D.C. Component</td>
<td>Value in Kilo Volts</td>
<td></td>
<td>Factor</td>
</tr>
<tr>
<td>Break</td>
<td>Red</td>
<td>2.30</td>
<td>11.95</td>
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**Remarks on Physical Behaviour**
- Slight emission of oil. Arc contacts moderately burnt.
- Slight emission of oil and smoke. Arc contacts moderately burnt and pitted.
- Slight emission of oil and smoke. Slight burning marks on arc contacts.
- Slight oil emission. Moderate smoke emission. Main contacts pitted. Arc burning marks on arc contacts.
Recovery Voltage

It will be noted that the recovery voltage never fell below 105 per cent. of the test line volts, so that the limit in BSS/116/37 of 102 per cent. is well covered. In Test No. 5 it rose to 104.6 per cent., which figure more than covers the requirements.

D.C. Component

The severe conditions of test on this breaker are further borne out by the figures obtained for the D.C. component. Conditions are laid down that for a symmetrical test the D.C. component in the instant not exceed 20 per cent of the A.C. component, and for an asymmetrical test it must not fall below 50 per cent.

M.V.A. Broken

The M.V.A. broken is well in excess of the rated capacity of the breaker. It should, of course, be noted that when a test circuit set-up is being made, it is only possible to set the M.V.A. figure to within approximately 5 per cent. of the rated capacity, and consequently the test allows a margin in excess as a factor of safety.

Restriking Voltage

The subject of restriking and active recovery voltage is one that has occupied a prominent place in the minds of switchgear engineers for many years. Its implications and bearing on circuit breaker performance has been the subject of many technical papers, etc., but the writer, in his experience and perusal of the subject has failed to find any work which sets the matter out in a simple way for the benefit of the general engineer, it will, therefore, be the effort here to explain the matter in the simplest possible way. To begin with, the reader should bear in mind that it is with the permanent extinction of the current arc across the circuit breaker contacts that we are mainly concerned. It will be recalled from our studies of oscillograph records that the arc is always interrupted on or about the instant of zero current. Consider now what is happening immediately before the arc interruption; the current is very quickly decreasing in value. In other words, the rate of change of current has been suddenly reduced from a very high value to zero. This sudden reduction in the rate of change of current gives rise to an oscillating voltage across the circuit breaker contacts. Such a voltage is termed "restriking voltage," because it tends to re strike the arc.

Frequency

The frequency of the restriking voltage depends upon the test circuit constants, viz., inductance and capacitance, and in actual fact is equal to the natural frequency of the test circuit. It does not depend upon the normal power supply frequency from the test generator.

Rate of Rise

The rate of rise of the restriking voltage is obviously determined by the frequency, and it is this rate of rise that determines whether or not the current arc is permanently interrupted. This will be understood when we recall the statement in Article 1, that permanent interruption of the arc can only take place if the rate of rise of dielectric strength of the insulating material between the contacts exceeds that of the voltage across them.

Amplitude

The amplitude of the restriking voltage oscillations depends upon the instantaneous value of the recovery voltage, at the instant of sudden rate of change of current or arc extinction; and if a short-circuit is interrupted at the instant of zero current the amplitude is equal to that of the instantaneous recovery voltage.

The Bearing of Synchronous Plant on Restriking Voltage

From what has been explained about the rate of rise of the restriking voltage, and its bearing on the restriking of the arc, it will be gathered that when a circuit breaker is in service, its ability to permanently interrupt a short-circuit depends much upon the type of generator supplying the line and the characteristics of any synchronous plant between the generator and the point of short-circuit. It would, of course, be out of line to discuss the characteristics of electrical machinery in these articles, but it is fitting that some attention be given to their effects on the subject in question. Whatever may be included in the system, the circuit can be reduced to three components, viz., resistance, capacitance and inductance. Resistance and capacitance are constant, but the sudden changes in current value cause corresponding changes in the flux linkages and hence the inductance of transformers, reactors and any rotating machinery.

Active Recovery Voltage Definition

It has been stated that the amplitude of the restriking voltage oscillations depends upon the instantaneous value of the recovery voltage. It is this instantaneous value divided by \( V_2 \) that is termed "active recovery voltage."

Bearing of Current Asymmetry and Power Factor

The value of the active recovery voltage depends upon the system power factor and the degree of asymmetry of the current wave. Thus is illustrated in Fig. 25, in which is shown an asymmetrical current wave and the corresponding phase voltage wave. If the current arc is assumed to be interrupted at the instants of zero current, it will be seen that at each such instant the voltage wave has a different amplitude. These corresponding voltage values, divided by \( V_2 \) represent the values of active recovery voltage at the particular instants. It will be appreciated that the lower the power factor of the system, the higher will be the value of the active recovery voltage since a zero point in the current wave will correspond more closely with a maximum point in the voltage wave. If the first two or three cycles of the current wave are examined, it will be noted that the degree of asymmetry is considerable, and that the values of voltage indicated by \( V_1 \) and \( V_2 \) are very far apart. At the other end of the wave, however, where the current is more symmetrical, the values of voltage indicated by \( V_4 \), \( V_5 \) and \( V_6 \) are substantially the same.

Relevant Provisions of BSS/116/37

The foregoing serves to explain the control of recovery voltage, test circuit power factor, and the degree of asymmetry in Part I of BSS/116/37. These provisions were outlined in Article 1. It will have been noted that when commenting on the provisions of voltage and power factor in Article 1, it was stated that for circuit breakers of larger breaking capacities than 500 M.V.A. the value of the recovery voltage must be as near to 100 per cent. of the rated service voltage as possible. This, in effect, leaves the matter uncontrolled, and it is now opportune to give some explanation for this. A circuit breaker of 500 M.V.A. capacity and upwards would only be installed at a point in the supply system where a large power is to be handled. Such a point is obviously at the head of the system, or in other words, near to the generating plant. If a short-circuit occurs near to the latter, the short-circuit current will be relatively high because of the comparatively small amount of line and plant reactance in between the generator and point of short-circuit. This, in turn, will effect a correspondingly large drop in voltage, and hence the value of the recovery voltage will be comparatively low.
Electricity from Dissimilar Metals

More than any material monument could ever do, that universal designation of the simple unit of electrical pressure or potential, to wit, the volt, has survived in perpetuity the memory of Alessandro Volta, the Italian physics professor, who first discovered the electric current towards the end of the eighteenth century.

Volta's lasting fame and celebrity is a deserved one, for it was he who, through the "invention" of the electric current, made the first really practical stride towards the day-by-day utilisation of electrical energy which we see around us in modern times. It was, indeed, this pioneering discovery of Alessandro Volta which paved the way for the host of important electrical discoveries and applications which came after him.

The epoch-making discovery of the electric current was intimately bound up with the "frogs' legs" business of Volta's countryman and contemporary professor Dr. Luigi Galvani, whose life-story formed the theme of our last article of this series.

Galvani, it will be remembered, had nailed his colours to the mast of "animal electricity," and perhaps because of that he had died a disappointed man. He had maintained that the convulsive twitchings of frogs' legs, when dissected and touched at certain points with metallic conductors, were due to inherent electrical charges within the animal muscles. Volta showed that such a hypothesis was simply not true, and because Volta, at that time, was professor of Physics in the University of Pavia, and, so to speak, Galvanii's "opposite number" in the Italian academic world, a controversy arose which at one period seemed to rock the very fundamentals of science.

Electricity from Dissimilar Metals

It was because Volta had been able to demonstrate the fact that the characteristic twitchings of the dissected legs of frogs were due to the influence of two dissimilar metals in the presence of moisture and traces of mineral salts derived from the flesh and muscles of the amphibians that the same investigator was led to experiment with the effect of salt solutions on dissimilar metals, and, as a result, not only finally and conclusively to confute Galvani's theorems, but, more important still, to introduce to the world for the first time a controllable means of generating a continuous flow of electricity—in other words, an electric current.

Alessandro Volta, Discoverer of the Electric Current

Alessandro Guiseppe Volta was born at Como, Northern Italy, on February 18th, 1745, the year of the "Bonny Prince Charlie" uprisings and their ruthless suppression in England.

Alessandro was the child of parents who were "down on their luck." Indeed, the child himself seems, as a youngster, to have been afflicted with some of his parents' bad luck, for at four years of age he was unable to attain the age of ten his wit suddenly quickened and a flood of intelligence came upon him. He went to the Jesuit school in Como, and within five years he was the school's leading scholar.

"I had a diamond in my house," remarked his father on one occasion, "but I failed to realise it."

Latin Poems on Chemistry

At the age of nineteen, Volta was composing Latin poems on various chemical subjects, a fact which tells us that the growing chemical science of the day must have claimed him as a close adherent.

Finishing his education at the Royal Seminary in Como, Volta settled down to the humdrum life of a teacher. However, he seems not to have taken too kindly to the monotony of this career. Stung up by the experimental writings of the famous Abbé Nollet, of France, he began experimenting for himself in the realms of frictional electricity. He entered into a voluminous correspondence with the learned Abbé, as well as with other pioneer electrical experimenters, including the famous English electrical and chemical pioneer, the Rev. Joseph Priestley, discoverer of oxygen.

The Electrophorus

In 1775 Volta announced his discovery of the "Electrophorus," the principle of which he hit upon when studying the insulative properties of oil-impregnated timber.

The electrophorus (or "electricity-bearer") comprises a circular moulded cake of resin suitably mounted on wood. Resting on its upper surface is a metal disc provided with an insulated handle.

The resin cake is electrically excited by rubbing a dry fur over it, after which the metal disc is placed in firm contact over it. The disc is then momentarily touched with the finger, and it is subsequently lifted out of contact with the resin. It will then be found to be heavily charged with electricity, so much so that it will be capable of emitting sparks.

At the same time, the cake of resin retains its charge, and it will induce a second and even a third and successive charge in the metal disc whenever the latter is allowed to make contact with it.

The explanation of the electrophorus' action is simple. The resin cake is charged negatively by the rubbing. On placing the metal disc on its surface the disc becomes positively charged on its lower or under surface and negatively charged on its upper surface. A mere touch of the finger provides a leakage path for the whole of the upper-surface negative charge, the disc retaining only its positive charge which is capable of giving rise to sparks and to other static electrical phenomena.

Here, therefore, was a simple means of generating relatively strong static charges without continuous frictional rubbing, for once the resin cake was frictionally electrified the metal disc could again and again be charged up without much diminution of the charge on the resin base.

The elements of the modern dry battery cell which has developed out of Volta's discovery. (The outer zinc casing forming the cell is not shown in this illustration.)

A modern reproduction of Volta's "Crown of Cups." From this primitive device, the primary battery was developed.
Invention of the Condenser

Volta gave a good deal of thought to the improvement of his electrophorus apparatus. In consequence of his ensuing experiments he not only improved the ordinary gold-leaf electroscope but he also devised an electrometer, or static potential measurer. More important still, he was led to the invention of the electrical condenser.

The principle of the condenser is so widely known that there is no need to occupy valuable space in again describing it. Let it be said, therefore, that Volta gave a long description of his plate condenser in the Royal Society's Philosophical Transactions for 1782 (about three years after he had originated the device), and that by means of this simple yet fundamental appliance he was for the first time able to store up minute electrical charges until they were able to produce plainly demonstrable effects.

In 1779 Alessandro Volta was appointed to the vacant professorship of Physics in the University of Pavia. It was an important teaching and academic post, for Pavia had become a noted centre of Italian learning, and it had gathered a name for itself in respect of its advanced scientific teaching. A year or two after his installation as professor of physics Volta made an extensive tour of the Continental centres of experimental science, coming into close contact with various investigators and, incidentally, collecting much apparatus for the enlargement of his own physics and electrical laboratories at Pavia. He travelled as far as London, demonstrated some experiments to the Royal Society, and then departed homewards. The Royal Society Council elected him an F.R.S., and, some three years later, awarded him its greatest honour, the Copley Medal, in recognition of his pioneering work in electrical science.

