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THE ELECTRICITY METER

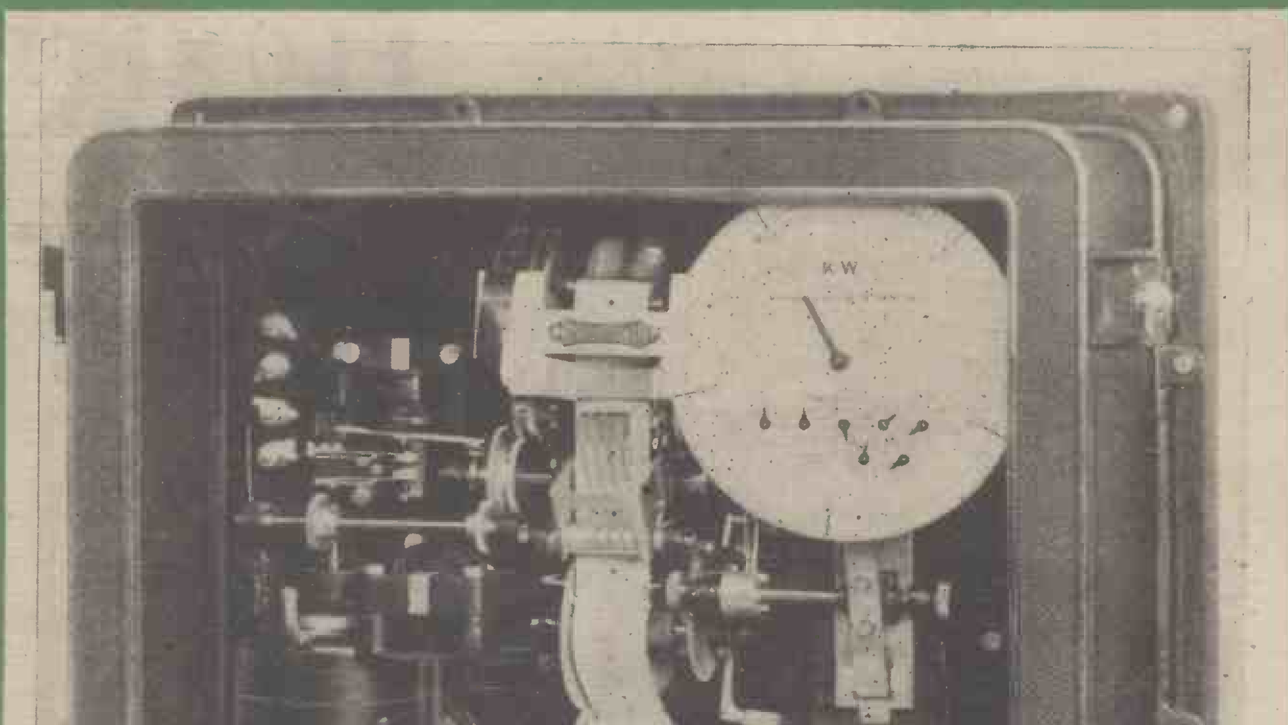
NEWNES

PRACTICAL MECHANICS

9D.

EDITOR: F. J. CAMM

SEPTEMBER 1945



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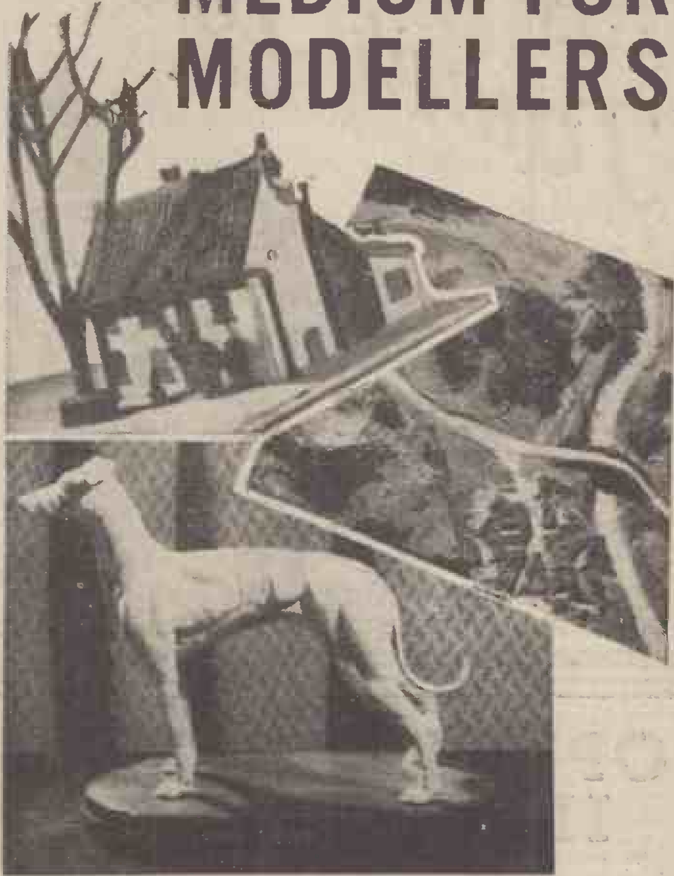

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XII SEPTEMBER, 1945 No. 144

FAIR COMMENT—BY THE EDITOR

The Atomic Bomb

THE disclosure that this country, in collaboration with the U.S.A., had at last discovered the secret of the atom, and the method of liberating the enormous force of cohesion which holds the atoms together, accompanied the news that Hiroshima had been selected by the Allies for a practical demonstration of the horrific power of this new weapon. The world knows now that the experiment was entirely successful, for Hiroshima and all living creatures, human and otherwise, were devastated by one bomb weighing less than half a ton. That one bomb carried by one plane thus performed in a matter of minutes more than has been accomplished by thousand-bomber raids cascading their bombs for weeks on, say, Berlin.

The discovery of this new power may well give pause to any nation which in future should be so misguided as to want to go to war. It has had a sobering influence on the whole world, and particularly on those who sponsored it. We realise that, at present, it is purely a destructive power, and those who feel that we have produced a means enabling the world to commit suicide at will may take comfort from the thought that neither this country nor America intends to disclose the secret.

Science always provides the answer to a problem. The magnetic mine, the V1, to some extent the V2, and other "secret" weapons produced by our enemies have been mastered and the antidote found. So it will be with atomic power. The explosive power of petrol was turned to good account, and there are many other examples where devices produced to destroy have been turned to the benefit of mankind. It is the conquest of mind over matter.

There are those who upbraid the scientists for their invention. Dr. Joad, for example, in a Sunday newspaper, wrote: "The atomic bomb is the greatest single disaster in the history of mankind, not even excluding the invention of the internal combustion engine. Will nobody stop these damned scientists, put them in a bag and tie them up? Or into a lethal chamber? Will they never learn that mankind always misuses the powers with which they so recklessly present it? Will they never rest content before they have helped us completely to destroy each other, including—the one gleam of satisfaction—the scientists? No, of course they won't. The scientists are so pleased and complacent about what they do."

These are strange words from one who has been permitted to use one of the greatest developments of science, namely wireless, to disseminate his views, with which many profoundly disagree. They do not, however, ask for him to be put in a bag and tied up, nor to be put into a lethal chamber. It is not the scientists who misuse their inventions, and where would Dr. Joad and the rest of us be if we had not scientists to produce radar, de-gaussing apparatus and the many other scientific devices which saved us from Germany and her satellites? Dr. Joad should remember that not all of us wish to spend our lives studying the questionable theses of Socrates, at whose shrine he worships.

Boyle and Dalton

THE history of Athens dates back to the earliest records of human thought and philosophy, but it was not until the time of Robert Boyle and John Dalton that our knowledge advanced, although their theories have since been proved wrong. The discovery of the radium elements gave the final blow to the Daltonian theory of atoms as being hard, solid, ball-like bodies. It became apparent that electrons are actually particles of negative electricity and that small indeed as the atoms of matter are, electrons are much smaller. Because experiments showed that atoms are neutral bodies, it was logical to conclude that atoms must contain positive electricity to neutralise or balance the electron, and this was the reason upon which Lord Rutherford had worked when, in 1911, he put forward his modern theory of the chemical atom, which is that every atom is composed of a central nucleus which consists of one or more particles of positive electricity or protons, and around the centre of the nucleus revolve, at high speed and at varying distances, the atom's complement of electrons.

The new atomic bomb makes use of a rare metallic element known as uranium, whose atomic number is 92, according to Mendeleef's periodic law. Uranium was first detected in pitchblende by Klaproth in 1789, who named it in honour of Hershel's discovery of the planet Uranus in 1781. The metal was first isolated by Peligot in 1840. It is a hard, lustrous, silver-white metal which is somewhat malleable, but which cannot be hammered into thin plates. It is the last of the known elements, since it occupies the end position in the table of elements. It has a complicated atomic nuclei, in which the arrangement of the large numbers of protons, nucleons, and electrons are somewhat irregular. By throwing out an odd electron, the energy holding the atom together, so to speak, is set free, and it is this broad principle which is used in the atomic bomb. The atom is bombarded, the nucleons freed, thus reacting on all the other atoms. All of the atoms must, of course, explode practically at the same moment, much as a charge of high-explosive does. Atom splitting has been achieved by a triggering projectile system, which, of course, is secret. The atoms in the target material, burst by the action of direct hits themselves, eject fragments which strike their neighbours and split them in like manner, and this process continues through the material in the minutest fraction of a second. The sudden release of such enormous power produces great heat and pressure effects.

Chlorine

WITH our increasing knowledge of atoms brought about by chemical and physical science came some years ago the discovery that atoms of any one element need not necessarily be all alike. Take, for example, the gas chlorine. This for many years had been known to have an atomic weight of 35.46, which means that chlorine is 35.46 times heavier than hydrogen. It was discovered by Dr. Ashton, of Cambridge, that many chemical elements could be separated into two or more components. Taking the case of chlorine as an example, it became apparent that there exist two chlorines, the first of these having an atomic weight of 35 and the other an atomic weight of 37. Both these types of atoms possess identical chemical properties, but one is heavier than the other. Such individual types of atoms are called isotopes. Chlorine gas, having an atomic weight of 35.46, is in reality a mixture in the proportions of 4 to 1 of the lighter and the heavier isotopes. In some instances as many as six or seven isotopes of the same element can exist.

"Radio Valve Pocket Data Book"

THE valve data sheets recently published in PRACTICAL WIRELESS have, because of popular demand, now been produced in vest pocket book form at 5/-, by post 5/6. The book contains 200 pages, fully indexed, and in addition to the tables a great deal of new matter has been included. There is a glossary of terms, a chapter on valve constants and characteristics, and methods of plotting them, formulæ, list of valve equivalents, abbreviations, symbols, units and prefixes, standard units, valve leg spacing, and other matter associated with valves. Copies may be obtained from the Publisher, George Newnes, Tower House, Southampton Street, Strand, London, W.C.2.

The Electricity Meter

Descriptive Details of Various Types of Instrument, and How They Work

By J. H. M. SYKES

WHATEVER may be the purpose to which the consumer puts the electric energy with which he is supplied, one of his main interests in the company's electricity service is bound to centre on the meter, on the registration of which he is charged.

It is of interest to note what it is that is registered by the electricity meter installed in every consumer's premises, no matter how small or how large. The fundamental quantity supplied is that of *work*; and the factors which influence the work are the current (that is, the amount of electricity), the pressure at which it is supplied, and the time during which a given quantity of energy at a given pressure passes from the company to the consumer. In practice the standard units in electric measurements are as laid down by the Board of Trade—the ampere and the volt. If a current of one standard ampere passes through a circuit in which the pressure is

Fig. 1.—Typical example of modern A.C. single-phase meter, for 230 volts, 25 amps.

maintained at one standard volt, the energy in that circuit is stated to be one watt, and the more usual unit, the kilowatt, is 1,000 watts. If 1,000 watts of energy are supplied for one hour, then the circuit has received one kilowatt-hour of energy, and this is known as the electricity unit, and is the basis of all charging systems and commercial measurements of electric energy.

Generating Costs

But the cost of generating electric energy has long been known to depend not only on the number of units supplied, but also on the maximum demand or peak demand made by the consumer on the generating station. This is obviously seen if extreme cases are considered. A consumer expects to be able to switch on his apparatus at any moment, in general without warning. Imagine a consumer with a 10,000-kW. load who might at any minute throw this load on to the undertaking's busbars. Sufficient plant would have to have been installed and held in readiness to cope with this demand, and yet for a large proportion of its life might not have been usefully employed. It is obviously equitable that a service charge for the provision not only of the generating plant, but of the mains, transformers and other service equipment would be made.

Electricity tariffs have tended more and more to take into account these dual factors in the cost of electricity supply, and while the larger consumers have frequently been equipped with meters which register the maximum demand accurately, in the case of the smaller users an empirical figure is arrived at to take into account their maximum demand by various means, such as the size of the house or the number of plug points installed, or the rateable value or similar non-electrical considerations.

It will, therefore, be seen that the electricity meter must always measure the rate of the supply of energy, which means that it takes into account the current passing through the circuit, the pressure at which that current is supplied, and the time factor; and that many meters for the larger consumers must also register the maximum demand taken over a given period.

Early Meters

In the early days of electricity supply many systems of metering were tried. Chemical methods found favour where the rate of electrolytic deposition of various chemical substances was measured, either by

Fig. 2.—Electro-magnet assembly.

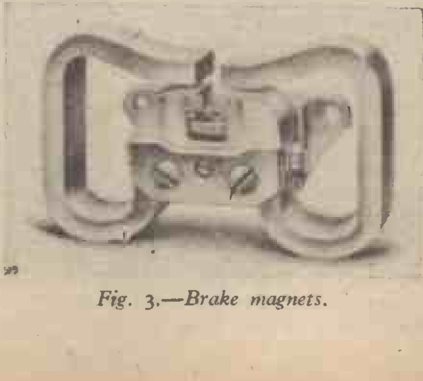


Fig. 3.—Brake magnets.