Returning to Italy and to his professorship at Pavia, Volta married. The lady in question was one Teresa Pergrini, a woman of noble birth but of no estate or fortune. She made Volta an excellent wife, assisting him in his researches and taking off his shoulders a good deal of the necessary routine work of his calling.

It was now that Alessandro Volta started on his immortal investigations which, in the end, led him to the discovery of the electric current and of a simple means of generating it.

Galvani versus Volta

Galvani, who had caused such a stir in continental scientific circles with his discovery of so-called "Animal Electricity," was, at that time, a professor of Anatomy in the University of Bologna. He had made his name celebrated by his theories of animal electricity, and there were few who were likely to dispute his contentions.

But Alessandro Volta, with his improved electroscopes and electrometers, with his newly constructed condensers and his superior electrical knowledge, was able to repeat the "frogs' legs" experiments of Galvani with a greater scientific exactitude. Volta obtained the same results as Galvani, but, as we have seen, his basic interpretation of them was altogether different. In short, Volta entirely refuted the theories and contentions of his contemporary, Galvani. Thus began an urgent scientific controversy, an academic contest during which feeling seemed, for a period, to run dangerously high on both sides, but which in the end was concluded with a decisive victory for Volta's experiments and Volta's reasons.

This contention between the professional anatomist and the professional physicist was no mere storm in a teacup. It raged throughout Europe. It penetrated into British scientific circles as well, splitting the scientific world of the day into two sometimes bitterly opposed factions, the Galvanists and the Voltaists.

Experiments on Criminals

An entire volume could be written on the subject of this early scientific controversy. But such a volume has not yet appeared. It would, however, tell of the manner in which the Galvanists applied their experiments with considerable ingenuity to the bodies of cows, calves, sheep and pigs in order to contort the limbs of these dead animals into life-like movements through the agency of "animal electricity." It would relate also the gruesome experiments on the bodies of executed criminals whereby dead limbs were made to execute mysterious contortions and even decapitated heads to produce horrible, convulsive grimaces.

But all such experiments, accurate and logical as they may have been, were all perfectly explainable on Volta's thesis of the electricity's origin. In a word, Volta discovered that electricity made its appearance whenever two dissimilar metals came into contact, particularly in the presence of salt solutions.

The "Crown of Cups"

In order to prove his contention that electricity can be produced by the action of mineral salt solutions on dissimilar metals Volta devised his now famous and classical "corona," or "Crown of Cups." The "Crown of Cups" was the world's first electric battery, the first current generator ever made. In it plates of zinc and silver (afterwards zinc and copper) were immersed in pairs, one zinc plate being soldered up to the adjoining silver (or copper) plate in the adjacent cup. The cups were filled with a solution of common salt. On joining up the two end electrodes of the series of cups (i.e., the silver and the zinc plate) a steady supply of electricity was drawn from the cups.

Owing to what we now term the "polarisation" of the electrode plates, the action of the Crown of Cups was not very satisfactory, but about the year 1800 Volta gave to the world his famous "Pile," the product of eight years' work on the "animal electricity" controversy.

Volta's Pile

Volta's Pile was described in a letter which was read before our Royal Society in June, 1800. In this letter Volta says that his

Another simple primary cell—zinc and carbon elements immersed in a solution of sal-ammoniac (ammonium chloride). From this was developed the well-known Leclanché battery.

The simplest voltaic cell—electrodes of copper and zinc immersed in diluted sulphuric acid.
NEWNES PRACTICAL MECHANICS

December, 1945

What Do You Think?
Further Comments on Some Interesting Subjects
By Prof. A. M. LOW

I HAVE been sitting in a garden. I cannot help feeling that Omar Khayyam and other poets have missed a great deal, for they write almost entirely of sensual pleasures. Wine, food and other subjects are in the ascendency. Is there no one who can tell me about things which last longer? Have we no glories, no interests, no hope, no dreams, no purpose, no belief in chance, and when I see a dandelion, I begin to wonder whether its final resting place is really due to chance.

I must use some apparatus which is better than my ears for recording, and I may find, in the wind, an extraordinary chirruping to everyone who has discovered that they can enjoy the pictures, sitting at great expense to everyone who has discovered that they can enjoy the pictures, sitting at great expense.

Disc for illustrating a peculiar property of the human eye.

The Glazier's Diamond
Let us now be entirely practical. Take a diamond and think what it can have to do with noise. Diamonds are, of course, used in many measuring instruments which themselves impart a combat noise. But I was thinking of an ordinary glazier's diamond which we hold at a certain angle on the glass for it best to cut. At the contact of course if you will notice, for instance, that the water acts like solid sulphuric acid. But this was the last of Volta's discoveries. Indeed, from a point of view of discovery, Volta's increasing fame seems to have been his downfall. The principle of the cell was enormously developed by Davy, Wollaston, Cruikshank and others. It was used for the electrolysis of water, for the production of the electric arc and for various other uses, yet never an interest did Volta himself seem to take in these British advances.

In 1823 he suffered an apoplectic seizure, from which he never really recovered. The end came nearly four years later, when, on March 5th, 1827, he died after a day or two's illness.

Dream Phenomena
The queen of speed and time is rather well illustrated by the dream in which you purchase a ticket to India, arrive, hunt the lizards and finally shoot it, waking up in alarm to find that the banquet is over. It is really a tap on the door with your tea. For the noise in your dream and the noise on the door to have such remarkable similarity, you must have traversed the whole period during the fraction of a second between the knock on the door and waking. More wonderful is it that for those two noises to coincide the story seems to have been constructed backwards in your brain!

The Human Eye
The eye is notoriously easily deceived, and one of the reasons is that, considered as an optical instrument, it is very badly made. Should we think of the human eye as a photoelectric cell which took an appreciable part of a second to recover after activation? Yet it is due to this very fact of retentivity that we are able to enjoy the pictures, sitting at great expense. The eye which sees colour and shape is well known to everyone who has discovered that they can look straight at the clock. But the colour and shape parts of the eye seem to be connected, or else one can irritate the other. Make yourself a cardboard disc about four inches diameter, and marked as in the accompanying sketch. Spin it slowly in a bright light and watch. It is only black and white, but just wait and see if you see what I see.

Supersonic Sound
Half the interest of science is supplied by devices to improve our senses. Thus, supersonic sound can kill fish or even flies, and everyone knows of the high-pitched whistle which can only be heard by a dog. One should live all the time trying to imagine that we have more than our mere human senses.

You must have noticed that the speed at which anything happens makes an enormous difference to its impact upon our senses, or even upon the result. Grains of sand will damage an airscrew if the speed of meeting is sufficient. Water is very high at speeds, and there is a water jet in a continental public garden into which it is impossible to put your walking stick because the pressure of the jet is so high that the water acts like solid rod. When engineers design inlet pipes for gas they bear this deciding factor of speed in mind, for they know that the gas acts more like treacle when the cubic feet per second flow is high.

It is in problems of this kind that our senses can be aided by the high-speed cinema. I recollect a case where aensation of convolvulus was able to force its way through six inches of concrete. The pressure was maintained for so long that the result was that of a hard steel rod boring into butter.

High-speed Problems
High-speed sense observation is rather fascinating. When you ask if the ruffling in a gun should be reversed when the weapon is to be used in Australia, I always reply by inquiring whether baths run out with a specific whirl at the plug dependent upon their geographical situation. Talk a little about jumping higher on the Equator, which is challenging, and most people are thoroughly confused.

High-speed cinemas show that the bath vortex depends upon what the plumber's pipe does. Try this too, and use a revolving mirror, so that your eyes can speed up and down as if you were a monkey, a cat or a fly.
Rocket Propulsion

Rocket Propelled Aircraft, Research with Models

By K. W. Gatland

(Continued from page 51, November issue)

The outbreak of hostilities, too, had much effect on the activities of the various British groups—the Manchester Astronautical Association and the Astronautical Development Society (the latter was not given a title until 1941, being originally a small local group)—and although it did not cause their disbandment, there was an immediate curtailment of active research under the Defence Regulations Act, 1939, which made the preparation and firing of rockets during the war illegal.

Thereafter theoretical research became the vogue, and much valuable work has been conducted during the war years which of detailed reports have been published on the following subjects: (a) The fundamental design of rocket aircraft; (b) The design development of meteorological sounding rockets; and (c) An investigation of reloading systems in "solid" fueled rocket units.

Rocket Aircraft

In the first issue of the Manchester Association's Journal, (Spacemurd, Vol. 1, No. 1, August, 1930), were published the initial sketches of a single-seat rocket aircraft, suggested by the M.A.A. Research Committee (Fig. 41). This conception was intended merely to form the basis for a report of the engineering and aerodynamical problems involved in the development of high speed, high altitude aircraft, and as such the design was not pursued in detail. It was, however, necessary to carry out a preliminary design procedure in order to estimate the essential dimensions and weights for the purpose of approximating the performance.

The machine in question (Fig. 41) differed in many ways from the orthodox. A high-wing aircraft, its fuselage was short and stubby, with horizontal surfaces swept back well beyond the rear. The vertical stabiliser, fin and rudder emanated from just aft of the nose cabin and, similarly, swept beyond the fin and rudder. The obvious remedy was to augment the thrust, and the centre of thrust, attached behind the centre of gravity and thrust, and and from the primitive firing of the machine's performance are

The Propulsion Unit

The driving motor was something quite new in rocket units, and solved the propellant feed problem very simply. Instead of employing a gas charging system, or pressure pumps, which would necessitate an auxiliary driving motor, a fuel injector system was devised in which the oxygen and fuel were centrifugally fed to a multi-chamber propulsor under the axial rotation of the complete unit. The centrifugal injector is shown in Fig. 42. It is an example of an entirely self-feed arrangement.

These are housed within the conical tail fining. The ignition circuit is then closed and the rocket chambers fired, causing the unit to light due to the igniter thrust. This immediately affects pressurisation of the fuel tanks through the rotation of the oxygen feed shaft, and the pump geared from it; at the same time the oxygen feed valve is automatically released, permitting the fuel and oxygen to pass to the centrifugal unit where delivery is made to the reaction chambers in correctly metered proportion, and at constant and high pressure.

Model Research

Several models of the aircraft were constructed, mainly for the purpose of gaining some idea of its stability, but, unfortunately, only the initial flight trials of a first powder driven model were possible owing to its completion only a few weeks before the outbreak of hostilities.

At that time plans had been formulated for the construction of a large oxyalcohol powered model, but the war left this particular project unfinished.

A later model was fitted with a thrust augmenter located behind the centre of gravity and the centre of thrust, attached over the propelling jets. Gliding trials, however, proved this arrangement unsatisfactory in that it had a detrimental effect on stability. Although the augmenter maintained the model on a direct course during sustained flight, this ideal condition remained even when the machine's nose was down. Landing, when such a condition became by no means ideal as the 'plane was incapable of levelling out. The obvious remedy was to provide the intake for the augmenter forward of the centre of gravity and thrust, and modifications were made to the basic design to provide for this.

 Shortly after the cessation of hostilities in Europe, the improved model was flown under power, and showed itself capable of rapid and well stabilised flight.

The propulsion unit in the models comprised, in each instance, eight individual powder charges. Four of these were termed "primary" and the remainder "secondary," being alternately placed on a circle in order to balance the thrust, and slightly inclined to impart axial rotation.

The primary charges are, of course, provided for the initial acceleration, and the secondaries for maintaining level flight once the requisite height has been attained. To achieve this, the primary units were provided with a more energetic powder composition than the secondaries, each firing phase being a duration of four seconds.

Complete references to the calculations arrived at of all the performance are
such they were not fitted with control aerofoils. Instead, directional control was effected by the simple procedure of providing an efflux discharge ring within the nozzle mouth, free to swivel—at the control of the pilot—in any direction, up, down, or sideways, so that the exhaust impinged, thereby causing offset thrust and controlling the 'plane's flight with the same effect as rudder and elevators. The wing was fitted with ailerons in the usual way.

The cabin formed the nose of the aircraft, and a large clear-view Perspex type hood was fitted in keeping with the nose contour, intended to afford a wide angle of vision.