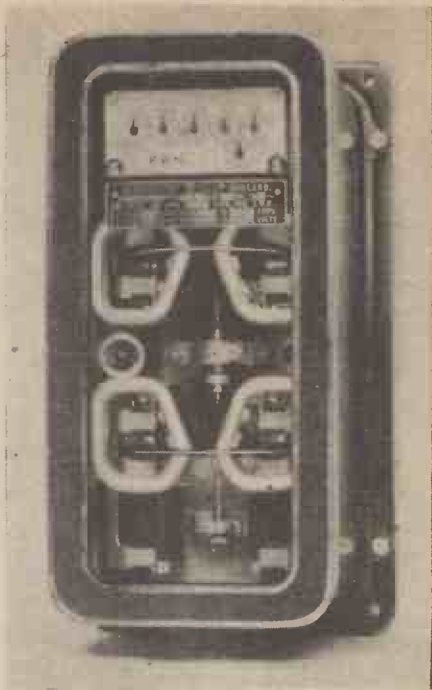


Fig. 4.—Typical 3-phase, 2-element meter.

weight or by change of level in graduated tubes. Pendulum types, in which the change of rate in the swinging of a pendulum which occurs when a magnetic field is superimposed on the pull due to gravity is made by ingenious clockwork mechanisms to register the rate of energy flow through the coil causing the magnetic flux. But few of these designs, except for special purposes, have survived to any great extent.

The alternating current meter seen on domestic premises has nowadays been developed and revised until it occupies a very small bulk. It is an extremely accurate instrument, and yet appears to be a very simple device. But behind the apparent simplicity there is an immense amount of technical research and development which has moulded and shaped the design of every smallest portion of its anatomy.

Induction-type Meter

The basic principle of the induction type watt-hour meter centres on a design where two laminated cores of magnetic iron are disposed close to each other. On one core is wound a coil which—in the smaller types of meter—carries the main current, while on the other core there is a coil which is connected across the circuit so that the current in it is proportional to the potential, or voltage, of the supply. The pressure coil is arranged to have a high inductance, while the current coil consists only of a relatively few turns and has a much lower inductance. It will thus be seen that the magnetic fluxes generated by these two coils will differ in phase, and their interaction will cause a rotating magnetic field.

Situated so that its edge cuts across the flux, and so disposed that it can rotate in the air gap between these two magnetic systems, is a copper or aluminium disc which drives a train of gearing, and so rotates the dials which measure the energy supply.

The rotating magnetic field induces currents called "eddy currents" in this disc, and the interaction of these "eddy currents"

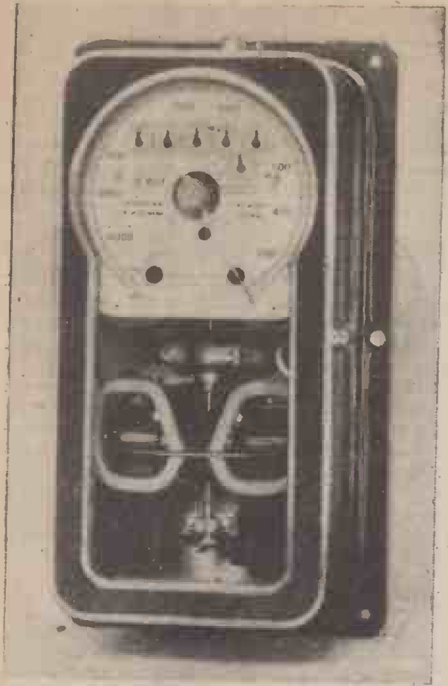


Fig. 5.—Three-phase meter fitted with maximum demand pointer.

with the flux causes the disc to rotate. If this were all the equipment of an induction meter, a serious difficulty would arise. The disc, being suspended on a jewelled pivot, is naturally made to be as free from frictional losses as possible. This being the case, if the current in the circuit were suddenly switched off there would be nothing to stop the disc from continuing to revolve for what might be quite a lengthy period, and all this while it would be incorrectly registering a transfer of energy. What is needed, then, is a form of braking, and this braking force must be proportional to the speed, since obviously the brake must stop the meter instantly at times when the passage of full load causes the disc to revolve at its maximum speed, and also at other times when the smallest load causes a very low rate of revolution. This is achieved by arranging that the disc also cuts the flux of one or more horse-shoe permanent magnets. A somewhat complicated mathematical deduction proves that the retarding effect—which, of course, is also caused by further eddy currents induced by the permanent magnets interacting with their fluxes—is directly proportional to the speed of the disc.

We have now described the elements of the ordinary alternating current induction meter as installed in the vast majority of consumers' premises. The whole assembly is made up in a very compact form, and Fig. 1 shows a typical example. The outer casing is shown removed. The base on which the whole meter rests comprises a bakelite moulding, and the cover being also of bakelite the whole assembly is thus entirely insulated. Some manufacturers, however, prefer an all metal assembly. Fig. 2 shows the electro-magnetic assembly with the current coils below and the pressure coil above. In Fig. 3 the brake magnets are shown separately.

Extreme Accuracy

The British standard for meter accuracy is very rigid, and in order to achieve exact calibration at least three adjustments are provided. For accurate registration on full load the strength of the magnetic flux of the brake magnets is slightly altered by a "divert," which causes a slight amount of the flux to be by-passed away from the disc, and this is adjusted by a screw seen in Fig. 3. For light-load adjustment a small vane which cuts the flux path due to the current coil, and thus alters its value, is made to be adjustable, and since the power factor of the load might cause the current vector to be at a considerable angle to the pressure vector, and thus alter the conditions leading to the production of a rotating field—which is, of course, essential for producing rotation of the disc—adjustment in an auxiliary short-circuited winding on the current coil frame is also provided, and this is seen at the top of Fig. 2.

By means of these three adjustments the commercial meter can be made to start at 0.3 per cent. of full load, and at unity power factor can have an error not exceeding 0.25 per cent. all the way from no load up to 300 per cent. of full load, while the accuracy is closely maintained from temperatures as low as −5 deg. C. up to 50 deg. C. Variation in supply voltage is also taken care of, so that down to 70 per cent. of full volts the registration is still only 1 per cent. in error. Highly inductive circuits giving a power factor as low as 0.5 per cent. lagging cause only slight deviations from accuracy, and variations in mains frequency also have negligible effect on the registration of the meter.

Direct Current Meters

Some few districts in this country are still supplied with direct current energy, and the meter used in these cases is of a type closely allied to a small electric motor, but without the iron yoke associated with motor construction. Here the current coil forms the stationary portion—the field—and the pressure coil is movable and generally takes the form of a small armature, but without iron, with a very light commutator. The torque on the spindle is proportional to the product of the magnetic forces exerted by the two coils, and (there being no iron in the circuit) these forces are in turn strictly proportional to the currents producing them, i.e., the main current and the main pressure, and therefore the torque is proportional to the power in watts. Again a brake is necessary, and it takes the same form as that we have already considered in the A.C. induction meter.

The two forms of meter described above are those which are by far the most commonly used, and of the two the A.C. pattern is, of course, very much in preponderance. In the case of three-phase A.C. circuits, which are the commonest form of electrical power supply systems, it is possible to measure the power by using two watt-hour meters only, and these may conveniently be combined on one spindle with a common registration dial. A typical assembly of this nature is shown in Fig. 4.

Maximum Demand

It was mentioned earlier that it is sometimes necessary to ascertain the maximum demand of a particular circuit, and for this purpose meters for power supply are usually equipped with maximum demand indicators. It would not be practicable to record the instantaneous maximum demand in many forms of electrical circuit, as the simultaneous starting up of two large electric motors might cause a momentary demand, for perhaps ten or twelve seconds, which would be out of all proportion to the demand during the rest of the day. For this reason the demand is taken over a fixed period, which may very often be thirty minutes. For the sake of clarity, let us assume first that a period over which a maximum demand is to be registered is one hour. If a load of exactly 1,000 kilowatts passed through the circuit during this hour, then the maximum demand would obviously be 1,000 kilowatts, and an ordinary meter would register 1,000 kilowatt-hours, that is to say, 1,000 units. Suppose there was attached to the registration gear train a pointer which moved round a scale, calibrated up to, say, 5,000 units. If it had been set to zero at the commencement of the sixty minutes we are considering, it would read 1,000 at the end of the period. Now let us reset it again to zero and imagine this time a load of 2,000 kilowatts are passed for thirty minutes only. Again 1,000 units will be registered and the pointer will read 1,000, even though the load, when it was on, was 2,000 kilowatts. Finally, let us imagine a load of 4,000 kilowatts, which is only on for one quarter of the sixty minutes, and again we shall have the same reading on the pointer of 1,000. Averaging out the power flow over the sixty-minute period we have allotted, it will be seen that the pointer always reads the average maximum demand over the hour.

Suppose now that the pointer actually comprised two arms, one—a red one—driven upwards by a second arm, painted black, which had on its spindle a device which automatically reset it to zero registration at the end of every hourly period. Then it will be seen that the red pointer would record the highest average maximum power demand

Fig. 6.—Summator, capable of receiving impulses from up to twelve meters, and adding or subtracting the totals; with combined maximum demand given on the pointer at the top.

which had occurred in any hourly period. Once a week or once a month, dependent on the accountancy period required, the engineer would reset the red pointer to zero and its registration, which he would record, would give him the highest power demand during the week or month *taken over an hourly average.* Obviously the same reasoning can be applied to any longer or shorter period over which the supply authorities consider it desirable to measure the average power demand, and in practice a thirty-minute period is the one most frequently adopted. This means that the meter installation must be provided with a time switch, which is frequently of the synchronous-motor type, which closes a contact every thirty minutes, and by energising a small trip coil on the spindle of the black maximum demand hand, causes it to reset to zero. The same time switch can, of course, reset a large number of such circuits on any one meter installation.

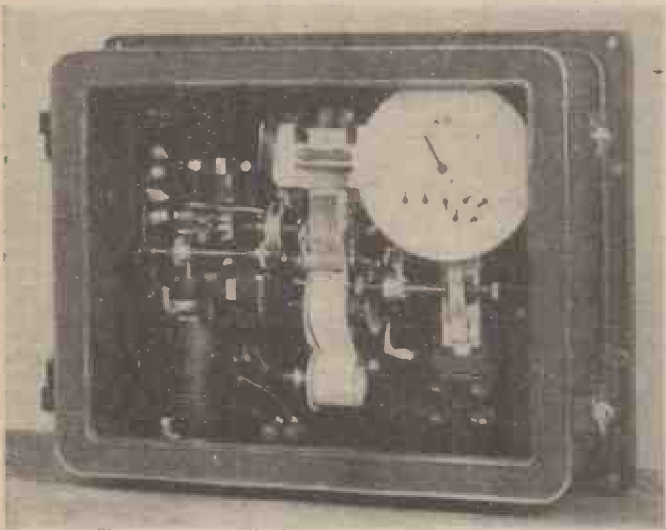


Fig. 7.—Printometer, which gives a printed record of the half-hourly demand.

Fig. 5 shows the maximum demand dial on a meter similar to that shown in Fig. 4.

Auxiliary Apparatus

The registration of large power supplies calls for a good deal of auxiliary equipment over and above the meters on the individual circuits. First come the current and voltage transformers. Obviously a current in excess of about 15 amps. cannot be passed conveniently through the current coils of meters, and so the load current is taken through the primary of a current transformer, in which the secondary is so arranged that it delivers, when connected straight to the current coil of a meter, an output of, say, exactly 5 amps., when the full load current in the mains is 100 amps. Much care is taken in the design of these transformers to ensure absolute accuracy from small loads up to several times the full load current. Similarly, voltages of over about 260 volts cannot be brought into the meter case, as insulation problems would then become troublesome. A voltage transformer is therefore used to reduce the mains pressure of 6,600 volts to exactly, say, 110 volts, and this transformer is also designed with the utmost regard for accuracy. A three-phase meter installed on a 500-kilowatt 6,600-volt circuit would need, in addition to the meter—which would be generally similar to that shown in Fig. 4—a pair of current transformers and also a pair of voltage transformers.

Summation

In power stations it is frequently desired to summate or add up the energy generated, say, by four generating sets. This can be done in several ways, one of them being to employ a special transformer which has a number of windings on its core, so arranged that a further winding connected to the meter carries a current proportional to the sum of all the currents in the separate primaries. A more usual system is by impulses. If a number of meters have each on their spindle a small cam which causes a contact to close when, say, x units have passed through the circuit to which the meter is connected, and this contact causes a small electro-magnet to notch on a pointer in a separate device, it will be seen that every time x units have passed, this pointer will be notched on one division. If it can be notched on by the contacts from a number of meters, it is again obvious that its total registration will equal the total numbers of times x units have passed through all the meters. Maximum demand arrangements on the same lines as those described previously can be applied to this summator pointer, and the combined maximum demand of all the circuits is thus registered. In many cases where an undertaking generates some of its energy and receives further supplies from the Grid, it may be desired to add perhaps two Grid imports and the generated load, and subtract the Grid export on other feeders.

Impulsing Type

The general impulsing type of summation lends itself quite easily to this procedure, as some of the impulses received at the summating device can be arranged to drive the pointer forwards while others drive it backwards, and cleverly designed clockwork mechanisms with "free wheels" and similar devices have been designed to achieve this. Fig. 6 shows a typical example in which it would be possible for all the six dials on the left-hand side—each of which is driven onwards by the contacts on six individual meters—to add up and drive the final megawatt-hour dial at the top (together with the maximum demand pointer above it) in a forward direction, while all the six on the right-hand side can add their registration together, and then cause this total to be subtracted from the total set up by the left-hand dials.

Printed Records

To provide a permanent record without the necessity of writing down half-hourly or hourly readings, many devices are extant to print the maximum demand at intervals. In some of these a recording chart is marked continuously by a moving pen, in others a pen is caused to mark the chart each time the demand period—usually thirty minutes—comes round, and in another form, used considerably on the British Grid, a roll of tape is printed, typewriter fashion, with the actual figures representing the half-hourly demand. Fig. 7 shows one of these designs, known as a printometer.

Metering Installations

On some of the largest metering installations it is desired to ascertain not only the prime matters of units supplied and maximum demand, but also the average power factor of the energy supplied to the consumer. The meters described above register, of course, VI cos ϕ, which is the real power in a circuit of voltage V, current I, and phase angle ϕ. The wattless component is VI sin ϕ, and if this can also be measured the power factor can be arrived at. Systems employing quadrature transformers, which utilise the various vector relationships between the three currents and the three voltages in a three-phase circuit to measure this wattless quantity, are sometimes installed, the meters themselves being exactly similar to those described above.

Finally, Fig. 8 shows a complete installation of meters installed in a power station with two Grid feeders—which might be used for import or for export—and five generators. The equipment enables continuous printed records to be made of the generated and imported demands, at half-hourly intervals, and also of the undertaking's own load.

(The illustrations Figs. 1 to 3 are reproduced by courtesy of English Electric Co., and Figs. 4 to 8 by courtesy of Messrs. Ferranti.)

Fig. 8.—Complete metering installation in a Power Station, with meters for individual circuits on the left and right of the centre panel, which contains printometers and summators, with maximum demand dials.