The Astronautical Development Society

This is a convenient stage to introduce the work of the Astronautical Development Society, as its early researches were very much akin to those of the Manchester group.

The A.D.S., formed in July, 1941, by the writer and Mr. H. N. Pantin, around the nucleus of a small local group at Surbiton, Surrey—whose activities date back to the summer 1938—was originally an independent organisation.

In January, 1942, however, contact was established with the M.A.A., and within a short while, in August of the same year, the two societies were provisionally amalgamated. This resulted in an agreement to the effect that, in order to facilitate a more "localised" programme of research for each group, the M.A.A. should govern the rocket interest of northern England and Wales and Scotland, while the A.D.S. administered to the southern counties.

The membership total of the Manchester group at that time was the very low figure of 13, while that of the A.D.S. was little better at 25. The war brought about a severe reduction in members, and both groups had definitely seen better days. The increased strength arising from the merger, however, had a marked immediate effect, and by 1943, the total membership was over 100. That year, too, saw the issue of a combined journal and bulletin; the title of the former remaining Spacemakers.

Although the pre-A.D.S. local group carried out free-flight tests of small powder rocket units, these were, in essence, very similar to those conducted by the Manchester groups, and were very largely pure duplication.

The first really significant work of the society proper was the investigation of problems associated with the development of rocket aircraft, and this survey was commenced in complete ignorance of the very research which was being pursued, at the same time, in Manchester. When notes were compared later, it was found that almost identical principles had been evolved by the two independently working groups.

The M.A.A. concluded, its rocket plane investigations shortly after the amalgamation, to commence a mathematical survey of sounding rocket trajectories, leaving the A.D.S. to continue the original line of work.

Unlike the M.A.A. rocket plane conception, the A.D.S. model (Fig. 43) had a low wing and an augmenter intake placed near the nose. Its only outward similarity was the tail assembly which comprised horizontal stabilisers, and a single dorsal fin, swept back beyond the rear fuselage. These surfaces were intended purely as stabilisers, and as

A Turbo-thrust-feed Motor

The liquid-fuel motor provisionally developed for the original A.D.S. model was, too, somewhat unique in design, and as with the M.A.A., "centrifugal injector" was the propellant feed problem which was solved quite simply. Similarly, once set in function, the unit would operate continuously at a constant feed pressure until the propellant was exhausted.

The feed system in the A.D.S. motor (Fig. 44) was arranged through a turbine driven pump, the turbine being fitted directly inside the combustion chamber at the back, and functioning by the thrust pressure of the expanding gases. A hollow shaft, fitted through the axis of the turbine, passed out through the rear wall of the chamber, and from this was geared the oxygen and fuel pumps.

The end of the shaft fitted into the oxygen delivery tank, in which it rotated on a sealed bearing, allowing the oxygen to pass through the shaft to the combustion chamber. The oxygen pump served to pressurise the liquid oxygen tank, and thus it was ensured that the oxygen entered for combustion at a high and uniform pressure.

The fuel—similarly forced from its tanks under pressure from the pump—prior to entering the chamber was utilised in cooling the motor casing. After passing through a jacketed portion, having been conveniently vapourised by the absorbed heat, it was fed for combustion, entering from two inlets placed behind the turbine.

On the reverse side of the turbine was fitted a centrifugal impeller blade system intended to fling the fuel out into the chamber from the back of the turbine vanes, and in this way the oxygen issuing from the shaft was isolated from the chamber walls until the propellant was adequately mixed. Thus, the danger of oxidation, the main cause of earlier motors' disruption, was thought to be largely eliminated.

A multi-chamber liquid-fuel motor—designed on the same principle as the M.A.A. "centrifugal injector"—was later proceeded with and in this it was arranged to feed the propellant centrifugally through rotating the complete unit by offset thrust. In view of the large masses involved, however, and the likelihood of excessive torque, a model of the unit was not constructed, although a model aircraft employing a similar powder system was successfully flown, prior to the official formation of the society.

Rocket Aircraft Development

The conclusions derived from the M.A.A. and A.D.S. investigations, covering the

Fig. 43.—Suggested layout for an air-augmented rocket aircraft. Air is induced and expanded by the exhaust stream in a secondary "expansion chamber."—A. D. S. (1941).

Three views of the original air-augmented rocket plane model developed by the A. D. S., and built by a member of the society, Mr. D. Ashton. Photographs by Mr. H. J. Kendrick, Surbiton.

The propellant tanks were well dispersed about the centre of gravity; the main fuel tank being immediately behind the cabin, while two additional containers were placed just outboard of the wing roots. A large cylindrical liquid oxygen tank extended from the nose fuel tank to the motor at the rear end of the fuselage.

A Turbo-thrust-feed Motor

The liquid-fuel motor provisionally developed for the original A.D.S. model was, too, somewhat unique in design, and as with the M.A.A., "centrifugal injector" was the propellant feed problem which was solved quite simply. Similarly, once set in function, the unit would operate continuously at a constant feed pressure until the propellant was exhausted.

The feed system in the A.D.S. motor (Fig. 44) was arranged through a turbine driven pump, the turbine being fitted directly inside the combustion chamber at the back, and functioning by the thrust pressure of the expanding gases. A hollow shaft, fitted through the axis of the turbine, passed out through the rear wall of the chamber, and from this was geared the oxygen and fuel pumps.

The end of the shaft fitted into the oxygen delivery tank, in which it rotated on a sealed bearing, allowing the oxygen to pass through the shaft to the combustion chamber. The oxygen pump served to pressurise the liquid oxygen tank, and thus it was ensured that the oxygen entered for combustion at a high and uniform pressure.

The fuel—similarly forced from its tanks under pressure from the pump—was fed into the chamber was utilised in cooling the motor casing. After passing through a jacketed portion, having been conveniently vapourised by the absorbed heat, it was fed for combustion, entering from two inlets placed behind the turbine.

On the reverse side of the turbine was fitted a centrifugal impeller blade system intended to fling the fuel out into the chamber from the back of the turbine vanes, and in this way the oxygen issuing from the shaft was isolated from the chamber walls until the propellant was adequately mixed. Thus, the danger of oxidation, the main cause of earlier motors' disruption, was thought to be largely eliminated.

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Rocket Aircraft Development

The conclusions derived from the M.A.A. and A.D.S. investigations, covering the
The "uranium bomb" has given dramatic illustration of the vast powers available in atomic disruption, and clearly, once this energy can be harnessed for direct reaction, we will have at our disposal a highly powerful and economic propulsor agent, not only adequate for all terrestrial uses, but also capable of fuelling the most enterprising "interplanetary space-craft." Many technical difficulties remain, however, before the liberation of this energy can be moderated; and these are also several associated problems which will invariably arise in its application—principally, the very high temperatures and pressures that are likely to be raised in the "atomic generator," and the necessity for providing suitable screening against the harmful radiation emitted in the bombardment of the radioactive U-235 isotope.

This subject is too vast in its possibilities to pass over hurriedly, and a more detailed account will be given in a later article.

The Thrust-augmenter
Apart from the high fuel consumption in chemical rocket units, the second disadvantage, directly associated with the first, is their inability to function without profuse waste of energy at low speeds, and within the atmosphere. Hence the importance given to the thrust-augmenter, which aims to increase the mass flow while decreasing the speed of ejection. The need for providing entry for the augmenter forward of the C.G. and C.T. has already been mentioned, but it is obvious that this involves a large area of ducting, which naturally would add materially to the drag due to friction. The better solution would appear to be the use of inlets flush to the skin, and, in this form, stability would not be impaired even though they were located in the rear fuselage. Not only would this arrangement solve the intake problem, but it would also bring about a useful increase of the form efficiency due to the removal of boundary layer.

Boundary Layer Control
The total drag of an aircraft is made up in two components: (a) skin friction, and (b) the formation of a turbulent wake. The form of the aircraft, of course, determines the character of pressure distribution about its surface, and, with careful streamlining, these changes in pressure can be arranged to take place gradually, so that the transition of laminar flow into turbulence is close to the rear of the body, and results in a narrow wake. Under such conditions the resistance due to turbulence comprises only a very small part of the total drag, the remainder being due to surface friction; the boundary layer, which has effect over almost the entire surface.

The boundary layer is formed as the result of frictional forces which arise between the surface and the air, represented by the resistance which each particle offers as it moves past others. The air particles immediately adjacent to the surface adhere, while those of subsequent layers, less able to resist the air flow, progressively obtain the speed of free air, the degree of frictional retard diminishing as the distance from the surface increases. This results in the formation of a thin layer of vortices over the surface, which, at the point of transition, suddenly effects a change, and the air particles in the boundary layer assume a vigorous swirling at right angles to the direction of flow, causing the turbulent wake.

The location of the intake is, therefore, most effective just forward of the point of transition, so that the depth increment of the boundary layer is reduced and the separation into turbulence delayed. Investigations have shown the most efficient intake arrangement for this purpose to be simple, wide slots, set at right angles to the skin contour, and flush in the surface, as shown in Fig. 46.

The diagram gives some idea of the boundary layer formation in this region, and indicates the method of abstraction to the rocket propulsor.

It is also a possibility to discharge the combustion effluent on to the outer surface in order to speed the boundary layer as a further means of delaying the separation. In this instance, the expulsion orifice is most efficiently arranged with its leading edge fined sharply to blend with the skin line, so that the gases are ejected tangentially to the skin curvature (Fig. 46).

These methods of controlling the boundary layer are, of course, most beneficial when applied in thermal-jet, and air-augmented rocket systems, because of the large volume of air to be exercised in the propulsors, and the large mass flow available in ejection.

(To be continued)

From Bombers to Furniture

Another British factory is switching over to peacetime production. In the illustration workmen in the background are assembling parts of a Mosquito fighter-bomber, while others in the foreground are making utility furniture in one of the assembling bays of the Walthamstow factory of F. Wrighton and Sons.
Winning the World's Iodine
A Modern Industry of the Highest Importance

Not only is the element Iodine essential to civilization, but it is also vital to life itself. For in the absence of the trace amounts of this active element which we daily consume in association with our foods, our thyroid glands, those small yet enormously potent iodine-regulated organs which are situated in the front of our necks and at the base of our throats, would cease their body-control functions. The thyroid glands would no longer discharge thyroxine, which is a complex iodine compound, into the blood. Physically, therefore, we should all go to pieces, for it is the thyroid secretion which controls the well-being of the body and the tempo of its processes, and, worse still, we should, in time, become a race of idiots.

There are, too, not many, important modern industries which are not influenced by iodine or its compounds in one way or another. Dyes, photography, medicines, antisepsics, metallurgy, chemical manufacturing, synthetic reactions, colours, oils, gases, preservatives, cosmetics, soaps, and pigments—all these and many other branches of manufacture, together with their multifarious side products, contact at one point or another the usage of iodine.

In modern life, iodine has become one of the indispensable elements like iron, oxygen, nitrogen, sodium and, perhaps, copper. Yet it is an element which has only been purposely used in civilization's activities for a little more than a century.

Iodine takes the form of shining greyish-black metallic-looking flakes which have a characteristic and a not unpleasant "antiseptic" smell. These flakes possess the remarkable property of turning into a vapour or a gas (even at ordinary temperatures) without passing through the liquid stage. If you want to melt iodine you have to melt it under sulphuric acid, which prevents the solid material from vaporising.

The vapour of iodine is of a striking brilliant violet colour, on account of which fact the element originally derived its present name—from the Greek ioneides, "violet."

The ordinary "tincture of iodine" of the pharmacist is merely a solution of iodine in diluted alcohol. Sometimes it contains a certain percentage of potassium iodide, which increases the solubility of the iodine and so enables a stronger solution to be made up.

Iodine in Seawater

Most readers will be well familiar with the fact that iodine is present in the sea. There is only about one-thousandth of an ounce of iodine in every ton of seawater, yet marine vegetation is able to extract these iodine traces and to concentrate the iodine in their stems and leaves. That is why seaweed was at one time the only commercial source of iodine. The weed was collected at certain seasons of the year. It was carefully burned at the lowest possible temperature in low-built stone kilns. The resulting greyish-white ash, termed kelp, was extracted with water and the resulting extract, after concentration, was distilled with sulphuric acid, whereupon iodine was liberated and subsequently collected in cooled receivers.

At no other place of the surface of the earth's natural mysteries which no one has solved. At no other place of the surface of our globe is there anything like the Chile "Nitr ate Desert." It is an entirely unique phenomenon.

One theory of the origin of this nitr ate
The “receiver” of an iodine still with its end removed. Note the mass of iodine crystals lining the interior.

accounts for the existence of Chile's nitrate desert. The clue to this great and engrossing natural mystery is still missing.

Not all the Chilean nitrate desert has the higher grades of this nitrate material are termed caliche, whilst the lower grades receive the name of costra. Caliche holds, usually, about 0.15 per cent. of iodine, costra normally containing some 0.05 per cent. of the same element. Hence, for iodine production, caliche is always preferred on account of its higher content of the desired element. The modern industrial process of winning the 8-out per cent. of the world's iodine supply from caliche is not very complicated, although, naturally enough, in the hot, trying and exhausting climate of the Chilean desert the process can become tedious in the extreme.

The process starts with the crushing of humps of selected caliche by means of mechanical disintegrators. The powdered material is then loaded into an extraction plant in which it is treated with hot water to dissolve out all the soluble salts. By this means a clear-cut separation of insoluble rock-like matter and soluble nitrate is diverted to what is known as the liquid is diverted to what is known as the

By this means a clear-cut separation of insoluble rock-like matter and soluble nitrate is diverted to what is known as the

...and iodates of sodium, potassium, magnesium and calcium.

The “iodine plant.” Here it is run into a large tank in which it is very carefully treated with a solution of sodium bisulphite, which is mixed with it in accurately calculated amounts.

The action of the bisulphite is to change the iodate into iodide. Iodate contains oxygen; iodide is free from oxygen, so that the function of the bisulphite is that of a “reducer” or oxygen remover.

The correct addition of the sodium bisulphite results in five-sixths of the iodate being converted into iodide. The iodate and the iodide then interact in solution with the liberation of free iodine. During the process the tank liquid is agitated by means of blowing in compressed air, or by means of mechanically-driven wooden vanes.

The liberated iodine sinks to the bottom of the tank. When it has done so completely, the top liquid is syphoned off and the crude iodine is run out into canvas filter-bags, in which it is washed well with cold water in order to get rid of soluble material. The iodine bags are now placed in a press so that, after the application of light pressure, the material is obtained in the form of “cakes,” which contain about 80 per cent. of iodine, 5 per cent. of soluble nitrates, and 15 per cent. of adhering water.

“A few crystals of pure iodine, slightly magnified.”
Purifying the Iodine

We have already observed that iodine vapourises easily and, curiously enough, without going through the liquid stage. This property of the element is applied to good effect in its purification.

The "cakes" of impure iodine are broken up into small pieces and are then charged into small cement-lined retorts, which are directly heated with fires underneath. The retorts are connected to a system of earthenware pipes which act as receivers. Each pipe is about four feet long and a couple of feet in diameter. From six to ten of these are placed in connection with the iodine retorts, the joints being luted with a compound of sacking and native mud. In the lower part of each joint a small hole is made, through which the water which has been admixed with the iodine can drain. The iodine vapour enters the pipe-like "receivers" and condenses or "sublimes" on the interior walls thereof in the form of long, irregular crystals. The admixed nitrates and other impurities remain in the retorts in the form of an ash which is subsequently removed.

The entire iodine purification process by means of vapourisation and condensation takes several days, but after the receivers have become quite cold their ends are re-moving, and the iodine crystals are extracted by means of wooden shovels.

Packing Room

When the iodine crystals prepared in this manner contain at least 99 per cent. of pure iodine, they are moved, and the iodine crystals are extracted from them. This process takes several days, but after the receivers have become quite cold their ends are re-moving, and the iodine crystals are extracted by means of wooden shovels.

The Packing Room

In the packing room of the iodine factory the purified iodine is immediately run into small, thick-walled wooden kegs or casks, each cask holding about 70 kilograms of the material. Fresh cow hides are used to cover the tops and sides of the kegs, these having been found to be the most serviceable form of wrapping for this purpose, for the hides, on drying, contracts, and uniformly grip the sides of the keg, thereby making an effective seal through which the contents cannot escape by evaporation during transport through hot climates.

In this condition, the iodine of the Chilean nitrate desert, the seeming "Desert of the Earth," is shipped directly to the ports of the world. There, to be chemically processed and converted into a variety of compounds in accordance with the varying and increasing demands which are being made upon it.

Compared with ordinary seawater, the Chilean nitrate deposits are some 8,000 times richer in iodine. Will the Chilean nitrate desert ever become exhausted? One supposes that such will be the case in the distant future in much the same way as the coal fields of our own country will, surely in time give out.

However, we of the present generation need hardly worry about such facts, for, despite ordinary seawater containing only about a thousandth of an ounce of iodine per ton, yet, calculating on this approximate figure, there must be something like 100 tons of iodine in every cubic mile of the ocean.

Until some discovery on the above lines happens, the world must necessarily depend more and more on the Chilean nitrate desert for its iodine. Little known to the majority of mankind, this great nitrate desert constitutes one of the world's priority supply centres, from which a continuous iodine traffic radiates to all the centres of civilisation.

(An illustrations pertaining to iodine production are reproduced by courtesy of The Director of the Iodine Education Bureau, London.)
The Story of Radar—2

The Operational Development of Chain Coast Stations

(Continued from page 44, November issue.)

In July, 1936, the Director of Signals at Air Ministry was so concerned about the need for early warning of aircraft approaching the coast that he wished to ensure that any device conceived by the Air Ministry research group at Bawdsey should be immediately applied to operational use within the Royal Air Force, and accordingly initiated arrangements to train any personnel necessary for maintaining and operating R.D.F. equipment, so that immediately anything was made by the scientists, the Royal Air Force could use it.

In February, 1937, a training school for R.A.F. personnel was opened at Bawdsey. Its first members included selected flight sergeants and other non-commissioned officers who had given distinguished service to radio-location.

It was decided that the best way in which the instructors could learn the intricacies of R.D.F. equipment was to build a training device which simulated the echoes obtained in actual observation of aircraft and could be used for training purposes without having to fly aircraft, so as to train operators in all the processes of taking readings. The first "trainer" caused the scientific staff some mild amusement, but it served two purposes. Firstly, it taught those who made it considerable about the mechanics of R.D.F. equipment, and secondly, it demonstrated the value of synthetic training equipment, which has been used so extensively throughout the development of radio-location.

A second air exercise was flown in April, 1937, with the students of the school participating; in May the Air Ministry Station at Bawdsey was declared operational as the prototype of the stations which were in the meantime to cover the Thames Estuary; Dover followed in July, and Canewdon (near Southend) in August.

Centralising the Information

It had long been clear that the information from a chain of stations, necessarily so far distributed, could not be independently locate the same aircraft (to ensure gaps cover), would require some reconciliation and interpretation, since none of the observations would be perfectly accurate. So in August, 1937, an experimental "Filter Room" was opened at Bawdsey, to extract the most probable facts from the incompletely concordant reports of the three Estuary stations, and to report expeditiously to the Operations Room of the Headquarters, Air Defence of Great Britain, the inferred tracks of observed aircraft formations. This first filter room played a very important part in establishing filter-room technique in the range of information of Bawdsey scientists, who recognised that this part of their work was no less important than that of getting the primary observations.

The process of filtering that was adopted at Bawdsey was devised of necessity rather than choice, so that the best use could be made of the range of information but inaccurate angular measurements, that could be derived from the equipment then in use.

After the first air exercise using R.D.F. had been flown, and the filter-room technique had been foreshadowed, the Engineer-in-Chief of the G.P.O. visited Bawdsey to investigate what facilities the Post Office could offer. A G.P.O. engineer was seconded to Bawdsey to co-operate with the scientific staff.

A network of specially designed communication lines was needed to link all the Air Ministry radio-location stations with each other and with R.A.F. Fighter Command Headquarters, and elaborate security precautions taken to safeguard the precious information and to preserve continuity in the event of damage by enemy attack. This contribution of the G.P.O. cannot yet be fully revealed because other, at present secret, uses are being made of it, but there is no doubt that this teleprinter network was an important factor in the success of the Air Ministry Radio-location Chain, and of our operational control during the battle of Britain (when 185 enemy aircraft were brought down during the single day of September 15, 1940).

A third R.A.F. exercise, now using the three interim radiolocation stations, was flown in August, 1937, with that variety of experience which is familiar to all experimental developers. The difficulty was to combine frequent practical trials, under constant operational conditions, with research, which demanded almost continual alteration and adjustment of apparatus. One of the operationally serious but experimentally negligible faults was the distortion of bearings which could only be corrected by extensive calibration on targets flying over known positions. There was no time to carry out these calibrations before the exercise, and to the research workers the errors were of little consequence, since the cause of them was well understood.

The Air Staff had not waited for this exercise, nor were they deterred by flaws in the R.D.F. performance. In July, 1937, orders were placed for the first commercially designed and produced transmitters and receivers for radio-location, and immediately the exercise was over the orders were made to cover equipment for a chain of twenty stations of hitherto undreamt-of power and sensitivity. The transmitters were entrusted to a leading British electrical engineering company, selected largely because of their work on demountable transmitting valves giving very high power output. The receivers were developed by another British company whose research staff had done much for television development and now were the producers of the most suitable cathode-ray tubes for the new application.

Finding Sites for Stations

The equipment design was only one part of the technical problem to be solved before an operationally valuable coastal chain could be provided. The finding of twenty sites to give, even and unbroken, an invisible radio front out at sea, 40 miles out at 3,000 feet flying height, 140 miles out at 30,000 feet (more or less) from Solent to Firth of Tay, was a maze of difficulty and compromise. A site on a high cliff rising sheer from the sea favoured long range detection and plan location; it was quite unsuitable for good height-finding. A site well back from the coast, with a smooth slope between it and the sea, gave good height-finding and a good range—there was a rule by which one knew how far inland it was worth going to gain height above sea-level. But irregularities of ground were inevitable, and these distorted the height-finding properties and also gave "permanent echoes"—hills sent back radio-location echoes just as if they were big aircraft flying low. The chosen sites had to be accessible for heavy engineering works, they had to have suitable soil to carry 350ft. steel towers, they had to be moderately convenient for electric power supplies, they had to be habitable by station crews, they had to be secure.
against naval bombardment, and they also had to be as inconspicuous as might be from the air.

"The Fruit Machine"

The inevitable imperfections of siting caused errors in direction-finding and in height-finding which could be measured once for all by calibration flights of aircraft, or balloons towed by ships, over known positions. There were never enough calibration flights operationally possible to satisfy the demands of the experimentalists. But the usual scientific method of applying to observations, tables or graphs of the errors known to be present, was time-consuming; the height of an air battle is no time for thumbing a "ready-reckoner." Moreover, the radiolocator read distance and bearing from the observing station; what the Air Staff were looking for was a map reference against naval bombardment, and they also had to be as inconspicuous as might be from the air.

The development of the main Coastal Chain of Air Ministry Stations was left, in earlier stages, at the completion of three interim stations and the planning of 20 "final" stations. The interim cover for the Thames Estuary was assured by five stations for which the equipment was built, still under the supervision of the original constructional engineer, in the workshops which he controlled successively at Radio Research Station, Slough, and at Orfordness and Bawdsey; they survived in operational use well through the Battle of Britain.

The Continuous Watch Begins

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This Estuary chain, comprising Dover Dunkirk (near Canterbury), Canewdon (near Southend), Great Bromley (near Colchester), and Bawdsey, went over to 24-hour watch in September, 1938, at the time of the Munich crisis. It was supplemented by mobile stations, which will be discussed in a later chapter.

On Good Friday, 1939, the chain of stations from Ventnor, I.O.W., to the Firth of Tay, went over to 24-hour watch, never since interrupted save for a brief suspension at one station, due to enemy action.