High-flying Kites

Now that Kite Flying can be resumed again, the following article should prove useful to readers interested in the subject

By E. W. TWINING

MANY years ago in the days of the old Kite and Model Aeroplane Association, since succeeded by the Society of Model Aeronautical Engineers, I made a number of kites which behaved extraordinarily well; in fact, from the point of view of efficiency their performance was about as high as it is possible for any kite to attain. The largest of these was flown in one or two competitions which were held upon Wimbledon Common and subsequently was used, with the association banner halfway up the kite line, as a landmark and guide for entrants in the model aeroplane competitions when the meetings were held in the out-of-the-way places; that is to say, in fields which were difficult to locate.

The Origin of the Design

Actually the design for the kite was evolved many years prior to the days of the K. and M.A.A., and at that time the only kite available was the well-known box form and, of course, the ridiculous, old-fashioned, pear-shaped kite with a long tail.

Efficiency

The box kite was, and is, a fairly good flier, but it appeared to me that for its weight-surface area ratio, and the number of sticks in its framework, it was very inefficient, and this was largely due to the fact that the lifting surfaces were all of them making an angle of 45 deg. to the wind instead of being normal, as they should be. I am not referring to angle of incidence, but to a line drawn through the kite at right angles to the wind. It is, of course, upon this 45 deg. cross angle that the kite depends for its stability. I therefore set out to design a perfectly flat kite like the old-fashioned tailed type, but which should be kept rigidly into the wind without needing the weight and drag of a tail; so I added a central fin, or keel, from top to bottom of the flat surface and braced this keel to the outer edges of the kite by means of cords. The result of this was a form of kite which is shown in Fig. 1.

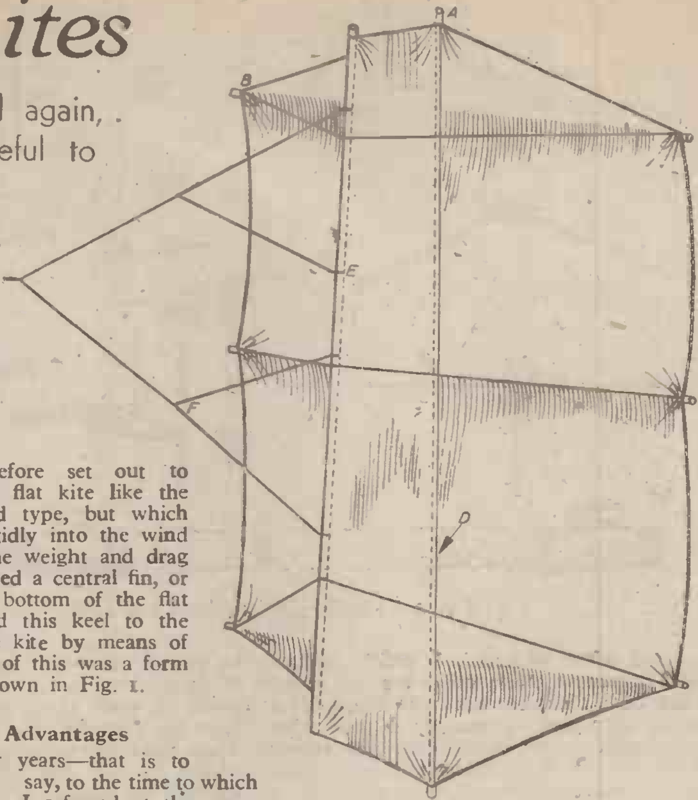


Fig. 1.—A perspective view of the finished kite.

Large Kites and Advantages

Coming to later years—that is to say, to the time to which I referred at the commencement, the particular kite which I built for use at Wimbledon and elsewhere was somewhat large, and it is this kite which I propose to describe first. There is a decided advantage in large kites over small ones, for they will frequently fly in the lightest of breezes, when a small kite will not keep aloft. In a high wind they are inclined to be a little bit too powerful and unmanageable except in the hands of a strong man. I would recommend that the large kite be flown only in breezes.

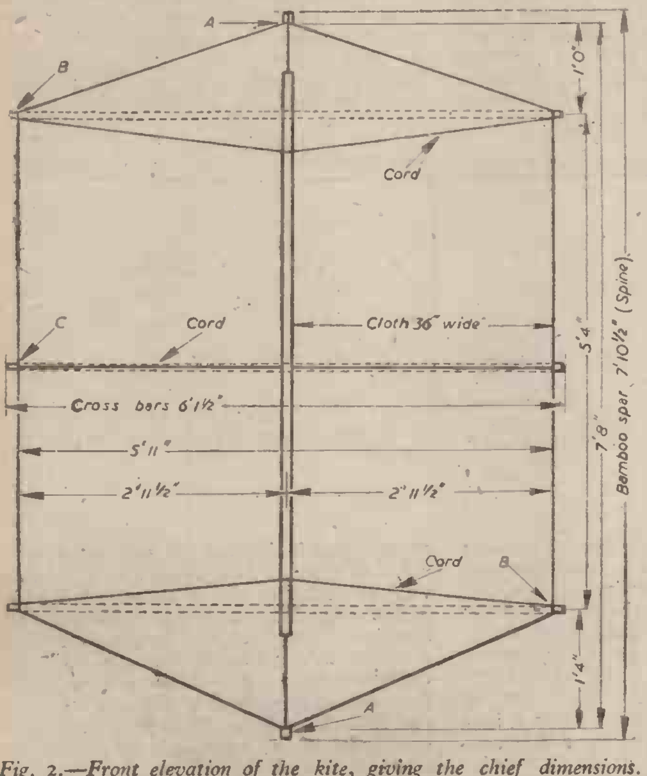


Fig. 2.—Front elevation of the kite, giving the chief dimensions.

I venture to think that in any such light winds and under certain conditions the reader will be astonished at the way this kite behaves. I have many times had it soaring vertically over my head and exerting absolutely no pull upon the cord, which was lying loosely in my hand. I cannot explain why it was able to do this except by assuming that, like birds and sailplanes, it was finding a thermal or up-current of air. That the current was not directly vertical is evidenced by the fact that the cloth was shivering as one frequently sees a flag; that is to say, the wind must have been blowing straight along the kite from top to bottom and it was, therefore, flying nearly horizontal.

Materials

As regards cost of construction, the expenditure of a few shillings is all that is called for, the most costly item being the kite line. For its making 8yds. of 36in.-wide strong white calico is required; five bamboo sticks, which can be bought from a nurseryman or, perhaps, at a florist's; 1½yds. of strong white tape, ⅝in. wide; some No. 16 gauge tinned iron wire and about a dozen

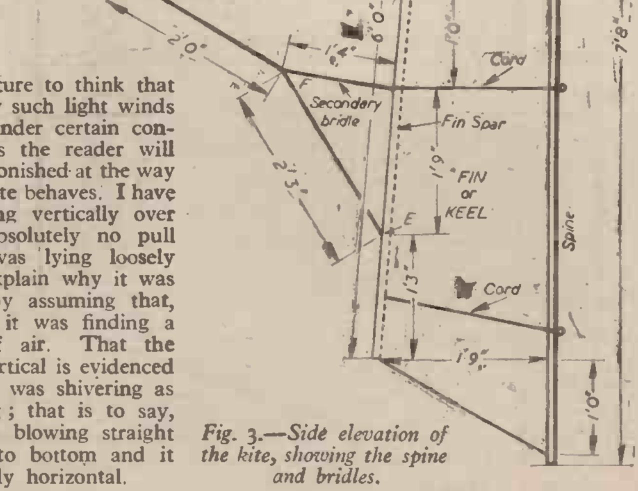


Fig. 3.—Side elevation of the kite, showing the spine and bridles.

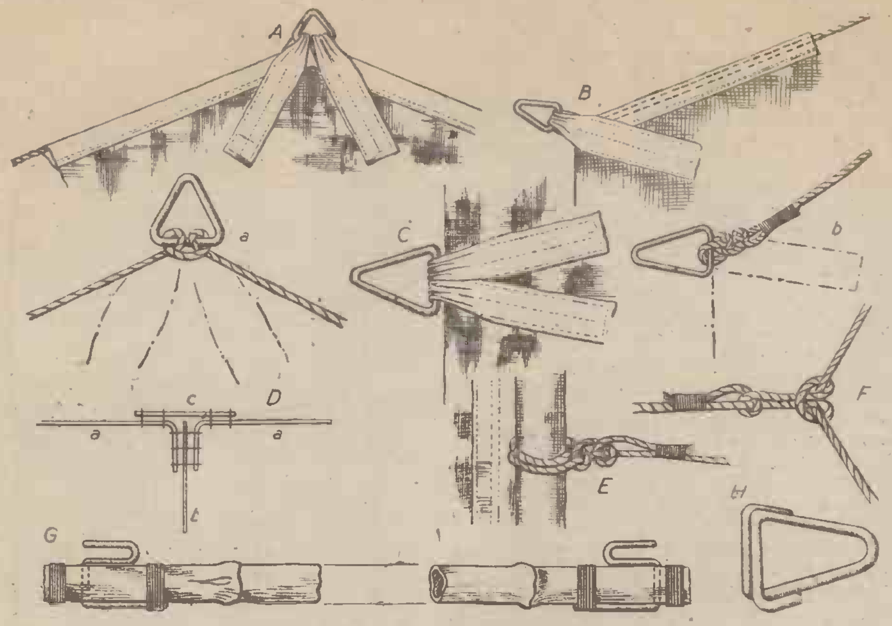


Fig. 4.—Details of joints, knots and bindings.

yards of strong whipcord. It will be noticed that I mention white calico for the fabric material. This assumes that the kite is to be all white. Personally I think that pure white looks better than any colour in the air, but if the reader prefers a colour he will have to use a material such as sateen.

Construction and Balance

It will be obvious that success in getting perfect balance of form will depend wholly upon the accuracy with which the cloth is cut out and sewn together, but really the shape is so simple that one cannot go very far wrong. The 36in.-wide material will have, of course, two selvedges, and these are not to be cut. The first thing to do will be to cut two pieces for the main surface of the kite, the actual diagonal cuts in both pieces of cloth being made together; that is to say, with the cloth of double thickness. Then from the remainder the keel, or fin, should be cut out. It will not matter whether the selvedge of this is placed at the back or whether it wraps around the spar at the edge where the bridle is attached. In any case the cloth should be spread on the floor, or a large table, and lines drawn upon it in pencil to the measurements given in Fig. 2, allowance being made at the top and bottom and at the front for turning in. It should be turned over for an ordinary narrow hem at the top and bottom and at the front edge with a hem large enough for the bamboo spar to be passed down inside of it. The back edge of the fin cloth is then sewn between the inner edges of the back cloth, $\frac{1}{2}$in. being turned up on each of these edges of the latter to receive it.

Referring to the drawings, Fig. 1 is, of course, a perspective view. Fig. 2 is a front elevation, and Fig. 3 a side elevation. These two elevation drawings will give the reader the whole of the dimensions needed: the measurements which the cloth will have after hemming, the width of the hems being added to the measurements in cutting the cloth, and the length of all the bamboo rods. The most helpful of the drawings will probably be Fig. 4. In this is sketched details of the construction. Reference letters, in capitals, against each sketch are repeated in the other drawings to indicate the position upon the kite where the detail occurs.

Collapsibility

It is essential, of course, that a kite such as this shall be capable of being taken to pieces in a few minutes, or seconds, and rolled up for carrying, and similarly re-erected. The simple manner in which this is arranged will be made clear by the details in Fig. 4. At eight points on the main surface triangular rings are fastened. One of these rings is sketched at H. At each end of the four main bamboos, which flatten the kite, wire hooks are fixed as shown at G. These hooks are bent, as shown, the wire passed through holes drilled through the bamboo about $\frac{1}{8}$in. from each end, and bound with either strong thread or fine tinned iron wire such as florists use. If wire is used it should be soldered, and, if thread, it may very well be beeswaxed.

Dealing with the rest of the details in alphabetical order, A shows the method of attaching the rings at the top and bottom of the kite. Here it will be seen that two tapes are used, each length of tape being passed through the ring and stitched with its ends one on each side of the cloth. Through the hem at the top and bottom a length of whipcord is passed. Below A is another sketch showing the same ring somewhat enlarged. This sketch, a, shows the way in which the cord should be secured to the ring. This cord may either have the hem made over it or may be passed through the hem with a bodkin after making. The cord terminates on each side of the kite at B, where it is secured to the ring with two half-hitches and a seizing. Great care should be taken to secure each of the side rings, B, at exactly the same distance from the centre ring, A. The particular knot to be used at the side rings is shown at b (Fig. 4). Here again tape is used, in this case one piece only. G is a sketch showing the ring in the middle of each side. D is a cross section through the three cloths where they unite down the centre of the length of the kite; aa are the two side cloths, b the fin, and c is a tape also extending from top to bottom. E shows one of the four attachments of the bridle. A hole is made through the cloth and the cord taken twice around the bamboo spar, then secured with two half-hitches and a seizing. The

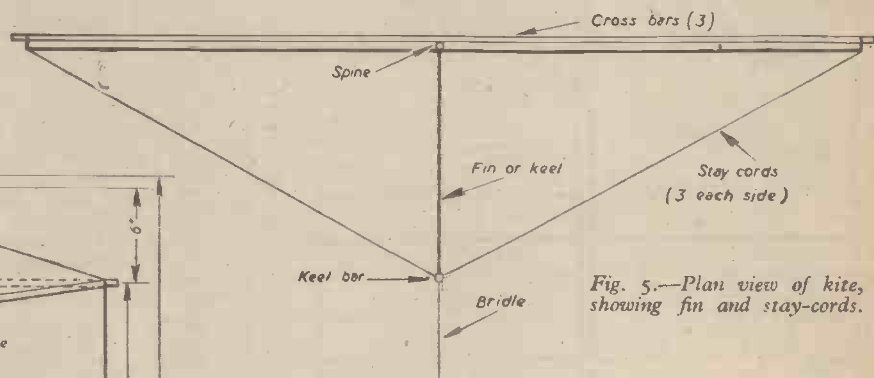


Fig. 5.—Plan view of kite, showing fin and stay-cords.