The main chain stations had, among other provisions against enemy interference with their operation, complete underground reserve stations of smaller size associated with them. The first of these reserve stations, at Poling, Pevensey and Rye, were completed in August, 1940, just in time for the first enemy attack on R.D.F. stations, which was in that month.

Radiolocation and the Eastern Lifeline

A description of the early development of radiolocation is not complete without reference to the fact that at the same time as the East Coast Home Chain Stations were completed in England, a station was erected at Malta, and another at Aden, and subsequently at other defended ports abroad. The build-up of radiolocation by the Air Ministry at Malta, and of night-fighter interception technique there, is just as magnificent a story as that of the build-up in the United Kingdom, and the Japanese would have been very grateful if a similar process had not been undertaken by the R.A.F. in Ceylon, where the defence organisation was in a sufficient state of operational efficiency to cause severe defeats to Japanese air attacks on the eastern and western coasts of this important overseas operational base. As an illustration of the efficacy of the Malta Station, a captured Italian air officer is reported to have said...
that he could not understand how our R.A.F.
manpower, and to be told that he
must erect a C.H.L. station and have it
operational in the shortest possible
time. Seventeen installations were
working by March, 1940, and by the middle of 1940
C.H.L. stations were located at 50-mile
intervals around our shores from South
Wales, along the South and East
coasts, to Scotland. When the Battle of Britain
began in August, C.H.L. had been reinforced
by C.H.L. in full operational condition in all
the danger areas.
Throughout the Battle of Britain the C.H.
and C.H.L. stations made a magnificent
contribution to the defence of the United
Kingdom by providing information concern-
ing the position, heights and numbers of
each aircraft, as well as the effort this
coast, so that the defending fighters could be
put up in the correct strength and in the right places to
intercept and destroy large numbers of
every aircraft, culminating in the destruc-
tion in one single day of 185.

(To be continued.)

MASTERYING MORSE
By the Editor of PRACTICAL WIRELESS
3rd EDITION
This handbook, written with special regard for service
requirements, will enable even the beginner rapidly
to become proficient in sending and receiving.

GEORGE NEWNES LTD., (Book Dept.),
Tower House, Southampton Street, London, W.C.2
Salt Water to Drinking Water

A new inventor has devised a new process for converting sea water into drinking water.

The invention provides for a device that reduces the size of the apparatus that is required for distillation. It is compact and easy to store in small containers, making it convenient for immediate use. The device is designed to be easily transported over long distances, as it can be assembled and erected on site with minimal effort.

Stream-lined Cycle Cape

A new idea in cycling is the stream-lined cape. This cape is designed to reduce wind resistance, making it easier for cyclists to ride at high speeds.

The cape is made from a lightweight material and is attached to the bicycle frame. It is designed to fit snugly against the body, reducing the drag caused by the wind. The cape can be easily removed when not in use, making it practical for cyclists to use in a variety of weather conditions.

Prefabricated Wall Structure

A new type of prefabricated wall structure is being introduced. The structure is made from pre-formed weatherboards and slabs, which are pre-formatted and stored in a factory or other central location.

The structure is assembled on site, allowing for a more efficient construction process. The prefabricated wall structure is also more sustainable, as it reduces the amount of waste generated during the construction process.

For Automatic-gyro Pilots

A new invention is a portable navigation instrument for automatic gyro pilots. The instrument is designed to assist pilots in maintaining a straight course without the need for constant manual adjustment.

The instrument is compact and portable, making it easy to use in a variety of conditions. It is designed to be accurate and reliable, ensuring the safety of pilots and their passengers.

Inventions of Interest

By "Dynamo"

The information on this page is specially supplied to "Practical Mechanics" by Messrs. Hughes & Young, Patent Agents, 7, Stone Buildings, Lincoln's Inn, London, W.C.1, who will be pleased to send free to readers mentioning this paper a copy of their handbook, "How to Patent an Invention."
It is an outstanding fact that most model enthusiasts have other hobbies besides their interest in the craft of modelling. They are sometimes keen photographers, often take an interest in horticulture, and not infrequently are gifted artists and musicians.

The subject of our article this month is no exception to the rule—Mr. L. G. Bodiley, of Northampton, is not only a very enthusiastic and skilful model maker, but is also a capable gardener and keen amateur photographer, and both he and his wife are clever pianists. And I think you will agree with me as this article proceeds that his talent as a modelling man has not suffered from his other activities!

From his very young days he has been interested in models and model making, electricity and mechanics generally, but it was after his one and only visit to the Model Engineer Exhibition in 1938 that he became particularly interested in the making of "live steam" locomotives. Since that time, this most fascinating of hobbies has "held the field" and even during the war he has carried on in what leisure time he could spare.

A 2½ in. Gauge Pacific-type Loco

One pleasant evening in the late summer he invited me to watch a steam test of his first completed model on his garden track. The model is a 2½ in. gauge Pacific-type locomotive, lettered K.R.R., No. 27.

On arrival at No. 27, Kingsley Road, I took several photographs of this model (Figs. 1 to 4) and examined the good workmanship, and then he began to raise steam, stoking up with charcoal and then steam.
tings, i.e., water and steam gauge, blower, whistle and reverse wheel. The tender, supported on leaf springs, holds about half a gallon of water, and this is fed to the boiler by two axle pumps (controlled by by-pass valves in cab) and a hand pump, as required. The rear truck of the locomotive is easily removable, and this allows the grate and ash-pan to be dropped for cleaning purposes.

Having witnessed this demonstration of the locomotive's possibilities, we were invited to inspect the workshop in which it was made. This was situated in an attic room at the top of the house, which Mr. Bodiley began fitting out as a workshop about seven years ago. It was well fitted up and neatly arranged. The machine tools comprise a 4in. Drummond lathe and a sensitive drill, both driven by electric power.

Mr. Bodiley does all his own work, with the exception of brazing.

A 3in. Scale "Royal Scot"

In the workshop we had the opportunity of seeing his most ambitious effort to date—the beginnings of a 3in. scale 3½in. gauge, 4-6-0 type L.M.S. "Royal Scot" locomotive. This model is being constructed with the aid of Henry Greenly's drawings, and various material and castings are from Bassett-Lowke, Ltd., and Bond's O' Euston Road. Features of the model will be three piston-valve cylinders (outside 1½in. and inside 1in. bore by 1½in. stroke) operated by Walschaert's valve gear in hardened steel, and a main frame constructed almost entirely of steel. Owing to the scarcity of castings, various parts of this, such as motion plates, buffer beams, check plates, etc., have been built up from odd pieces of steel, fitted and brazed together, and these, in Mr. Bodiley's opinion, make a better job than gun-metal castings. It is hoped to fit injectors to this model, but an axle-driven pump and a hand pump will be included, in case of injector failure. This model has occupied nearly three years of Mr. Bodiley's spare time, but he has been rewarded by seeing the wheels "tick over" on one cylinder, using compressed air at about 15lb. pressure. It will run equally well in either direction and will "notch-up" well, and promises to be a successful engine.

Mr. Bodiley has taken great pains to make and fit everything as perfectly as his limited equipment will allow, even though this means at times scrapping and starting again.

His little daughter Joan, aged seven, is a keen admirer of his work, especially when it is "in operation," and he has encouraged her interest in the hobby by making her models, one of which is an attractive model of the Santa Maria, made up from a set of printed cardboard parts.

I wonder how many model engineers heard the interesting broadcast by Mr. W. J. Bassett-Lowke, "Models in Peace and War," which was recorded for the Pacific and North American services of the B.B.C., and afterwards given as a topical talk on September 13 after the 1 o'clock news on the Home Service? This talk occupied fifteen minutes, and gave some very interesting information on the valuable part models have played in helping to win the war.

A Model Kitchen

Here is another example of a housing model—a portion of a kitchen designed by Jane Drew (Fig. 5). It shows the special arrangement of a small dining recess partitioned off, then the kitchen and washhouse—all interconnected. The model is made more realistic by the reproduction of the various kitchen utensils—kettle, plates, cups and saucers to scale. This type of model is being used increasingly for display by architects, town planners, municipalities, and firms who manufacture household equipment.

This sturdy pedal-driven jeep, built by Mr. F. Chapman for his small son, took just two weeks to make. It is constructed chiefly from odds and ends, the only parts purchased being the wheels.
Letters from Readers

"Preventing Railway Accidents"

Sir, I should like to voice an opinion in the face of a letter written by "Safety First", headed "Preventing Railway Accidents" in the September issue of Practical Mechanics. As a railway employee temporarily working for H.M. Forces, I should like to make a few observations on this subject which will show that the writer has, in no manner, neglected the possibilities of automatic train control.

For many years the railway companies have been experimenting on methods of bringing a train to a standstill should the driver neglect to observe the distant signal in the warning position.

The Great Western Railway have in extensive use a system which has proved very successful and enables a driver to ascertain it. However, your reader asks for the focal length, and the simple method outlined, above, is of quite enough accuracy to enable him to proceed. As a matter of interest the focal length of any mirror should not be shorter than six diameters. Therefore, for a 6in. mirror, the shortest that can be corrected accurately for visual work. Another point that may help your reader is that a spherical mirror will not function in a telescope. It is a property of the spherical mirror that it can only produce an image free from distortion if the object is at centre of curvature (the second distance measured by the method previously mentioned). The returning image is then formed also at centre of curvature, beside the object, and as the usual subjects of telescopic study are far away, this is obviously not the correct place for the image.

The figure needed for the surface of a mirror for making it will be a "paraboloid of revolution" and is recognised by the fact that, when tested at the centre of curvature, the rays from the edge of the mirror form an angle whose sides are drawn from the centre. The distance between the two focal planes must be equal to the radius of the mirror, divided by the radius of curvature. The formula is written thus

\[ R = \frac{2f^2}{d} \]

and for a 6in. diameter mirror of 96in. focal length works out as follows: diameter of mirror 6in., radius square therefore \( \frac{f^2}{2} \), focal length of mirror 96in., radius of curvature = 72in. The distance between edge and centre rays must then be \( \frac{f}{2} \), and 6in. with the edge rays focussing furthest away from the mirror.

This is the only shape known to science that has the property of producing a perfect image of an object at infinity, and the image is distant from the mirror half the radius of curvature.

In view of the above, I consider that it is most unlikely that your reader has a mirror that will repay his work in mounting if it is a spherical mirror for telescope use is not at all great, provided that the constructor has the necessary patience. I find there is a large amount of optical curiosity among the general public, and have myself started one or two people on amateur optics with very good results. The processes are not at all expensive, and for a mirror no special glass is needed.

—G. A. Hole (Patcham).

Bournemouth and District Society of Model Engineers

Sir,—Since November last we have managed to revive much interest in model engineering here and have had many successful meetings.

The most outstanding being visits to 2 in. gauge garden railways. Mr. A. G. Green's in May, with his "Prince Royal" (4-6-4), and Mr. G. A. Turner's in June, with his "Green Arrow" (2-6-2), where members past and present were able to enjoy the experience of driving locomotives.

Club meetings are held weekly and most interesting lectures and talks have been given relating to all types of model locomotives, and on the layout and electrical control of the hobby. Negotiations are at present in hand with Mr. G. A. Turner, who is planning to build a model of an old gauge layout in the Club headquarters, where members have been able to test and exhibit their models, and Mr. Ray Coomer's S.R. Schools and Merchant Navy Class Locos being excellent examples of the hobby.

Another meeting was held at the Stand Grammar Girls School, Whitefield, at 8.30 p.m. on November 20th, 1945.

The visiting locomotive was that of Mr. W. M. Mobley, which to lunch and operate a multi-gauge track. It is also hoped to hold an exhibition shortly.

Application for membership should be addressed to the Hon. Secretary, G. E. Freezer, "Arun," Elm Avenue, Christchurch.

—G. E. Freezer (Christchurch).

Model Engineering Society for Prestwick

Sir,—It is proposed to start a Model Engineering Society in the Whitefield and Prestwick districts of Lancashire. It is felt that a club of this description would meet with support and enthusiasm.