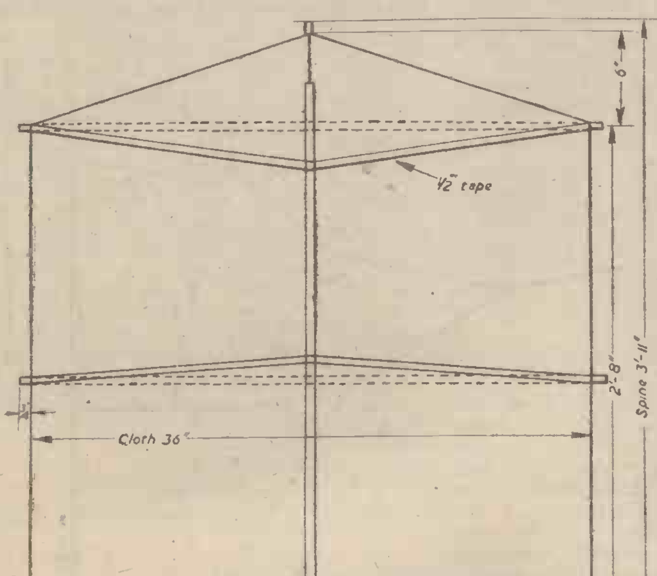


Fig. 6.—Front elevation of a small kite.

reader will understand that the object of using two secondary bridles on the fin spar, and a primary attached to the two secondaries, is to distribute the pull of the main cord equally over the whole area of the kite. This object is further achieved by taking from the fin spar additional cords to the ends of the three crossbars, not actually to the bamboos themselves, but to the rings which fit over the hooks in the bamboo. Sketch F shows the attachment of the ends of the primary bridle to the two secondary bridles. Before making these knots (F), the reader must decide how he will attach and detach the kite line from the main bridle. I suggest that a good plan will be to get two key split-rings, and on one of the rings secure the bridle in the manner shown at a; the kite line is attached to the other ring

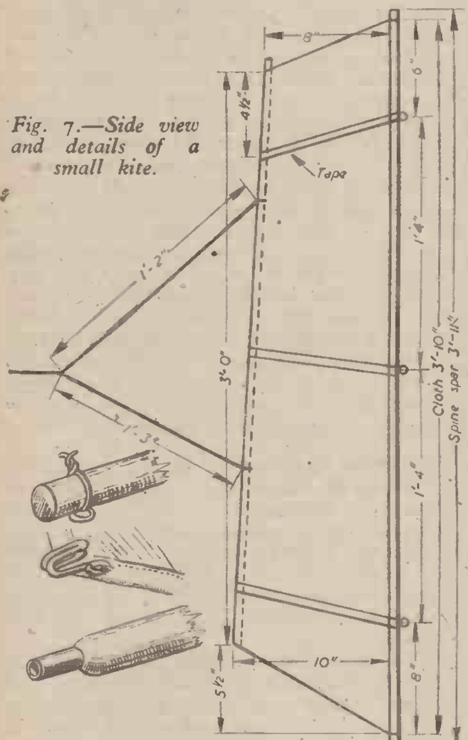


Fig. 7.—Side view and details of a small kite.

as at F. It will thus be seen that the line can be attached and detached by opening one of the rings.

Stay Cords Regulate Symmetry

This completes the construction of this kite, and it only remains to impress upon the reader the importance of making the whole of the six stay cords, which are clearly indicated in Fig. 5, and which run from the fin, or keel bar, to the points B and C, of exactly equal length. If this is not attended to, the main surface will not be perfectly flat, and the kite will not fly well. For instance, suppose that the stay on the left-hand side at the bottom is longer than the left, then there will be a twist upon the surface, and this will cause the kite to turn over in a left-hand direction; similarly, if the bottom left is shorter than the right, the kite will twist over to the right.

A Smaller Kite

Many readers will probably think that the drawings just given show a kite which, for their purpose, is unnecessarily large, and I therefore give in Figs. 6 and 7 the proportions and one or two details of construction of a smaller kite. This can be made from a single width of 36in. calico. It should be hemmed at the top and bottom, but will not need a cord in these hems. The sticks can be of either very light bamboo, strips of deal, or some carefully selected round dowel sticks of about 5/16in. diameter. The side stays can be ½in. tape sewn to the cloth, and here again the greatest care must be taken to make them all exactly equal in the length. For attaching the corners and middle of the sides to the sticks the largest of dressmakers' hooks can well be used. These can be attached as sketched in Fig. 7, or they can be hooked tightly into the ends of bits of brass tube pushed tightly over the ends of the sticks. A single bridle only will suffice for a kite of this size, although the use of two secondaries and a primary bridle is to be recommended. I have mentioned calico for covering this smaller kite, but it would be preferable if a lighter material were obtained, such as "Dorcas" or some other very light cambric.

Kite Lines

The strength and fitness of any particular cord for use as a kite line is important. Cheap string should not be used, and it is well worth spending an extra shilling or two to obtain some which has the maximum breaking strain coupled with the smallest diameter of not less than 5/64th of an inch, and it should have a breaking strain of at least 60lb. The reader is advised to go to a firm of rope and twine merchants rather than to an ironmonger's shop to purchase what is required. The cord should be of such a nature that it will remain hard and smooth and not become ragged and woolly. The length of the cord is purely a question of how high one wishes the kite to be flown, but I suggest that the large kite can very well do with a quarter of a mile of line.

Kite Line Reel

The next point, and rather an important one from the point of view of convenience, is the form which the apparatus shall take upon which the line is wound. Obviously some form of windlass; that is to say, a drum upon a shaft, carried in bearings and with a handle on one side is the best, but such a windlass would be difficult to make, and, furthermore, it ought to be provided with a brake and ratchet with some means of attaching the whole thing to a fence or post. For kites very much larger than the bigger one described a windlass would have to be used, but the reader should be able to manage fairly well with the device shown in perspective in Fig. 8, which is a form of reel. This is quite easy to construct. It should have a handle on each side of fairly large diameter so that it can be gripped well by the hands when paying out the line.

The best way to get the big kite aloft will be to get someone to walk away with it in the direction of the wind, trailing it along the ground, whilst you stand and let the line unreel with the winding gear simply running round in your hands. Then, when the kite is about 100ft. away, get your assistant to raise it to the vertical. It should then take the wind and rise aloft without any running or pulling. When it is well up you can begin to let the handles slip around in your hands. To get the kite down again do not attempt to pull in the line and turn it over and over on the reel, for this will twist the cord and produce kinks in it, but get your assistant to walk away from you and pull the line down hand over hand. When the tension is thus slackened on the line you can yourself walk forward and spin the reel in your hands, so taking in the line in exactly the same way as it was paid out.

Team Flying

A considerable amount of interest and pleasure can be derived from both of the

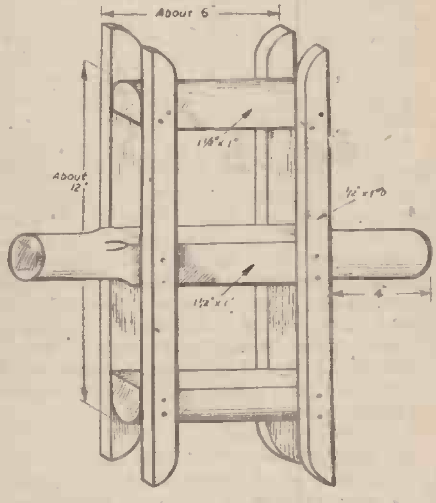


Fig. 8.—A simple reel for a kite line.

kites, the large and the small, one behind the other in a team, the smaller kite being flown, of course, uppermost. In doing this it is necessary to see that the line of the upper kite is attached at the correct point upon the back of the big lower kite. This particular point is exactly opposite the centre of the bridle of the large kite; that is to say, if you draw an imaginary line from the main bridle through the kite, at right angles to its flat surface, you will find a point upon the main upright or spine of the kite, and this is where the upper kite line should be secured. It will be necessary, however, on the back of the cloth of the main kite to sew a piece of tape about 8in. long, stitch it at the middle of its length, leaving two ends which are used to tie around the spine. If the upper kite line is secured to the spine just where the tape holds the spine to the cloth, the pull of the upper kite will be transmitted straight through to the bridle and main line of the lower kite.

Modern Glue Manufacture

Little-known Details Concerning a Common Constructional Commodity

ANIMAL glue of one sort or another has been known and used since very ancient times. Yet it is only within comparatively recent years that glue as a serviceable material has been accurately standardised both as regards its manufacture and the characteristics which it is required to possess.

When one thinks of glue, the idea of adhesion at once comes to one's mind. Glue is, indeed, one of the oldest and one of the most reliable of adhesives. Yet, in view of glue's pronounced lack of waterproof qualities, other adhesive materials, as, for example, casein and the various synthetic resins, are able to compete successfully with it as a bonding agent.

Nevertheless, its bonding properties do not constitute glue's only advantages. In a finely ground condition, enormous quantities of glue are sold as "size." Glue, as a filling material, is used on a large scale in the paper-making industry, in the manufacture of colour washes and distempers, in the match trade, in the manufacture of abrasive papers and cloths, and in many other industries. Each of these specialised trades requires its own special variety of glue, the result being that it is now customary for a glue manufacturer to produce batches of glue to very precise specifications.

In the olden days, and even comparatively late in the last century, glue used to be made in a very haphazard manner. Bones, fragments of hides and other animal refuse were all massed together inside a sort of rope bag, which latter was then lowered over a pulley into a tub of boiling water. When the "glue cauldron," as the water tub was termed, had extracted sufficient soluble matter from the scrap material within the bag, the latter was raised out of the water and allowed to drain, after which another bag of fresh material was immersed into the "cauldron." Eventually, a thick, dark-looking solution was obtained. This was skimmed, boiled for a short time in order to concentrate it, and then run out into moulds or long channels to set. The product so obtained was often almost black. It usually had a vile smell, and its adhesive properties were sometimes very good, and at other times just the opposite.

Mysteries of the Proteins

It is only since the rise of protein chemistry that we have been able to understand just what glue is. The chemist, if he has not yet solved all the problems of glue manufacture, has at least thrown sufficient light upon them to enable the manufacturer (and the user) of animal glue to realise the innate character of the material.

A reproduction of an old line engraving depicting the ancient method of glue production. It shows the rope bag raised above the "glue cauldron," its liquid contents of hide and bone extracts being allowed to drain therein.

"Protein" is a chemical word which is much used nowadays, especially in connection with foodstuffs. It is a name which is conveniently applied to a very large class of enormously complex nitrogen-containing chemical compounds which are mostly derived from animal sources.

The chemical constitution or make-up of the proteins remains, as yet, one of the first-rate mysteries of chemical science. No experimentalist has ever yet made a protein compound in the laboratory, yet, of course, much valuable information has been gathered concerning the essential characteristics of the various classes of proteins.

All animal hides and bones contain within them (among other matters) certain varieties of protein substances which serve to bind together their individual cells. These are the "sclero-proteins." They are mainly insoluble in water, and when treated with certain agents, as, for instance, tannic acid, they become more insoluble still. The conversion of hides into leather by means of treatment with tannin solutions depends on this fact.

Now, if we take one of these naturally occurring insoluble "sclero-proteins" and boil it for a long time with a dilute acid or a weak alkali, it gradually breaks up into much simpler compounds known as "amino acids." These amino acids are comprised of acidic groups of atoms united to nitrogen groups. They are soluble in water, and they represent the units from which all the complex protein and protein-like substances are built up. By stringing together (in a chemical sense) large numbers of these amino acids the chemist has been able patiently to create artificial materials which are in many ways very like the natural proteins.

Chemical Action of Water

By taking one of these "sclero-proteins" and by subjecting it to suitable treatment with steam or boiling water, it is possible to get the water to act upon it and partially to break down the protein material into a somewhat simpler substance. This constitutes the essence and the "theory" of glue manufacture.

To make ordinary glue, we take waste hides or old bones (generally the latter) and subject them to treatment with steam, whereby the sclero-proteins contained in them become converted into a simpler material which is semi-soluble in water and forms a colloidal solution. This material is glue.

But if we attack the protein material in the hides or bones still more lightly with hot water or steam, we get a material which,

Loading the bones into the crushing machine prior to the "bone boiling" process.

The hand-sorting of broken bones prior to the commencement of the "de-gluing" treatment.

although soluble in hot water, sets to a firm jelly when cold. This protein-derived substance is known as gelatine. It is a substance of enormous importance in view of its use in the foodstuffs, photographic and other industries, yet it has not the same characteristics as glue.

Gelatine can be converted into glue by prolonged boiling, and glue, in its turn, by similar treatment, can be changed into substances which are more soluble still until, at last, by continued treatment, we are able gradually to break down these materials of unknown chemical composition (for neither glue nor gelatine have known compositions) into the simple "amino-acids," the ultimate units of the natural proteins.

Here, then, quite clearly, is the reason why prolonged heating and boiling are detrimental to glue solutions, since under such treatment the glue thins, loses its characteristic viscosity and its adhesive power. A glue solution should never be heated above about 60 deg. C., that is, beyond a temperature just sufficient to keep it nicely liquid.

Such is the "theory" of glue manufacture. It should be noted that glue does not exist as such in the animal materials from which it is obtained. The process of glue manufacture is not one of simple water extraction. On the contrary, the hot water or steam has to act upon the animal material in the guise of a chemical agent, and it has actually to attack the highly complex protein substances and to break them down into the rather simpler glue substance.

Collagen and Ossein

The glue-forming protein of hides is not identical with that of bones. The scleroprotein of hides is known chemically as *collagen*; that of bones is called *ossein*. Both of these are quite insoluble in water. On treatment with steam or hot water both are converted first into gelatine and then into glue.

In bones the ossein is not only mixed up with mineral matter, but it is also surrounded with fat. Hence, in the manufacture of glue from bones, the first stage in the process is to extract the fat from the bones.

After a preliminary inspection of the bones and the removal from them of scraps of flesh, horn, hair, and other non-glue-forming materials, the bones are broken up into small fragments and are then mechanically loaded into an "extractor." This is a vertical steel cylindrical vessel capable of holding anything from five to ten tons of the prepared and broken bones. Benzene vapour is passed upwards through the extractor. The vapour condenses, and the hot liquid benzene as it trickles downwards dissolves out the fat from the bones. The resulting solution is collected and the benzene distilled off, leaving behind a very valuable quantity of bone fat.

The de-fatting of the bones takes anything up to 30 hours, the eventual product being a mass of bone, which is completely degreased and devoid of any oil or fat.

The de-fatted bones are then passed into a revolving cage, which serves to remove dust from them and to break them up a little more, after which they are soaked in cold water, or, more usually, in a weak solution of sulphurous acid, which serves to remove the natural salts from the bones. Following this, the bone material is packed into a high-pressure boiler (or "autoclave"), wherein it is submitted alternately to high-pressure steam and to the action of boiling water. In this manner the water is made to exert a chemical attack on the ossein of the bone, changing it into glue material, which is dissolved out by the hot water.

Steam and Hot-water Treatment

Usually, up to 15 alternations of steam and hot-water treatment are necessary before all the ossein in the bones is converted into glue, and, normally, the autoclaves are worked in series, the hot-water discharge from one autoclave being fed into the next one. A full 24 hours (sometimes more) is occupied in completely "de-gluing" a charge of prepared bone material, after which the residual bone is dried, ground, and disposed of commercially as valuable fertiliser material.

In the production of glue from waste hides and fragments thereof the first process is to wash the material in cold water for the purpose of removing loosely adherent matter and also soluble substances such as salt. After this the hides are immersed in a mixture of lime and water for a month, during which period the hides swell, the hair loosens and some of the fat is removed by conversion into a lime soap.

The hides are then again carefully washed, treated with cold dilute hydrochloric acid in order to remove adherent traces of lime. Finally, the hides are for the third time washed in cold water to eliminate all traces of acid.

The prepared hides are then placed in wooden "pans," which are heated by means of steam coils. Usually the hide material

A piece of solid cake glue after immersion in cold water gradually absorbs the water and slowly swells, becoming a formless mass of mixed water and glue particles, which disperse into a clear colloidal solution on heating the liquid.

Removing the long slabs of glue-jelly from their moulds.

Cutting up the glue-jelly slabs into thin slices, in which condition they are then dried to form the solid glue "cakes" for commercial purposes.

is first heated with water in these "pans" to a temperature somewhat below boiling point (say, 85 deg. C.). This heating goes on for a working day (eight hours), after which the water extract is discharged into a shallow vat or tank, and, after cooling therein, the fat is skimmed off it. This process is known as the "melting out" of the glue, although, strictly speaking, the glue, as we have already seen, is not melted out of the hides, it being produced therefrom solely by means of the chemical action of hot water.

Vacuum Concentration

The solution thus obtained contains about 5 per cent. of high-quality glue. It is filtered, bleached and concentrated in vacuum evaporators until it contains about 15 per cent. of glue. In this condition it is run into long zinc vessels which are cooled by means of running water. In a few hours the glue solution sets to long slabs of jelly.

The jelly slabs are removed, sliced up like loaves of bread by means of a mechanical slicing machine, and the glue-jelly slices are placed on wire nets, which are run into a long tunnel to dry.

The drying tunnel may be up to 60ft. in length. Air is blown through it and a drying time of approximately three to four days is allowed. The dried glue slabs are then removed, graded and packed.

One charge of hides can be "extracted" three or four times with water, but after the fourth time it is no longer economical to extract any further glue material. The hide residue is called in the trade "scutch," and it can be used as a fertiliser.

We must now return to the glue extract produced by the autoclave treatment of degreased bones. The glue solution from the autoclaves is very dark in colour. It is usually first filtered, after which sulphur dioxide gas is bubbled into it in order to act as a bleaching agent. After this comes vacuum evaporator treatment, which concentrates the glue solution. The thickened glue solution is afterwards treated on much the same lines as the material prepared from hides. That is to say, it is run out into long, narrow vessels, in which it is cooled and set to thick jelly consistency by means of running water cooling. These jelly slabs are then sliced up and tunnel-dried as before described.

On the face of it, glue production appears to be a very simple process. Yet it can be a surprisingly difficult one to control, particularly when the process chemist has to arrive at a glue material of definitely predetermined qualities. The time and temperature of the steam/water treatment of the raw material have an enormous effect upon the solubility and viscosity of the resultant glue. Hence it is that the finest possible control must be applied at this stage of the manufacture.

The advent of modern automatic gluing machinery, such as that used in the cardboard carton trade, the abrasive paper industries and in modern book production (to mention merely a trio of glue-using industries) necessitates the production of varieties of glue which can be guaranteed not to depart appreciably from a given specification. For such reasons all glue-manufacturing firms are now equipped with up-to-date laboratory staffs, whose duty it is to supervise the glue production and to test out each finished batch in order to ensure its adherence to the required standard.

Glue Quality

The quality of a glue cannot be estimated merely by the appearance of the material. A dark glue is not always "stronger" than a pale-coloured glue, as is often believed. Neither is a thick solution of glue necessarily more adhesive than a thinner solution. Colour, viscosity, adhesion, jelly strength, melting-point are all characteristics which have to be individually tested for by the technical staff of the glue manufacturer, and it is usually upon the sum of these qualities that the reputation of the glue depends.

By treatment of a glue solution with various amounts of formic acid, the jelly-forming character of the material can be done away with. In this way very strong glue solutions can be obtained which will remain plastic or semi-solid indefinitely. Such are the various "liquid glues." These, of course, have their many uses, but for sheer joint-strength they do not come up to the average excellence of the normal hot-glue joint.

One of a battery of "de-gluing" extractors for the treatment of waste bones.

Again, by treating ordinary glue with formalin (formaldehyde solution) the glue can be insolubilised completely, so much so that it will readily withstand the action of hot water without dissolving or jellifying. The commercial solution of formalin contains only about 40 per cent. of formaldehyde. Yet so potent is the action of this substance on glue and gelatine that one part of commercial formalin diluted with four or five parts of water will completely insolubilise glue material. The chemical nature of this insolubilising action is not known. Yet it is a very important effect, many interesting technical processes being solely based on it.

Making Glue Solution

When allowed to soak in cold water, glue absorbs water and swells up to a maximum extent, depending upon the precise nature of the glue. The thick plastic mass which results is not even a colloidal solution of glue. It is merely a sort of mixture of water particles and detached glue particles. The rate of the swelling of the glue varies a good deal, depending upon the exact type of glue used. Some glues absorb water to a maximum extent within two hours. Others take eight to ten hours to absorb their fill of water.

When the glue has attained this condition, however, its detached particles are readily dispersed through the water, forming a clear, colloidal solution merely by gentle stirring or agitation of the liquid accompanied by heating.

During the heating process a temperature of 65 deg. C. should be regarded as a maximum. Indeed, this temperature is rather high, a temperature of 60 deg. C. being better. Glue heated to a higher temperature darkens considerably, gradually loses its viscosity or "stickiness" together with its adhesive power, and, in addition, wastes a proportion of itself by surface scum formation.

There is, indeed, an art in making up glue solutions, the secrets of which are all embodied in the above paragraphs. Maximum swelling of the solid glue under water and subsequently a minimum temperature for its solution, are the two main guides for the production of a perfect glue solution for normal and average use.

The National Physical Laboratory

Notes on the Work of Some of the Divisions

(See illustrations on the following page.)

ONE of the chief functions of the National Physical Laboratory is the accurate determination and maintenance of physical constants and linear dimensions, in which capacity it works in close association with the British Standards Institution, and makes important contributions to international physical standards. Routine and special tests of materials and methods are made on behalf of British Industries and important fundamental researches often guide British industrial technicians in new lines of development.

Electricity Division

In the Electricity Division, the high-tension laboratory is equipped with special large scale apparatus designed to develop very high voltage for the study of the properties of insulators, high tension cables and problems associated with high voltage supply systems generally.

Ship Division

The two main branches of work in the Ship Division are (a) fundamental studies in hydro-dynamics and (b) the testing of hull designs and the measurement of propulsive and steering efficiencies. The laboratory works in close association with British shipbuilding firms.

Aerodynamics Division

In the Aerodynamics Division fundamental studies in aerodynamical science, combined with routine and special test work for the British aircraft industry, are the main functions.

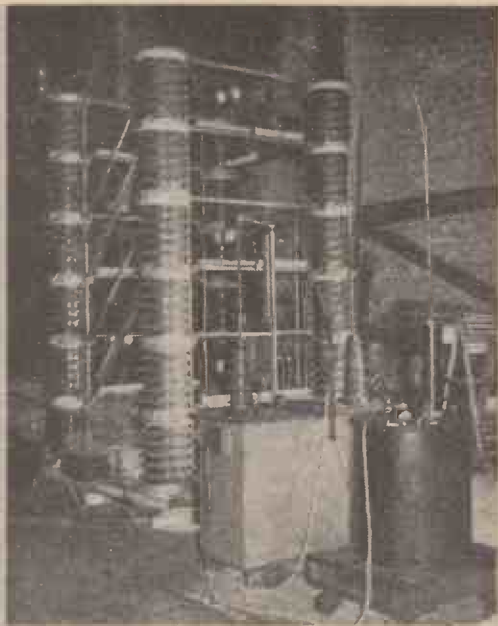
Metrology Division

The maintenance of high accuracy standards in a number of physical dimensions is the main purpose of this division. Standards of length, mass (weight) and liquid volumes are determined, and barometers, high precision test gauges and balances manufactured by British firms are tested for accuracy.

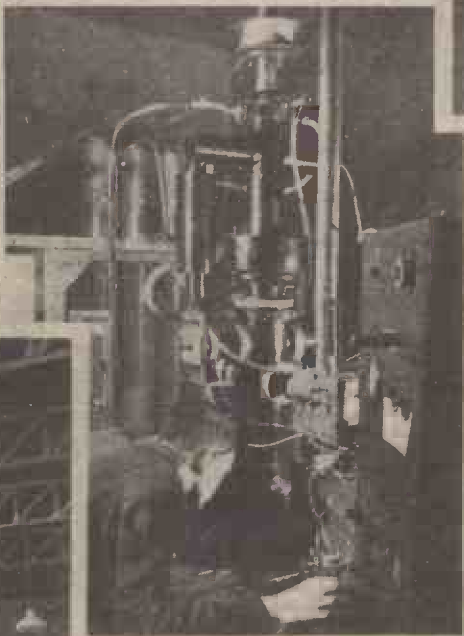
The National Physical Laboratory

One of the largest and most important of Britain's scientific and industrial research stations is the National Physical Laboratory at Teddington, Middlesex. It was founded in 1900 and controlled by the Royal Society —Britain's world-famous academy of sciences. In 1916 the National Physical Laboratory was taken over by the newly constituted Government department—the Department of Scientific and Industrial Research. The work carried out at the laboratory includes fundamental and applied research linked with many important branches of British industry. There are eight departments—Physics, Electricity, Radio, Metrology, Engineering, Metallurgy, Aerodynamics and Ship Research.

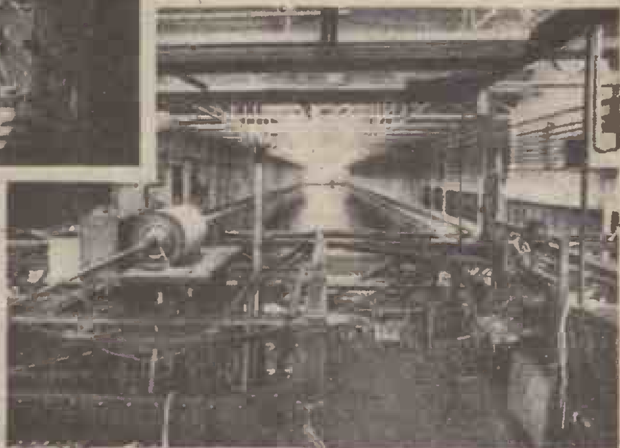
(Above) A view of the power frequency high voltage equipment showing the transformer from which the 1,000,000 volt output is taken.



(Above) A corner of the high tension laboratory. High capacity impulse generator for producing voltage surges simulating those due to lightning.

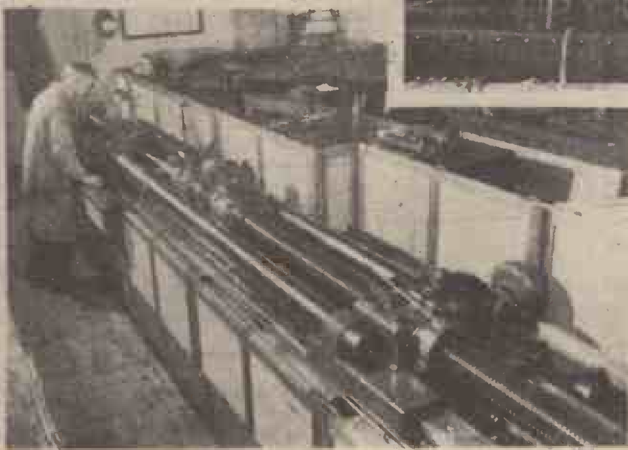


Electricity division. High speed cathode-ray oscillograph for recording rapid changes of voltage and current.



(Below) In the ship division. This picture is taken from the carriage which runs on rails along the whole length of the tank. On the left can be seen the apparatus for recording the behaviour of the model as it is drawn through the water. This tank is 550ft. long, 30ft. wide and 12½ft. deep, and the carriage is capable of a maximum speed of 25ft. per second.

(Above) In this view of the compressed-air tunnel the operators can be seen manipulating the electric controls which govern the position of the model and measuring the forces acting on its surfaces. Pressures up to 25 atmospheres are used, produced by an air-screw driven by a 400 horse-power electric motor.



(Left) In the metrology division. The standard lathe, upon which a lead screw for a machine tool is being corrected, until its accuracy is closely the same as that of the master screw seen in the foreground, which is accurate in pitch to within 0.0002 deg. over five feet.

Electric Welding

Notes on the Various Types of Plant Used, and How They Operate

By J. L. WATTS

ELECTRICITY is used in industry to join together metal parts by welding. There are two principal methods of electric welding; these are called electric arc welding and resistance welding.

Air is normally a very good insulator and resists the passage of electricity through it; in fact, many thousands of volts may be needed to pass an electric spark through an air gap one inch long. If, however, the air is "ionized," or rendered conducting by metallic vapour, a much lower voltage will pass current through it, the resulting electrical discharge being called an arc. An arc can be described as a luminous discharge of current through a conducting gas and appears as a flame, which burns at a few thousand degrees Centigrade. The arc welding plant utilises this high temperature to fuse together the metal parts.

Arc welding is carried out by means of a generating or transforming plant capable of supplying current at about 70 to 100 volts, and either direct or alternating current can be used. A high current value is required for arc welding, varying from about 50 amperes for a small plant to several hundreds of amperes for a plant capable of welding together thick pieces of metal. A flexible cable from one terminal of the plant is clamped or bolted to one of the metal work pieces, whilst the other terminal is connected to an electrode holder which the operator manipulates by hand. Various types of electrode can be gripped in this holder as required by the work in hand. (Fig. 1.)

In order to start the arc the operator touches the electrode on the work piece so that a "short circuit" path of low resistance is provided between the terminals of the welding plant; this allows a heavy current to flow from the electrode to the work piece. As the electrode is drawn away again the air between the electrode and work piece becomes "ionized," that is, the molecules of air become electrically charged and move across the gap at high velocity, conducting electricity from the electrode to the work piece. The electricity thus continues to flow in the form of an arc, which is assisted by metallic vapour resulting from the arc melting portions of the work piece and electrode. The operator moves the electrode along the edges of the metal which are to be joined; the arc following the electrode, which is held a short distance from the joint.