A meeting was held at the Stand Grammar Girls School, Whitefield, at 8.30 p.m. on November 20th, 1945.

Interested readers are asked to get in touch with Mr. A. G. Green, 1, Newlands Drive, Prestwick, Lancs.—A. T. Stevenson (Prestwick).

Electric Gas Lighter

Sir,—I was very interested in the article on "An Electric Gas Lighter," by Hobbyist, in the October issue of Practical Mechanics. As I constructed a similar lighter from odds and ends of scrap some months ago, I thought perhaps the details might be of interest to your readers.

My "gun" had a hollow barrel with eight holes drilled about \( \frac{1}{4} \) in. from the business end. The element consisted of wire taken from a burnt-out soldering iron. I wrapped six turns of this wire round a darning needle and formed an element about \( \frac{1}{4} \) in. long. When tested with a grid-bias battery on \( 7\frac{1}{2} \) volts the result was entirely satisfactory. Instead however, of using a battery I led the flex to the nearest house power plug and connected it to the 8-volt tapping of a mains bell transformer. The result again was entirely satisfactory, and it has been in use in that way ever since.

When time permits I intend fitting another of these gas lighters in the bathroom and to feed it from the same transformer. Whether the transformer will be powerful enough to drive both lighters at once remains to be seen. In any case it is hardly likely that both lighters will be in use at the same time.—A. Whethereill (London, N.)

Workshop Calculations, Tables and Formulae

By F. J. CAMM

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From George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.1

December, 1945 NEWNES PRACTICAL MECHANICS 105
Small Motor Generator

To WISH to construct a motor generator to convert 2 v. D.C. to 120 v. D.C. at 10 m.a.

Please state the reasons of lamina tions of armature and poles, number of turns motor and armature, orientation of both same direction, of type of bearings, gauges of wire, etc. I want the motor generator to be as small as possible. Could you send a book on the subject?—E. D. Medcalf (Saffron Walden).

A generator set of the capacity stated we are going to construct has armature diameters of about 11½ in., diameter by 1½ in., long. running at about 1,000 r.p.m. and it, and if you manage to construct such a machine we are afraid the cage of the motor is considerably due to variations of brush contact void-drop on the motor. It is not the most easily winding specifications without having fully dimensioned and descriptive sketches of the field iron systems you propose to use, including the number of slots and teeth, and the air gap between the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges).

For a smooth output voltage the number of slots and commutator segments of the machine could be as practical as possible. The book "Practical Design of Small Motors" (C.R. Newnes, Ltd.), gives some useful information on the design of such machines. Messrs. George L. Scott & Co., Ltd., Shotton, Caernar, may be able to supply suitable armature material.

Running D.C. Motor on D.C.

I have a D.C. motor of 12 R.H.P., 1,400 r.p.m., laminated fields, series wound, 2,500 m.m. Should I be able to run this motor off A.C. mains? The brush position has got mixed up; with the brushes between these fields, the armature will not rotate, and with the brushes in line with the fields the armature turns very slowly and can be stopped by pushing the hand. —A. Robertson (Glasgow).

For a smooth output voltage the number of slots and commutator segments of the machine could be as practical as possible. The book "Practical Design of Small Motors" (C.R. Newnes, Ltd.), gives some useful information on the design of such machines. Messrs. George L. Scott & Co., Ltd., Shotton, Caernar, may be able to supply suitable armature material. We also would require to know the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges). We also would require to know the armature and field magnets (mannge and pole face, feeder gauges).

Dyes for Veneers

I would be pleased if you could give me information concerning the dyes used in marquetry for dying veneers. It must be a dye that will penetrate the thickness of veneer, usually about 0½ in., and, of course, will not slide because of the hard wood. —A. Robertson (Glasgow).

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I would also require a method of fixing. Any colour would do.—J. Chisholm (Glasgow).

You do not give many details concerning the nature of the cement which you desire to use, but it is only in circumstances in which we are somewhat hesitant in issuing advice. If the cement is to be set when cold, it will be easiest for you to purchase ordinary photographic lantern plates. You should then cut out the required parts of the sketch on glass which you desire to copy. These cut-outs of the sketch on glass which you desire to copy by means of an adaptation of the process in (h) above. You will have to make sure, however, that the cement is absolutely firm and rigid in the cold, but softens completely when heated. The actual pressure of the heating steam will be dependent on (a) its mass, (b) its temperature, (c) its specific heat, but since the specific heat varies with temperature, all the above three factors in your case will be varying. (c) its specific heat, but since the specific heat varies with temperature, all the above three factors in your case will be varying.

If a glossy surface is desired with the cement, you might advantageously add about 1 part of shellac in order to colour it to any required shade. If necessary, you can add a little pigment, such as lampblack, brown ochre or red oxide, to the cement solution. For effective barometer filling, three parts of ordinary resin will be adequate for your purpose for which you desire to use a cement.—R. H. Carpenter (West Bromwich).

In the absence of more details concerning the exact purpose for which you desire to use a cement, you can make a cement for the purpose of which you desire to use a cement. In such instances dissolve 1-2 grains of potassium bichromate in sufficient water, 5 ozs.

WISH to mount a photograph on a piece of vitreous or "metallic" form of selenium which will - photo-electrically "necessitate some trouble, for by this means all living stages of the beetle, therefore, any material which is partly conductive, i.e., which partly resists the current, will become heated when a current is forced through it; the actual amount of heat produced is determined by the degree of resistance of the material, the intensity of the current, and other varying factors.

If you desire a selenium cell, then an efficiency of 40-45% may be obtained. The sensitive surface of the selenium cell is now in contact with a second, which is immersed in clean water to wash away the solutions, and finally dried.

WISH to fill a glass tube with mercury for a barometer. How can I clean the mercury perfectly into the tube? Would a 3/16 in. internal diameter tube answer the purpose?—G. Bond (Belfast).

(Caution) Mercury will impinge on to internal surfaces at a temperature of 60 deg. to 212 deg. F. This will cause the tube to burst. It is a good practice to pour out a little of the mercury, pour in some clean hot water, and then pour the remainder out. The tube can then be dried inside with a clean absorbent towel. If the tube is still not clean, it may be cleaned by immersing it in nitric acid which is a strong oxidizing agent. It is found that a 1 in. diameter tube becomes clean after about half an hour. If the acid is too strong it will attack the glass and if too weak it will not clean the tube. The acid should be renewed every few weeks, as it gradually becomes neutralized.

The treatment will supplement the fumigation of the house and the barriers, and it is absolutely essential to the proper action of this treatment that the creosote be heated. The actual pressure of the heating steam will be dependent on (a) its mass, (b) its temperature, (c) its specific heat, but since the specific heat varies with temperature, all the above three factors in your case will be varying.

The effect of the light exposure will be to make the silver or mercury is not applied to glass. This is a "negative image," and if a "positive" image of dark parts of ordinary resin will be adequate for your purpose for which you desire to use a cement. In such instances dissolve 1-2 grains of potassium bichromate in sufficient water, 5 ozs.

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Talk in the Stable

A Phantasy

By R. L. JEFFERSON

THE cycle shed in the popular North Road hostelry was full of all kinds of shooting and fishing guns, some were, of the road-racing type, many had sights and tubulars with "spares" lashed to the saddlebags; the owners of the machines were in the in, having late tea and talisling of to-morrow's event.

At seven o'clock out came the cyclists, and the shed soon became a scene of feverish activity, wheels were changed, tyres inspected and pumped up, and the hundred and one other things that racing men do were done to the accompaniment of much chat and banter.

Soon all the jobs were done, and one by one the men left the old cycle shed until only the elderly doctor remained. This grizzled veteran always rode in the "24"; he had never won anything, but always made only the banter.

Other things that racing men do were done and pumped up, and the hundred and one activity, wheels were changed, tyres inspected in the inn having late of the road-racing type, many had sprints from your doubtful fittings."

"May I ask," said the Chater-Lea, "why your master has addressed its remarks to a very new light-weight maker's latest product. "May I ask," said the Chater-Lea, "why your master has allowed your master to put such a vulgar finish on you?" Frankly, your finish looks cheap and nasty, and serves to draw attention to the moon shone through the window of the night wind rustling through the trees.

"Ordinary," I don't wish to be rude, but you must admit I've been very patient in you in more ways than one from a very good master came to an end, and I was sold for £4 10s. to a fairly keen young clubman of the Canonbury Bicycle Club. I'm sorry to say this young man didn't treat me in anything like the manner of my old master. I was seldom oiled or adjusted, and never cleaned, even when I'd been out in the pouring rain. One day my rear wheel bearing seized up solid, and my young master 'went over the top.' I can't say I was sorry for him. I believe he had been killed I wouldn't have shed a tear, but unfortunately he wasn't, and soon recovered. He mounted after freeing the cone in my rear wheel, but he never bothered to oil me, although 'goodness knows' I could have done with it. I doubt whether he ever owned an oil can. He had very few spanners, and only used them when something went wrong. Of course, I gradually got worse under such treatment. My head bearings were in a shocking state, and when the spoon brake was applied to my front wheel I shook all over as with the palsy. Eventually I got relief when my backbone broke clean in two on Pentonville Hill. My master this time was a hospital case; in fact he was in the Great Northern Hospital for over two months."

The Hobby-horse:

Dawn was just breaking, and the old Humber was about to resume, when he was interrupted by a hobby-horse, completely covered by wood and sacks, under the front wheel of the "Ordinary." "Why don't you shut up," said the hobby-horse out of its mahogany mouth, "or I'll begin and turn you all green with envy." He never started, for the door was thrown open by a lad in tights and alpaca who grabbed the new light-weight and wheeled it into the yard. The "Ordinary" and the hobby-horse relapsed into silence and the dust of years, and prepared to wait patiently for the return of the cyclists' steeds to tell them the result of the "24."
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THE CYCLIST

DECEMBER, 1945

Vol. XIV

December, 1945

No. 286

Comments of the Month

New Road Safety Campaign

The Rt. Hon. Alfred Barnes, M.P., the new Minister of War Transport (incidentally, why continue to include the word "War" in the title of the Ministry?) has just been made, the Minister proposes to plough the same old furrow, and to presume that motorists go out at night with large searchlights attached to their cars looking for people to kill. If the Minister would investigate these reports, he would find therein valuable information, and he would also be able to assess the results of previous publicity campaigns. All of them have been abortive.

It is true that the Minister’s campaign is largely directed to motorists. We are all agreed that the majority of accidents involve motorists, and the new campaign virtually points the minatory finger at them. In fairness, however, we must admit that carelessness is not the prerogative of the motorist only; cyclists and pedestrians are also careless. The real test of the campaign is to see what effect it has upon the accident problem, say, within a week of its inception. We are certain that there will not be a diminution. Yet this campaign is to cost the taxpayer £5,000 a week which would better spent improving the roads. Although we are confronted, as the Minister says, with as much danger from accidents on the roads as we were from air attacks during the war, the vital difference is that the solution to the road accident problem is in our own hands. Even with air raids the accidents could have been less but for the carelessness of members of the public who ignored advice to take precautionary measures. We agree with the Minister that what is needed is a treaty of alliance between all classes of road users, based on the golden rule of doing unto others as you would have them do to you. By scrupulously observing the Highway Code, whether we are on foot, on a bicycle or at the wheel of a car. The new campaign will draw attention to the false sense of security, especially among children, resulting from the absence, in recent years, of heavy traffic, to increased motor traffic, the poor condition of many vehicles, inexperienced drivers, and road obstructions due to war conditions. We suggest that the Minister of Transport, in connection with the latter, should press for the release of labour to build new roads and remove the obstructions, and that he should impress upon the Government the need for applying the Road Fund to the purpose for which it was intended. Regarding the poor condition of many vehicles, this is easily remedied by a tax which compels motorists to use old vehicles instead of buying new ones; and also to the great shortage of replacement parts, due to the stupid Government policy of demobilisation.

"Self-preservation" is a myth. We do not for one moment believe that pedestrians are now presumption that because there were few vehicles on the road during the war, there are not more to-day. They are not blind, and can see for themselves. Self-preservation is the first law of Nature, and if people continue to be careless, they will pay for their folly. To suggest that accidents are due to a desire for manslaughter on the part of motorists is fantastic and untrue. We hear far too much to the sectarian arguments of particular bodies, especially where those arguments are based on false premises and are divorced from fact. Our cycling bodies, if they wish to conform to the new road order, which Mr. Barnes wishes to inaugurate, will have to modify their unbending attitude, which they have adopted for 50 years. In other words, they must become realists and bring their ideas up to date. It may be necessary, in order to bring this about, to lob off some of the dead wood from the trunk. It is high time that a new and enlightened outlook permeated the dusty portals of Craven Hill and Doughty Street.

The Treaty of Alliance between all classes of road users is concerned, the Minister should be aware of the fact that the National Cyclists’ Club, the members of which are non-sectarian, and composed of cyclists, motor-cyclists, pedestrians, politicians, motorists, Ministers of Transport and all those interested in the solution of road problems and who are without axes to grind.

The Roadsters’ Club issued, at the request of the Ministry of Transport, a memorandum on the Design and Layout of Roads in Built-up Areas, and if the new Minister will study that memorandum and adopt the proposals made therein, he will achieve a diminution in accidents in built-up areas at once. This National Body is a non-political and non-profit-making organisation which does not favour motorists, cyclists or pedestrians. It wants the roads made safe for all to use.

The campaign of hate against motorists which has been promoted by the C.T.C. and N.C.U. during the past fifty years, and their stubborn opposition to every suggestion for improved methods of road safety if such methods oppose the so-called liberty of the cyclist, has been one of the chief stumbling blocks to progress.
Producers Bicycles
A FORMER "shadow" factory at Berkswell, near Coventry, once owned by Mears, Roates, has been converted for the production of bicycles.

From Northern Scotland
THE 'Roth G. E. Thomas and R. DRake, Bournemouth Arrow C.C., who was taken prisoner.

Tropical Twiddlers' Change
W. V. CAMERON has taken over the honorary secretaryship of the Tropical Twiddlers in place of L. E. Howes, who has been posted to a training camp.

Course Record Lowered
BY clocking 1.05.125 to win the Hounslow 25-mile event, C. G. Cartwright, Manchester Clarion, lowered course record which stood to the credit of G. Fleming with 1.05.3.

"Painted Boats"
"Painted Boats," a semi-documentary production, designed to stir a life on Britain's inland waterways.

Glad News
E. DRAKE, Bournemouth Arrow C.C., who was taken prisoner at Singapore, is now safe and sound.

Tyres in France
IT is anticipated that the French Dunlop Factory, which is now about 30 per cent. of its pre-war output, will be back at full pre-war capacity next year.

Manchester Wheelers' Loss
FRED LEEMING, former president of the Manchester Wheelers, has died. He was 86 and an active rider until a year or so ago. Mr. Leeming had a wide circle of friends in the North.

Southampton Champion
DESPITE his three years in the Road and the Track championships of the Southampton Wheelers.

Southgate Promotions
BOTH G. E. Thomas and R. S. Philpot are now majors in the Indian Army.

At Long Last
A BRIDGE over the River Severn between Aust and the Beachley Peninsula, which will save a mileage of 54 on the Southampton-Bristol-Cardiff journey, is stated to be in the highest priority category. Tourists will welcome its construction.

East Liverpool's Jubilee
THE year 1945 will see the arrival of the classic East Liverpool Wheelers' "go." It will also see the postponed "jubilee" celebrations of the club which was founded in 1890.

Redditch Diamond Jubilee
THE Diamond Jubilee of the Redditch Road and Path Club was appropriately celebrated recently by the only founder-member, H. Guise, in the chair. Mr. Guise is the president of the club.

Machines for Overseas
DESPITE the fact that bicycle manufacturers in this country aim at producing 1,500,000 cycles, two-thirds of these are for export. The industry, says George Willson, president of the Manufacturers' Association, wants 20,000 more men before it can begin to cope with its export commitments.

Hitchin Club Bereaved
A MEMBER of the Palestine Police, James Barry (Hitchin Nomads C.C.), has been killed in the execution of his duties.

Veteran's Win
THE final fixture of the Veterans' Time Trial Association—a 24-mile road handicap—was won by J. B. Austin, Oxford City Road Club, with a time of 1.12.7.

New Record
BY riding 50 miles motor-paced on Herne Hill cyclo-park, Harry Oxley established a British record for the distance with a time of 1.25.4. The ride is, of course, subject to official N.C.U. confirmation.

The Catford Climb
THE old-established Catford Climb was won this year by G. Fleming, Belle Vue C.C., with a minute 31.5 seconds. He used a gear of 56. for the Brasted Hill ascent.

Honour Deserved
BARNSLEY Road Club have made Jack Simpson a life member in recognition of his outstanding rides this year. He is current 50-mile National champion and was last year's 25-mile champion.

The Dutch Desire
IT is stated that Holland wants 3,000,000 British bicycles. Meanwhile, it is of interest to note that the recent dock strike in London held up the export of many machines, among them 25,000 of a famous make.

Overseas Demand
REGULAR shipments of British machines are being made to America. There is a demand from Brazil for British bicycles; one famous firm has sent 10,000 machines to Holland, and has in hand orders from India, Australia, Kenya, Egypt, Iraq and Portugal.

Regate Club Reforms
A MOVE is afoot to re-form the Regate Road Club.

National Hill Climb Champion
R. H. MATTLAND, of Southend, was in National Hill Climbing Championship in 1941, and is still in performance in scaling the stiff test near Chapel-le-Frith, Derbyshire, in 3 mins 1 sec. He used a gear of 62.8 for the 503 yards test.

Tynsider Decorations
FLYING OFFICER M. W. STOTT, Barnsley C.C., has been awarded the D.F.C. for devotion to duty. Jack Garside, who has received the D.C.M.

Liverpool Traders
A DETERMINED effort is about among leading Liverpool traders to form a cycling club among themselves.

Scottish Successes
J. ALLISON, Musselburgh Road Club, won the R.T.C. British All-Rounder Competition with an average speed of 22.52 m.p.h. A. Overton, Kingston Road Club, was second with 23.25 m.p.h., and D. Scott, Cawick Wheelers, third with 23.08 m.p.h. Calleva Road Club (Derbyshire, 21.612), D. S. Bennett, 21.609, and L. C. Dunster, 21.477, with an average of 21.61.9 m.p.h. won the team race.

Aero Model Winners
A TEAM of five model aeroplane makers from the Midlands region has won the Aero Modellers' Trophy in a competition, open to the whole country, organized by the National Association of Sportsmen. The five come from Fort Dunlop tyre production department, the machine shop, the offices, and the new factory at Speke.

TOPOICAL NOTES
By "Wayfarer"

Catechism
THE dry-eyed little boy, complete with bicycle, seemed to spring from nowhere just as the hill I was climbing was beginning to "hurt." He said, quite unemotionally, "That bike runs a bit 'ard, do-an' it?" A criticism of my bicycle being a criticism of me, I replied, laconically. "No." Young Dirty-face persisted: "What sort of chain is this? It's a big 'un, isn't it?" I replied curiously to the second part of the inquiry: "Dirt!" The catechism continued. Was I camping? Yes! Where was I going to? Birmingham! How long would it take me to get there? Two hours! Discouraged by my (rather unusual) attitude of non-irritation, young Dirty-face slid out of my ken unostentatiously as he came into it, leaving me to "get on with it" in peace and quietness—which was my strong desire.

Bargaining-point
I OBSERVE that some ingenious person has written to the press to say that he has taken his gas mask to pieces, to find that it contains, among other ingredients, more than 32 lbs. of pure rubber. This, he says, represents some 70 tons a million. Thus there must be thousands of tons of non-country rubber lying idle in the possession of the public. The ingenious one wants somebody to do something about it. Well, if it is of any interest, I am prepared to exchange my gas mask for a pair of pre-war light tyres. And I'll throw in a stirrup-pump—and a basket of sand!
**Around the Wheelworld**

By I CARUS

ONE of the advantages of membership of a National cycling body is the touring handbook supplied to members, containing addresses of places where caterers can be found. Presumably, before the names and addresses are inserted in the handbooks the premises are approved of by the authorities. It is approved by a committee. I would not concede that

Right to any committee. Such, however, is the constitution of this club, which really exists to promote cycling, and that this is possible. I suggest that it gives a little more time to the touring side and eschews entirely mixing politics with it. It is for this reason that I have resigned from the so-called National Body, which was founded by a political party.

I warn the C.T.C. that if they want to make a political issue of cycling they are riding for a fall.

Safely First for Children

I HAVE received the following letter from Mr. R. Stevens, B. S. Criddle, and A. H. Binnerhassett:

"We read with considerable interest the activities of the various county police, checking the cycles and the schools. One county police-chief states that every child rider should have to pass the Highway Code before being allowed on the road; another states, 'We have the finest cycling clubs and organisations in the world, with men and women who have spent a lifetime on the roads. There is nothing these experts do not know about cycles and the rules of the roads of Great Britain, and we feel sure that if they were approached in the right spirit these people would jump at the opportunity to assist, check, teach, in fact anything within their power. It is in the interest of the country and the children's safety that this is done.'"

"Before full recognition is given it would greatly assist the authorities and cyclists' clubs if the Minister of Transport hinted that they would be removed. One of those complaints is that many children do not know about cycles and the rules of the roads of Great Britain, and we feel sure that if they were approached in the right spirit these people would jump at the opportunity to assist, check, teach, in fact anything within their power. It is in the interest of the country and the children's safety that this is done."

TWO new competition records

At a meeting held on October 7th, the National Committee of the R.T.T.C. passed as Competition Records the following performances made on July 13th, 1945:

R. J. Maitland and R. W. Rovers (Solihull C.C.): 50 miles Tandem, 1hr. 47min. 15sec.
A. Overton (Kingston R.C.): 12 Hours Single Bicycle, 2351 miles.

R.R.A. Secretaryship

THE Committee of the R.R.A. announces that at their meeting on October 16th, the vacancy caused by the regrettable resignation of Mr. C. Newman has been filled. A liaison officer was appointed to act between the committee and the public until the end of the year, or until a new secretary has been appointed. The committee invites nominations, or suggestions for suitable candidates for the post of secretary. It should be noted that the post is an important one and it is highly desirable that applicants should have the use of a telephone during the day and have reasonable office facilities. There is nothing experts do not know about cycles and the rules of the roads of Great Britain, and we feel sure that if they were approached in the right spirit these people would jump at the opportunity to assist, check, teach, in fact anything within their power. It is in the interest of the country and the children's safety that this is done."

It is time that the officers of the club

New N.C.U. Clubs

The following clubs have recently affiliated to the Union: Chelmsford B,C., Greenock United C.C., Queentown C.C., Wombwell Wheelers C.C., Maghull A.T.C. Wheelers, Cedars Cycling and Camping Club, and Woodville C.C.

The Southern Counties Cycling Union

THE S.C.C.U. intends to make a return to its pre-war eminence south of London as soon as possible, judging by plans made for 1946. Two of the fixtures are given below:

January 19th: Victoria Coach Station Reunion Dance.
February 16th: Kennards, Croydon Dance.

On the road the "Syl Gray 100" will be promoted again and the Annual Meeting is to be asked to inaugurate a championship decided on average speeds over 25, 50 and 100 miles. All S.C.C.U. events will be eligible, and times recorded in any fully open " 50 " or " 100 " on southern roads will be included. The competition will be confined to members of clubs affiliated to the S.C.C.U.

The famous Good Friday meeting at Herne Hill will be promoted by the " Counties," with the usual gathering of road and track stars. It is expected that Tommy Godwin will be able to retain his hold on the B.S.A. Gold Column in the 5-mile point-to-point event.

Cadmium Plating

I AM informed by the Board of Trade (Industries and Manufactures Dept.) that there may shortly be made available to the bicycle industry a certain amount of materials for cadmium plating.