Carbon Electrodes

In one of the earliest forms of arc welding a carbon rod electrode was used and this method is still used for certain purposes, suitable metal being added to complete the joint. Carbon electrodes must be used with direct current, the supply being connected so that carbon from the electrode is not carried into the joint, as this would be liable to make the metal brittle. An arc of about 1 inch to 1½ inches long is used with a carbon electrode; if the arc is too short the metal is liable to "boil" and absorb carbon; whilst if the arc is too long the metal may become oxidised.

The next stage in the evolution of arc welding was the introduction of metal electrodes, which are used with either direct or alternating current. With such electrodes no added metal is necessary, as the electrodes are of suitable composition and the metal is gradually projected direct into the weld. Later on covered metal electrodes were introduced. One type of electrode has a wrapping of blue asbestos through which runs a fine aluminium wire. When the arc is struck the wrapping fuses to form a protective slag round the arc, which has a cleansing effect on the molten weld, the slag being easily removed when the weld has cooled.

Atomic Hydrogen Welding

Another form of arc welding, which has originated in America, is called Atomic

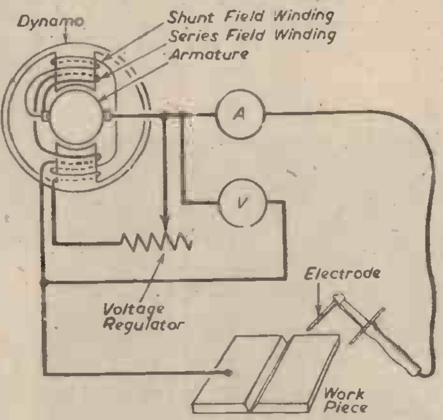


Fig. 1.—Circuit diagram of an arc-welding system.

Hydrogen Welding. A fairly long fan-shaped arc is produced between the tips of tungsten electrodes which are fed with alternating current. With such electrodes gas is blown through the arc and absorbs heat which causes the molecules of gas to become dissociated, or parted, into atoms. As the atomic hydrogen passes to the cooler regions it recombines into its molecular state, and in so doing releases the heat which it received from the arc during dissociation. A small zone of high temperature is produced at a spot about half an inch in front of the tungsten arc, this being used for welding with a filler rod of uncoated wire to provide the necessary added material.

An electric arc is inherently unstable, that is to say, it is not self regulating. Suppose the operator is using a metallic electrode with an arc about three-sixteenths of an inch long and happens to bring the electrode within about one sixteenth of an inch of the work piece. If the supply voltage is steady the result will be that the arc current will increase due to the reduced resistance of the arc; more metal will be melted and a greater quantity of metallic vapour produced, which will still further increase the arc current, and so on. In order to enable satisfactory welding work to be carried out without undue strain on the operator, it is necessary to use a supply plant which has what is called a "falling characteristic" to compensate for the arc instability. In other words, the plant is designed so that the voltage across the arc falls if the current should increase, and this tends to keep the arc current within limits.

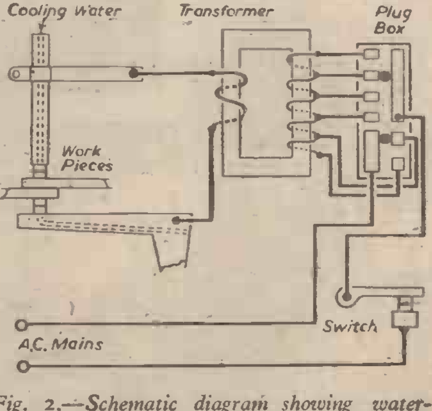


Fig. 2.—Schematic diagram showing water-cooled welding electrodes, and method of controlling output of transformer.

A.C. Working

Alternating current welding plant is quite simple. A transformer, which is usually immersed in a tank of oil to keep it cool, is required to step down the supply voltage to about 100 volts, as most supply systems operate at a higher voltage. The transformer may have extra connections so that sixty or seventy-five volts may also be obtained. The voltage obtained from this transformer is fairly steady and does not vary much with the load current, but by passing the current through a choke coil or reactor before reaching the electrode the desired regulating property is obtained.

A choke coil is only suitable for alternating current. It has a laminated iron core which is magnetised by alternating current passed through a coil of wire round the core; when the coil current increases, due to a shortened arc, an opposing or reactive voltage is generated in the coil which reduces the voltage available at the arc. The choke can be regulated so that it is suitable for various welding loads. This may be done in one type of choke by sliding the iron core further into the coil to reduce the arc voltage, and vice versa; whilst in another type of choke regulation is effected by using a switch or various terminals to control the number of turns of the coil which are connected in circuit.

D.C. Operation

A quite different type of plant is required for use with direct current. Arc welding could be carried out from a steady direct current voltage of about 100 volts if a resistance were connected in series between the supply and electrode to perform a similar purpose as does the choke coil with an alternating current plant. The voltage drop or loss across the resistance is proportional to the current passing through it, so the arc voltage would be reduced with increased current to stabilise the arc.

As most direct current supplies exceed 100 volts, however, it is usual to use a special type of direct current generator for arc welding; this can be driven by any sort of engine or electric motor. Such generators are designed with a particular type of field winding to provide the "dropping characteristic," and this enables welding to be carried out without the loss of power which would occur in a series resistance. The terminal voltage of a direct current dynamo, which is driven at a constant speed, is practically proportional to the magnetic strength of the field magnets. One type of welding dynamo has a shunt field winding, which maintains a constant field strength so long as the dynamo voltage is constant; with an opposing series field winding which weakens the field strength and thus reduces the voltage, with increase of arc load current.

Carbon electrode arcs are also used for electric cutting of metal plates, such as cutting up old boilers, armour plate, etc., this method being very convenient where neatness and accuracy are not essential.

When electric current is passed through any conductor heat is generated at a rate which is proportional to the resistance of the conductor and to the square of the value of current. This property is made use of in resistance or "pressure" welding of metal plates, and has an advantage over a riveted joint in that the metal is not weakened by drilling holes for rivets. All forms of sheet iron and steel, except cast iron, can be welded by resistance methods; and, to a limited extent, the method is also applicable to copper, aluminium, brass and other metals of comparatively low resistance.

As the resistance of the metals, including the contact resistance between the two metals to be joined, is comparatively low, very high currents must be employed. Several thousand amperes are needed, but the voltage is only a few volts. The supply for the welder is obtained through a step down transformer supplied by alternating current mains. The transformer is usually air cooled and is incorporated in the welding machine.

Water-cooled Electrodes

The welding machine has two metal electrodes which are mounted on arms connected to the output or "secondary" side of the transformer; these electrodes are usually kept cool by water which is circulated through the electrodes and the bottom arm. The output of the transformer can be controlled, to suit various classes of work, by means of plugs which can be fitted between contacts on the primary side to control the number of primary turns of the transformer in circuit, and thus vary the welding voltage. (Fig. 2.)

The two metal parts to be joined are laid on the bottom electrode and pressure applied to a foot pedal, which brings the top electrode into contact with the work and closes the switch. The metal is heated to fusion point in a fraction of a second, continued pressure on the foot pedal then applies the pressure of a spring to the top electrode to squeeze the molten spots of metal together to complete the joint.

Butt Welding

Butt or end welding can be carried out in a somewhat similar manner, but in this case the two metal parts to be joined are fitted in separate clamps and connected to the output side of the transformer. The metals are brought into contact to complete the secondary circuit by hand pressure or automatic means and, when the temperature has reached a certain point, the ends of the metal become plastic and are forced together. Seam welders are used to make a continuous watertight joint, as may be required for boilers and other articles. The seam welder is of similar construction to the spot welder, but the work is passed between two power-driven water-cooled discs which are connected to the output terminals of the transformer. The power is switched on and off at regular intervals by means of a power-driven switch to avoid the metal reaching too high a temperature and getting burnt.

The introduction of welding processes has reduced the cost of manufacturing many articles, and has enabled metal frameworks to be lightly and strongly constructed of sheet metals instead of having to make them of heavier castings, with all the additional cost of making patterns and machining.

High-power Short-circuit Testing—5

By S. STATON

(*Continued from page 385, August issue.*)

In the last article, we considered the necessary preliminary testing operations, and the setting up of the test circuit prior to a short circuit test.

A no-load timing test was explained, and an analysis given of the film record obtained from the no-load timing test, the timing was obtained for the setting of the control relay. After these tests and the setting up of the test circuit, the actual short circuit test can be carried out.

At this stage all personnel are evacuated from the dangerous regions. This is effected by the sounding of a suitable horn or buzzer under the control of the control engineer. The generator field circuit breaker is then closed and the excitation adjusted to correct value of voltage. It is usual here to allow a few minutes for the generator voltage to steady itself. During this time, a spot check is made on the control apparatus.

Test Operations

It was explained in Article 3 that the control of testing operations is automatic, as under the control of the control relay. The control engineer merely closes the control circuit supply isolator, which sets the control relay in motion, and thus automatic control is assumed from this point.

The following operations now take place in the order set out below:

(1) The generator driving motor circuit breaker is tripped out to prevent any danger of shock to the mains supply.

(2) The circuit breaker under test is closed to establish the short circuit by the energising of its closing coil. This operation is carried out for "make" and "make-break" tests only. If a "break" test is to be carried out then operation (2) would be replaced by the following one.

(2A) The station making or closing circuit breaker is closed to establish the short circuit (the circuit breaker under test being closed before the initiation of the test operations).

(3) At the same instant as operation (2) the oscillograph camera shutters are opened.

(4) In the case of a "break" and "make break" test, the trip coil of the circuit breaker under test is tripped. If a "make" test is being carried out the station circuit breaker is tripped.

(5) The generator field circuit breaker is tripped.

(6) The control supply isolator is opened.

It will be understood by the reader that the foregoing operations are only a brief outline of what happens in certain cases.

The contacts of the control relay may be set to give any desired sequence of operations for a given case. It would, of course, form uninteresting reading if all possible combinations were detailed out. The physical behaviour of the circuit breaker under test is noted and recorded by an observer in one of the advanced concrete dug outs which were described in Article 3. In the event of any maintenance of the circuit breaker in between a series of test duties the same observer would record all such details for inclusion in the test report.

Analysis of Records

It is surprising how many engineers are unable to interpret oscillograph records; not merely as applied to switchgear, but in any field of application, and it is proposed to set out some typical oscillograph records of short circuit tests on circuit breakers and explain how to interpret them to assess the performance of the particular circuit breaker under test. Fig. 1 shows a record of a "break" test on a circuit breaker.

(1) *Line-to-line Volts*

The top trace on the record represents the line-to-line voltage which from the points A to B is the generator open circuit voltage. At the point B, the station closing switch is closed, thus establishing the short circuit and current flows, this is displayed in the voltage wave by a drop in its value. This drop is due to the inductive drop in the generator windings. It will be seen that whilst the short circuit lasts, i.e., from the point B to C, there is a progressive drop in the value of the recorded voltage. This is due to the demagnetisation effect of the stator ampere turns. It may be said, here, that the terminal voltage of a short circuited generator follows a decremental law, similar to that of the A.C. component of the current, the rate of decrement being determined by the amount of reactance external to the generator. The greater the value of this reactance, the slower is the rate of the decrement, the recorded voltage between the points B and C constitutes mainly the drop across the reactors in the test circuit.

When the point C is reached, the short circuit is broken or interrupted, by the opening of the circuit breaker under test, and from this point to the end of the trace is the open circuit generator voltage once more. The voltage that reappears at the point C on the interruption of the short circuit is called recovery voltage. It will be noticed on examination of Fig. 9 that the value of the recovery voltage is decidedly lower than the open circuit voltage recorded between the points A and B. It is, however, progressively increasing in value between the point C and the end of the trace. The method of computing recovery voltage and some remarks on its significance in relation to severity of test will be given later.

Phase Currents

These values are recorded on traces 2, 5 and 8. Up to the point B a straight line is recorded, showing that no current is flowing. At the point B (i.e., the commencement of the short circuit), the current commences to flow in all three phases. A little observation of Fig. 1 will show that in trace number 2, the current wave is asymmetrically displaced about its zero axis for approximately eight cycles. Trace number 5 is also asymmetrically displaced with respect to its zero axis, but to a lesser degree.

Trace number 8 is asymmetrically displaced to approximately the same degree as trace number 2. A further feature to be noticed is that all three current traces gradually return to a symmetrical displacement about their zero axis. After the point C the traces become a straight line again, showing that the arc has been finally interrupted.

Some explanation will now be given of the reasons for these current traces being asymmetrically displaced about their zero axis. In Article 1, reference was made to the displacement of the current wave from the zero line in Fig. 1. It was stated there that the displacement depends upon the instant at which the short circuit occurs, also that the displacement is a maximum when the short circuit occurs at the instant of zero voltage.

If the test circuit was purely inductive (in practice this condition cannot obtain) and a sinusoidal wave-shaped voltage were applied to it at the instant when the voltage was at its maximum point, the resulting current would be of a sine waveform symmetrically disposed about its zero axis. This current would, of course, lag 90 deg. behind the voltage wave.

If, however, the voltage were to be applied at the instant when it was at the zero point on the wave, the resulting current would be double the value obtained in the above case. It would rise to this value during the first half cycle of the voltage wave, and fall to zero during the next. It would never fall below the zero line. This resulting current wave is the same as that obtained by adding together a symmetrically disposed sine wave and a D.C. component of current equal in value to that of the sine-wave. In practice, we cannot have a circuit without resistance and hence the current will only rise to some value lower than the double value as stated above. In such a case the D.C. component of the current gradually dies away to zero value. From this it will be seen that the symmetrical conditions will only remain so long as the D.C. component is present. When this has been dissipated in the circuit resistance, the current wave will be symmetrical again.

In summing these facts up, we can say that :

(1) The degree of asymmetry depends upon the instant of switching.

(2) The value to which the current attains is governed by the relative values of inductance and resistance in circuit for a given voltage. (In practice this value is usually about the 1.7 or 1.8 mark.)

(3) The time taken for the current wave to become symmetrical again depends on the value of resistance in circuit.

The reason for the degree of asymmetry in each phase varying, is because the phase voltages are all different in value at the instant of switching.

Phase Voltages

The phase voltages are recorded on traces 3, 6 and 9, from the point A to almost the point C, the traces are a straight line in each case. Here the traces become uneven lines, having no definite shape or form. This continues over a period of approximately ½ cycle to the point C. At the point C the traces become sine waves symmetrically disposed about their zero axis.

Reference to the diagram of test circuit connections, Fig. 1, Article 3, will explain why no voltage is recorded between the points A and B. It will be seen from this diagram that the voltage transformers are on the dead side of the station closing switch, thus no voltage is applied to the recording apparatus until this switch is closed.