Northern Tricycle Association

THE Northern Tricycle Association held their closing run on October 28th at Holmchurch Chapel, when a large number of members and guests had lunch.

Clements Wins Stalingrad Memorial Circuit

ERNIE CLEMENTS, Wrekin Racing Club, made sure of the " Stalingrad Memorial Circuit " promoted by the London Section, B.L.R.C., in Battersea Park recently. Later on came the long awaited "Memorial Circuit" comprising the full distance of 50 kilometres—18 laps of the park. This event had brought together a hot field, with a large contingent from the Midlands. The "fireworks" were confidently expected, especially in view of the points system under which the event was run. The full field of 40 started and at the finish there was no terrific battle ensued between Clements and Baker for full points. Clements gained the verdict by inches. The second lap proved to be another exciting "all the way" struggle between the same two riders, Baker taking premier honours by the same margin. The crowd present would have relished any two lap sprints, for the speed was noticeably greater than ever before, and it was obvious a fierce fight was to take place for each lap. This proved to be the case, for the points were hotly contested, with Jones and Clements, Wrekin R.C., Baker, West London, and Jeggard, Ealing C.C., taking the lion's share.
**The Cyclist**

Focus on Truth

THE price of good second-hand bicycles of good pre-war breed is increasing, and will continue to increase, as the fashions come home, except when the trade applies itself to the superior models required by discerning buyers. It has been noted by some manufacturers that the war machine has been good enough to serve the great eastern and western areas, and they see no reason why any great change is necessary. On the other hand I know most manufacturers were not very proud of their war products in bicycles they were changed to the military supply of the component parts we require. I think we cannot fail to see the fact that the price of second-hand machines of good make and quality still requires to be more than seven years, The palms of those gloves are now a series of patches and in a few years of the surrounding trees, with the quiet rain breaking the reflections of the...
"After what I saw 'out there'—
no other tyre
will really satisfy
me now"

Firestone
New ideas in design and construction giving extra lightness, easier running and rigidity are outstanding features of the New Dayton Tourist Models which promise to be the sensation of the cycling world. Look out for future announcements.
How Many Cyclists?

THERE has always been a great deal of argument and controversy about the number of cyclists in this country. Whenever the claims of cyclists have been put forward, and it has been desirable to give figures for the number of people owning and using cycles, wild guesses have been made, and various differing estimates given. Has the recent investigation of the War-time Social Survey clarified this matter? Have we at last got a reliable estimate? It is hard to say, but what is certain is that the Survey revealed some most interesting things.

For instance, we find that no less than 27 per cent. of the workers of this country reach their place of labour by bicycle! When we consider that no less than 20 per cent. of the adult population use cycles for pleasure, investigators interviewed some 2,800 persons, and the information gleaned cannot but be helpful to the industry, and it is to be hoped that the full story will be published and the old figure of ten million cyclists in the country either confirmed or rectified.

Michaelmas Magic

I HAVE ever been fond of the season of Michaelmas. It brings us many good things, and not the least is the glory of the Michaelmas daisies ... those good flowers which seem to bloom well in any garden and flourish in any soil. They are the blossom of the season, and for many years I have had a fancy to wear one in my button-hole on Michaelmas Day. Then there is the Michaelmas goose ... and I always vow that goose is a better dish at this season than at Christmas! And out in the lanes the early morning rider may see the gossamer webs of the spiders stretched from bush to bush ... and there is a tang in the air which only this mellow season can give.

Cycling ... the "Handmaiden"

IT often occurs to me how wonderfully the bicycle assists one's various interests and hobbies. Lately I have done a good deal of fishing, and it is the bicycle which has carried me, and my impedimenta, to river and pool. And when I go out, as I sometimes do, on a butterfly-hunting expedition, it is the faithful cycle which takes me to that common where the Chalk-blues abound, and where I also obtain my specimens of the Fritillaries. Is one a keen photographer? Then the finest pictures are within reach if one has a bike. Yes, there is no doubt about it. Cycling has an article of utility it stands supreme and unchallenged.

There are More Cycle Pumps

NOT so long ago there was an acute shortage of cycle pumps, and many a rider had a good alibi when tackled about that ever-green question of tyre inflation! But I gather that the situation is now much easier, and it is getting comparatively easy to buy a pump at the local cycle-dealer's. And what a good investment a pump is! Those few strokes with the pump may mean extra miles. Nothing robs the cyclist of mileage so much as the habitual under-inflation. "Pump 'em up hard" is a slogan which pays good dividends, and apart from the extra mileage there can be no question that riding is more comfortable when tyres are well inflated than when they are flabby ... despite the widespread belief to the contrary!

The Rolling English Road

AF TER six years of war, when our roads have been called upon to carry truly enormous loads, and when repair work has necessarily had to be largely suspended, I have come to the conclusion that our roads have stood the strain amazingly well. Hearing in mind rides through various counties, on main and secondary roads, and on lanes and byways, I find myself willing to pay tribute to the makers of our roads ... they built well, and whilst, of course, one knows that much repair work is now necessary, there can be no doubt that the good old English road has "taken it well." When I think of the convoys of grand lorries which roll along our highways, when I remember the tank-transporters of the war years, when I remember that in pre-war days repair work went on all the time ... then I feel like saluting the makers of our roads.

... and I trust that I am not alone among cyclists in this feeling!

Wiltshire Ways

IT is strange how certain of our English counties seem to be unknown territories to the average cyclist. In talks in little inns, in wayside cafés, I have discussed the scenic merits of all our shires ... and heard the expected eulogies about Devon and Sussex and Warwickshire and Surrey. But I have rarely heard much about Wiltshire ... and on asking a cyclist recently what he knew of that county, he remarked that he liked Wiltshire bacon, and dimly remembered gazing in awe at Stonehenge! But I told him that Wiltshire had much more to offer than a tasty breakfast and the awesome memorials of the dim past. ... I told him of Salisbury, with its graceful cathedral built in one harmonious design; I recalled my own memories of Devizes, where, in front of the Bear Hotel, there is the strange "Liar's Cross"—erected on account of the prevarication of a certain market-woman named Ruth Pierce who is reputed to have told a lie; called upon God as her witness, and been immediately struck dead! I told my fellow-rider of the curious White Horses, cut in the turf of the immortal Wiltshire hillsides ... the famous "Bratton" horse, some 180ft. in length, and of the one at Cherhill, which is reckoned to be visible 30 miles away. And I interested this rider who so summarily dismissed Wiltshire by telling him of the glories of Savernake Forest—that glorious woodland which ever gladdens the heart of the man who loves trees.

Get Ready for the Winter

A T this time of the year the wise cyclist gives his mount a thorough overhauling ... attending to all those little items which make for good riding and freedom from trouble. The all-the-year-round rider, particularly, should now see to it that everything is in order ... for winter riding finds out the weak spots, and it is annoying to be held up when a gale is blowing or the roads are muddy, and the rain pelts down!
Notes of a Highwayman

By Leonard Ellis

Britain's Touring Grounds (13)

For some reason South Wales has not achieved the same popularity as North Wales as a touring ground. I suppose the reason is not far to seek. The tremendous area of coal-mining activity to the north of Cardiff and Swansea acts as a deterrent to many cyclists, and it must be admitted that industry has left its mark very heavily on these parts. It is true, however, that much of this can be avoided, and for those who try and succeed there is a great reward. It is personal experience, and I feel that the scenic gems to be encountered in the north, the mountain scenery, the coast, the villages, are not to be equalled. But the absence of the larger churches and the lack of mountain scenery in South Wales is not altogether on the basis of the larger churches. It is true that the days are coming when we shall have to light up the carbide prematurely. As usual, I shall provide a magnet, as there are dozens of miles of really fine, but in the same breath let us admit that the country is not as varied. There are, of course, those of a great solitude, in the lack of mountain scenery. The mountain scenery in South Wales is perhaps true to say that South Wales does not possess the same popularity as North Wales as a tourist resort. The blacker the night, the better. The tremendous area of coal-mining activity to the north of Cardiff and Swansea acts as a deterrent to many cyclists, and it must be admitted that industry has left its mark very heavily on these parts. It is true, however, that much of this can be avoided, and for those who try and succeed there is a great reward. It is personal experience, and I feel that the scenic gems to be encountered in the north, the mountain scenery, the coast, the villages, are not to be equalled. But the absence of the larger churches and the lack of mountain scenery in South Wales is not altogether on the basis of the larger churches. It is true that the days are coming when we shall have to light up the carbide prematurely. As usual, I shall provide a magnet, as there are dozens of miles of really fine, but in the same breath let us admit that the country is not as varied. There are, of course, those of a great solitude, in the lack of mountain scenery. The mountain scenery in South Wales is perhaps true to say that South Wales does not possess the same popularity as North Wales as a tourist resort. The blacker the night, the better. The tremendous area of coal-mining activity to the north of Cardiff and Swansea acts as a deterrent to many cyclists, and it must be admitted that industry has left its mark very heavily on these parts. It is true, however, that much of this can be avoided, and for those who try and succeed there is a great reward. It is personal experience, and I feel that the scenic gems to be encountered in the north, the mountain scenery, the coast, the villages, are not to be equalled. But the absence of the larger churches and the lack of mountain scenery in South Wales is not altogether on the basis of the larger churches. It is true that the days are coming when we shall have to light up the carbide prematurely. As usual, I shall provide a magnet, as there are dozens of miles of really fine, but in the same breath let us admit that the country is not as varied. There are, of course, those of a great solitude, in the lack of mountain scenery. The mountain scenery in South Wales is perhaps true to say that South Wales does not possess the same popularity as North Wales as a tourist resort. The blacker the night, the better.

Mountains and Brecon Beacons. And, of course, the shop in the town, and even he realised the hopelessness of finding us any accommodation. He was a good sort, and after extracting a promise from us not to smoke and asking us to forget that we had ever seen him, he found us a nice little bungalow and wished us good luck. It was a glorious trip, but would have been better with a little more iron and some more cheap tents of scope in South Wales.

On the last Saturday in September I found a rather curious experience in connection with tea. The house to which I went, about 20 miles from home, yielded no reply to my summons, and I transferred my custom to an adjacent bungalow advertising tea. The front door was open and I could hear somebody moving about. Almost pulling the bell out by its roots nothing: neither did shouting and banging on the door. At last the woman-of-the-house happened to come into the entrance-hall and saw me. She turned out to be as deaf as a post, but, reading the question on my lips, she admitted me, providing quite a little blackboard with pencil and paper. After some time she passed the door and I entered the room. She said to me: "Get out. I'll open the door for you. Oh! it's open." (Anti-climax!)

Eleven o'clock struck as tired and hungry we entered the village of Llandow, and in a small shop of which I was rather a solemn thought, as regards the co-operative. The presence of private and other motor-vehicles in each village in my line of journey, there were post-office scales (what a splendid advertisement for our pastime, in which he has revelled for almost as many years as I. He has a penchant for making our beds in a pine spinney when a policeman found us a nice little haystack, and wished us good night. So far, so good, but here the road petered out, and for the next 15 miles we plodded and floundered along the banks of the River Towy going southward. So far, so good, but here the road petered out, and for the next 15 miles we plodded and floundered along the banks of the River Towy going southward.}

When I asked what that had to do with the matter, he changed his ground and suggested that it was not easy to get teas nowadays. "Oh, yes it is," I retorted. "I'm out every Saturday and Sunday, and I experience no difficulty. Anyhow," I added, "that's beside the point." Again he changed his ground and said that they didn't want to supply teas. "Then why the blues don't you take in your notice?" I remarked. At this point the writer made no mention of the fact that in South Wales the people are rather a solemn thought, as regards the co-operative. The presence of private and other motor-vehicles in each village in my line of journey, there were post-office scales (what a splendid advertisement for our pastime, in which he has revelled for almost as many years as I. He has a penchant for making our beds in a pine spinney when a policeman found us a nice little haystack, and wished us good night. So far, so good, but here the road petered out, and for the next 15 miles we plodded and floundered along the banks of the River Towy going southward. So far, so good, but here the road petered out, and...
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