It will, of course, be remembered that in the particular test recorded, the circuit breaker under test is closed, initially, and the short circuit is established by closing the station closing switch.

In the case of a " make " test, the station closing switch is closed initially, thus, the open circuit generator voltage would be recorded in the form of a sine wave between the points A and B—the latter point being the instant of closing the circuit breaker under test to establish the short circuit. From the point B to within approximately ½ cycle of the point C, the straight line indicates that there is no voltage. In actual fact, the voltage during this period is absorbed by the generator windings, and the series test circuit reactors. The impedance drop across the circuit breaker under test, and the remainder of test circuit connections is so small that it cannot be observed on the oscillograph record. The line X—X through the record indicates the point of contact separation. To determine the exact instant of contact separation on a short circuit test oscillogram, reference has to be made to the no-road timing test made on the particular circuit breaker. On this record (shown in Article 4), it will be seen that the contacts separate at a point midway along the third step of the travel record. The vertical line X—X on the short circuit oscillogram is therefore drawn in to cut the travel record at the corresponding point. During the period from the line X—X, to the point C, the arc voltage is indicated by the uneven lines on the three-phase voltage traces. Since the contacts separate at the point X, it follows that between this point and the point C, the currents recorded in traces 2-5 and 8 are the arc currents. The uneven lines on traces 3, 6 and 9 are therefore records of the arc voltage. It was stated earlier that these lines have no definite shape or form, this in one sense is not true, and it will be noticed, on careful observation of the traces at this point, that they reverse direction in accordance with the current wave cycles. This is because the arc is virtually all resistance (the value of resistance being proportional to the length of arc), and hence the arc voltage is in phase with the current. The arc voltage progressively increases during the period X to C, due to the increasing length of arc as the contacts separate. The comparative evenness of the traces during the fraction of the cycle immediately following the point X is explained by the fact that the volt drop across the arc is too small for the oscillograph to record. This fact lends weight to the necessity of including a record of the contact travel. This is particularly so in the case of a high voltage circuit breaker, since the current is consequently decreased for a given capacity of breaker. The arc current on breaking is correspondingly decreased, and so the volt drop across the arc.

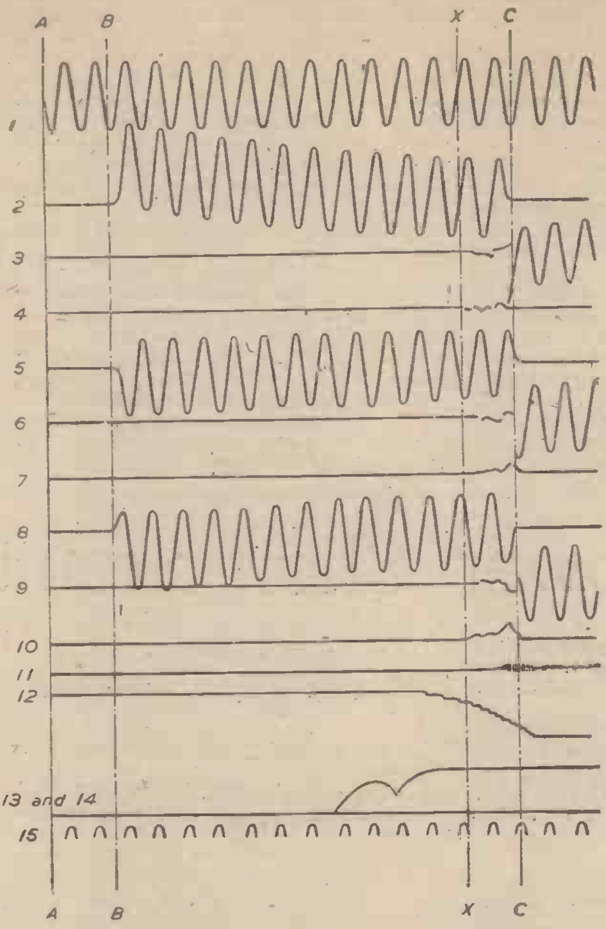


Fig. 9.—Oscillograph record of a short-circuit test on a circuit breaker.

In the next article some further features of this trace will be considered.

(To be continued.)

Floating Workshops

Repair Ships for the Far East

AIRCRAFT of the Fleet Air Arm now have their own repair and maintenance ships to accompany them to the battle areas of the Far East. These ships, which are responsible for the repair of main planes, tail-plane units, hydraulic and electric apparatus, and wheels, are able to carry out the jobs which have hitherto been the work of shore factories.

Spacious Workshops

The holds of the ships have been stripped and converted into 18 spacious workshops, including a machine shop equipped with many machine tools, from an 8-in. lathe to a watchmaker's lathe and an engraving machine. There are also a fabric shop, dope shop, woodworkers' shop, and an electricians' shop. Drawn from the Fleet Air Arm the staff consists of over 250 skilled fitters and 80 electricians, in addition to another 360 skilled tradesmen such as blacksmiths, turners, fabric workers and metal workers.

Every comfort is installed on the repair ships, which are provided with air-conditioning throughout. To increase ventilation, portholes and main hatches are enabled to be kept open by having mosquito nets fitted over them. A laundry, cinema, canteen and shower baths are among other necessary amenities provided for the staff on the repair ships.

Rocket Propulsion

Pre-war Experimentation in Britain

By K. W. GATLAND

(*Continued from page 374, August issue*)

THE Manchester Interplanetary Society was the second organised British rocket group, having its inception in the summer of 1936, due to the efforts of Mr. E. Burgess (now president of the Combined British Astronautical Societies). Its function was entirely independent of the pioneer British Interplanetary Society, whose existence did not become widely known until some years later. Contact did not, in fact, materialise until after the original Manchester Society had been dissolved and another group, the Manchester Astronautical Association, inaugurated in its place.

Prior to its dissolution, the former Manchester Society carried out numerous experiments with powder charge rockets, and of these several are worthy of mention. It will be remembered that in the majority of similar experimentation previously mentioned, the propellant charges were obtained commercially, and while this was also true of the early months of the Manchester group's activity, their later research also concerned the manufacture of special charge cases as well as the charge filling.

Of the experiments conducted, the most promising lines of development were those resulting from the investigation of methods of combustive control in powder charge rockets and the flight stability of rocket projectiles.

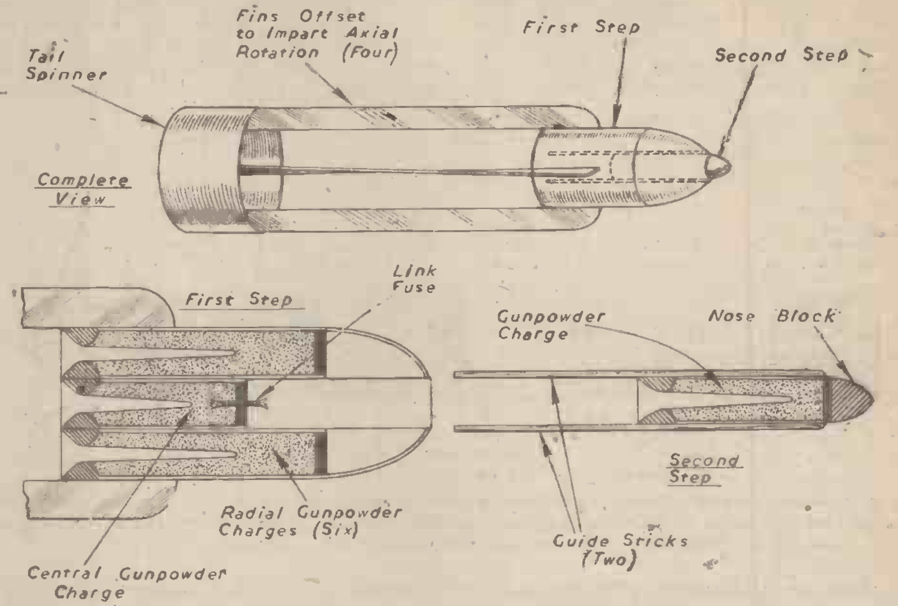


Fig. 33.—Diagram of two-step powder rocket, developed by the Manchester Interplanetary Society (1936).

The production of charge cases, too, formed an important part of the Manchester group's research during the 1936-7 period and many of these, fitted with special nozzles and heat-resistant liners, were proved during test greatly superior to similar charges of commercial origin. As an outcome of this research, there were also developed several original methods of loading and compressing the propellants, which resulted in increased steadiness of burning and a subsequent improved combustive efficiency. Later test firings were made with rockets which embodied various devices intended to control the rate of combustion.

Stability

The initial experiments concerned the flight trajectory of rocket projectiles, and a number of types were produced and flight tested with a view to determine the particular method of stability best suited to function under normal conditions of atmosphere.

There are several methods of achieving this stability, and the society found its most satisfactory results in axial rotation—created either by offset vanes fitted in the efflux, or airstream, or through the offsetting of grouped rocket tubes, or nozzles. Other models were fitted with the more conventional straight-set, stabilising fins and spinners. A selection of the types which featured in the testing is shown in Fig. 32.

Control of Combustion

The rockets constructed to test firing and combustion-control methods comprised several of the "step" type and, of these, a model having two propulsor components (Fig. 33) gave a highly creditable and stable performance.

The first "step" comprised seven individual black powder charges arranged in a cellular construction and fused so that the firing of the tubes took place in the order "four," "three." The second component, a single charge rocket, was fitted to form the rocket nosing, and designed to fire from the "carrier" rocket at the latter's greatest velocity. This was arranged through an interconnecting fuse ignited from the central charge.

Stability of the original component was achieved by the provision of offset airstream fins which causes rotation about the body axis. The second "step" embodied two balancing "sticks," but depended also upon the angular momentum which it derived from the parent rocket.

It will be appreciated that the main point of significance with this type of rocket is that the small component is released in combustion at a high velocity, and therefore its function is so much nearer the maximum propulsive efficiency.

A firing test carried out at Manchester in December, 1936, gave good illustration of this point. The complete rocket, propelled by the lower component, reached a height of between 150 to 200 feet before the release of the second "step," which

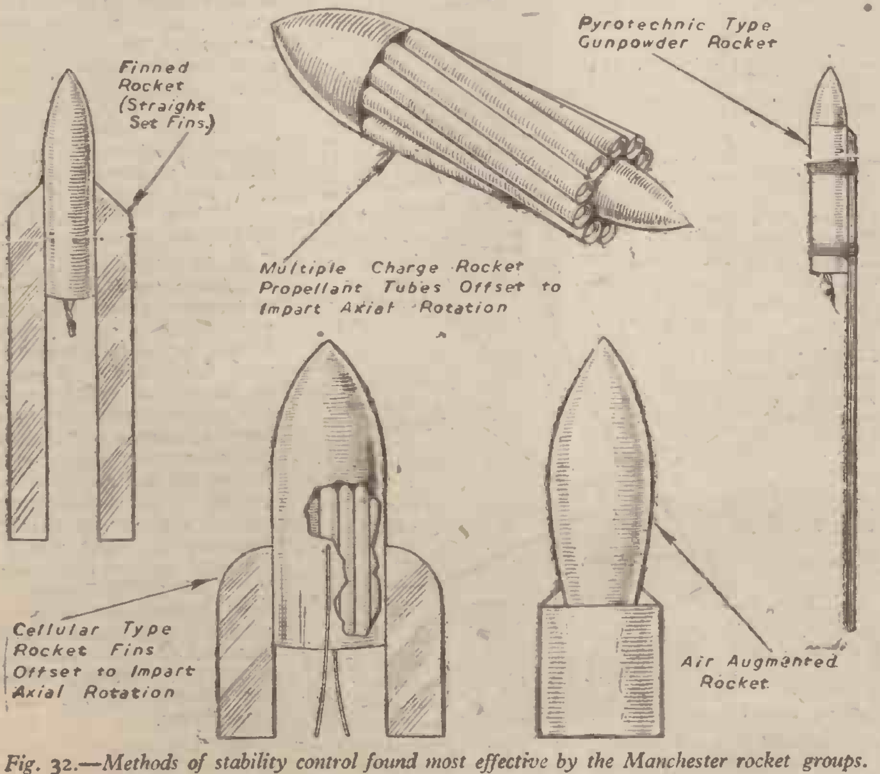


Fig. 32.—Methods of stability control found most effective by the Manchester rocket groups.

accelerated at such a rate as to render its trajectory invisible to the observers. The small rocket was not recovered after the experiments.

Fuel Developments

Working in conjunction with a pyrotechnical expert, the late Lt.-Col. W. T. Southam, the experimental committee of the Manchester Society developed several black powders of various constituencies, for use both with paper formed and metal charge cases. These experiments, which were commenced in December, 1936, involved the society for a year, and although their results can hardly be said to have contributed greatly towards propellant development, several of the powders proved highly effective for the type and were the means of testing several original propulsion systems.

During the course of this research a number of public demonstrations involving the flight testing of rockets, both paper and metal, were undertaken by the society at Manchester. It was, in fact, while testing under these conditions before a large crowd who, despite repeated warnings, would not retire from the launching site, that an accident occurred in which several of the bystanders were slightly injured by fragments of an aluminium rocket which exploded on the launching rack.

This incident brought court proceedings against the society, and the findings showed that an infringement of the Explosives Act of 1875 had been caused by the admixture of potassium chlorate in a black powder composition which comprised the base chemicals, potassium nitrate, sulphur and charcoal. The union of potassium chlorate and sulphur was the offending act, any propellant of this constituency being decidedly unstable and liable to instantaneous detonation.

A few months later the Manchester Interplanetary Society was dissolved, to be followed almost immediately in December, 1937, by the inception of another group, the Manchester Astronautical Association. The founders were E. Burgess and the late T. Cusack, two prominent members of the former society.

The work of the new Manchester group was more or less a continuation of the earlier research, with the emphasis again towards the improvement of combustive control in powder rockets.

An interesting development aimed at improving the performance of single charge rockets is shown in Fig. 34. It will be observed that the propulsion charge is divided into a number of separate compartments, the powder in each being insulated by layers of combustible felt. The propellant sections are made as capsules, each of which has a conical-formed base of rapid burning powder, the idea being to produce the largest possible area of burning.

The main advantage of this arrangement is that any slight explosion which were to occur would limit the disruption of the fuel to one section, whereas a similar happening in a conventional "fuel store" rocket would invariably explode the entire filling.

The diagram shows a development of the original scheme which the experimental committee tested in August, 1938. The trial rocket had four fuel compartments and a conventional paper case, although an extended nozzle and fireclay choke were fitted. No parachute was incorporated in the test type.

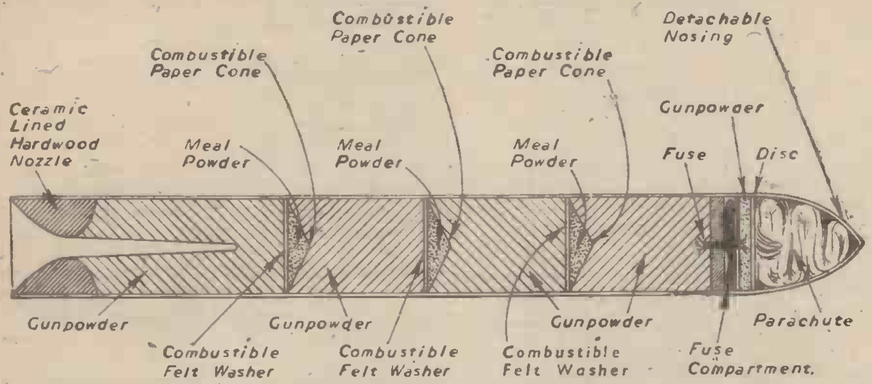


Fig. 34.—Diagram of a powder rocket having four charge compartments. This system is intended to prevent disruption of the entire propellant through isolation of the burning section. Developed by the Manchester Astronautical Association from a German idea (1938).

Cellular Construction

Tests of cellular rockets followed, and in these the association found its most satisfying results.

In essence, the cellular method of rocket construction means simply a power unit composed of a number of "fuel store" charges arranged in lateral contact, each a complete propulsion element in itself and having individual means of ignition. The rocket illustrated (Fig. 32) had merely a single-bank cellular arrangement, but other types have been produced in which several banks of cellules are employed. In this latter instance the expended tubes are automatically jettisoned, succeeding tubes being fired upon their release until the entire propulsion system is expended. It will be readily appreciated that this removal of dead mass brings about a progressive improvement of the fuel/weight ratio, and a parallel increase of the propulsive efficiency.

The combustive control is another factor that is much improved by cellular construction. It is obvious that the thrust of the unit can be increased or decreased at will by the firing of varying numbers, or different sizes, of cellules.

Apart from light "retaining" members, the cellules themselves compose the structure, and the strength of the rocket is very largely dependent upon the density of the propellant and the cellular formation. The need for any involved and weighty arrangement of forming members is thereby eliminated.

The model tested in the Manchester experiments was a single-bank cellule rocket, and this proved to be one of the best stabilised of any type produced during the entire period of active research. Stability in this instance was achieved by the offsetting of four small fins to the air-stream, which caused rotation about the body axis. In order to ensure stability during the initial moments of ascent, the launching device had means for pre-rotating the rocket, thus enabling correct function from the instant of release. This was simply a turntable with a length of metal rod projecting from its centre, mounted to a base platform, and the rocket, which had a metal sleeve built in along its axis, fitted over the guide rod and rested on the turntable (Fig. 35). The turntable was rapidly rotated just prior to launching, thereby imparting an initial spin to the rocket, which was maintained in flight by air reaction on the fins.

Only one problem of significance arose from the cellular tests. This involved burn-out of the power element, in that should one of the cellules burn through, it was capable of destroying the entire make-up of the cellular unit. A later series of firings, however, proved the remedy to be dependent entirely upon the efficiency of tube construction and, using carefully prepared tubes, these further trials gave no evidence of burn-out.

In the autumn of 1938 the association constructed a light air-augmented rocket (Fig. 36) powered by a single charge. In this model four small fins were fitted at the aft end of the body shell, and attached over these, and extending from the rear, was a cylindrical augmenter tube, which also served as a stabiliser. On test the rocket showed a particularly high rate of acceleration, and the flight was well stabilised with a high trajectory. As in the majority of flight experiments conducted by the group, the rocket was launched from a metal tube. A two-rail launching apparatus featured in the earlier experiments.

The foregoing is a review of the pre-war experimentation

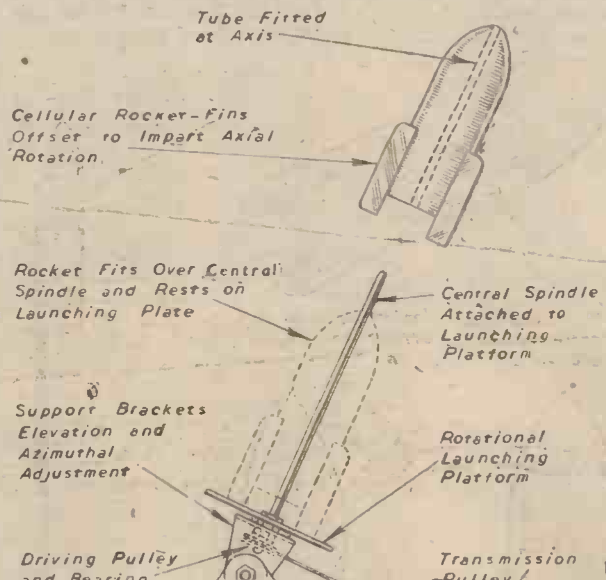


Fig. 35.—Diagram of pre-rotational launching stand developed by the Manchester Astronautical Association (1938).

conducted by the Manchester rocket groups. A great deal remains to be said of their work during the war period; but first, a word about the investigations of contemporary organisations which functioned in Britain in the years leading to the outbreak of hostilities.

The Paisley Research Group

Among the early rocket groups whose activities largely concerned the practical was the Scottish, Paisley Rocketeers' Society, a student body of some twenty members, subsequently affiliated to the Manchester Astronautical Association. Its inception took place in February, 1936, and working under the direction of its founder-president, Mr. J. D. Stewart, the group carried out a programme of technical development which involved the design, manufacture and testing of various powder charge rockets.

Of these perhaps the most significant were the rockets produced for aerial survey. The first model of this type was fired in August, 1938, and its initial weight, complete with a miniature camera and parachute was only 9oz. The operation of the camera was achieved through the pull on a wire cable, which connected the parachute shrouds and the shutter, and thereby ensured the function of the shutter at the same time as the ejection of the parachute, when the rocket was at its peak trajectory. In this first flight trial the rocket rose to a height of approximately 300ft. before ejecting its parachute, and landed at a point 600ft. from the launching rack. Although in this test the camera operated as arranged, the photograph secured showed only sky.

A second rocket was constructed, and as in the previous model, the camera was fitted at the nose, with the lens aperture at the side, the sole difference being the provision of a small mirror fixed above the lens at an angle of 45 degrees. This arrangement ensured that the resultant picture was of what lay below the rocket at the instant of the parachute's opening.

Further trials were made with a rocket having a parachute and camera which operated on the ejection of the expended propulsion charge—this latter arrangement was adopted in order to lessen the rate of descent by reducing the weight and so ensuring that the camera, and any other delicate equipment carried, reached the ground with the least chance of damage. Other models, of light construction and not fitted for delicate apparatus, simply incorporated an ejecting device to free the propellant case, and no parachute, thus making the rockets so light that they dropped without harm. The loss of momentum which occurred with the release of the case, however, caused an appreciable reduction of the range. A solution would appear to be the provision of a simple time fuse, set to discharge the case at the peak trajectory.

Stabilised

The society carried out still further tests of rockets stabilised by rotation, and though of simple construction and small size, several of these proved highly effective, both as regards range and accuracy of trajectory.

The first model of this type comprised simply three small powder charges grouped around a short length of dowel, each unit set at a slight angle to the longitudinal axis. This rocket, whose initial weight was $\frac{3}{8}$oz., travelled a distance of 250ft. in well-established flight before assuming a spiralling trajectory, due presumably to the reduction of the rotational velocity as the fuel became exhausted. Its final range was a little under 500ft.

A second rocket, having four inclined tubes and no central stick, travelled a distance of 150ft. Its path of flight was at first irregular, but became more stable as the angular rotation increased, the poor range being accounted to excessive drag created at the commencement of flight.

To overcome the initial instability the society built a special launching apparatus for pre-rotating the rockets, similar, in fact, to the one developed earlier by the Manchester group. When pre-rotated, the models rose smoothly and were quite effective until the latter stages of flight, when "spiralling" would invariably occur. In some instances the oscillatory motion was apparent under power as well as during momentum, and it is likely that this was caused by unequal thrust in the tubes and through the rocket shell not being truly symmetrical.

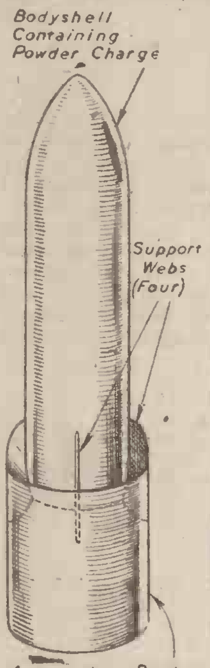


Fig. 36.—Air-augmented powder rocket by the Manchester Astronautical Association (1938).

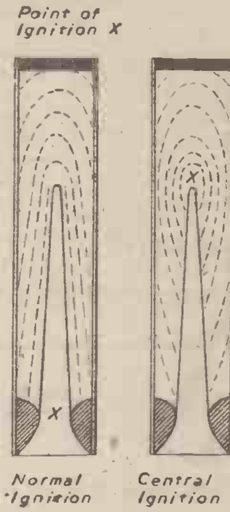


Fig. 37.—Diagram showing burning lines in conventional powder charge, and one centrally ignited. Paisley Rocketeers Society (1939).

Later experiments concerned the thrust augmenter and, using standard $\frac{3}{8}$oz. charges, flight trials showed a generally improved performance in the use of "augmented" tubes, despite their greater weight, also that rockets thus fitted were capable of sustaining a more accurate trajectory. The latter factor may be accounted jointly to an increased mass effluent and the stabilising effect of the augmenter "spinner."

Commercial Charges—Unmodified and Developed

The charges used during the entire period of the Paisley group's active research were obtained commercially, and while in the majority of tests these were unmodified, in certain cases the tubes were fitted for "central ignition" of the propellant.

In the accompanying diagram (Fig. 37) are shown the progressive burning phases in powder charge rockets, and indicates both the firing faces as formed in the conventional tube and those of a tube centrally ignited.

Proving stand tests have shown that the latter method of ignition provides a marked increase in thrust, and this is attributed to the greater burning area and a more uniform rate of combustion.

The thrust figures as derived from four proving tests of standard $\frac{3}{8}$oz. rocket charges are as follows: using unmodified tubes, $1\frac{7}{8}$lb.; 2lb.-tubes "centrally ignited," $2\frac{1}{8}$lb.; $2\frac{1}{8}$lb.

Improved performance also resulted from the use of an extended fire-clay nozzle ($\frac{1}{2}$in. long, 14° flare angle), fitted to unmodified standard charges, but unfortunately, in the absence of proving stand data, it is impossible in this instance to give any comparative figures.

(*To be continued*).

In the Far Eastern theatre of war a famous Artillery Regiment carried out repairs to their medium guns on the field. The illustration shows a gun crew hauling a gun barrel into position.

Fitting Sails to a Canoe

Constructional Details of Sails, Spars, Rudder and Lee-boards

By F. HOOK

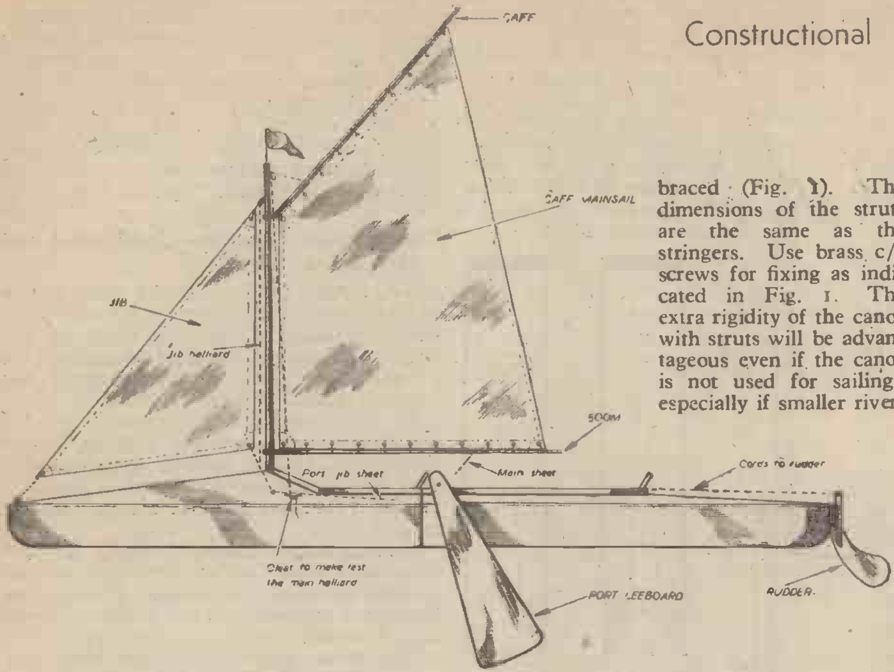


Fig. 2.—General arrangement of the canoe fitted for sailing.

READERS who have constructed the canoe described in the June issue of PRACTICAL MECHANICS may like to add sails to their craft, and so enjoy the exhilaration of sitting back in the cockpit and sailing along before a pleasant breeze.

It is imperative that a warning should be given about the dangers of sailing a small craft such as a canoe. If you are caught unprepared by a sudden strong squall of wind it is likely that the craft will be capsized. Several fatalities have been caused by this happening. If the reader can benefit by the faults of others it need not happen to him. At no time must you under-estimate the power of that mighty force, the wind.

For this reason give attention to the following points concerning canoe sailing. Use only a "pocket handkerchief" sail at first. Take precautions to step your mast very securely to the keel strip of your canoe, as considerable force is exerted at this point. It is desirable to strengthen the hull of the canoe by the addition of cross struts across the stringers (before the canvas covering is tacked on, if possible). This will relieve the strain from the tacks and canvas which normally help to brace the stringers when no cross struts are provided.

Additional Bracing

The three cross frames each side of the centre division of the canoe need to be braced (Fig. 1). The dimensions of the struts are the same as the stringers. Use brass c/s screws for fixing as indicated in Fig. 1. The extra rigidity of the canoe with struts will be advantageous even if the canoe is not used for sailing; especially if smaller rivers are explored, when a considerable amount of portaging is necessary when encountering fallen trees, low bridges and other obstacles. In any case, when carrying the canoe out of water do not hold at the extreme ends, but station yourself and your partner at about a third of the length distance from bow and stern and on opposite sides, with hands under the gunwales.

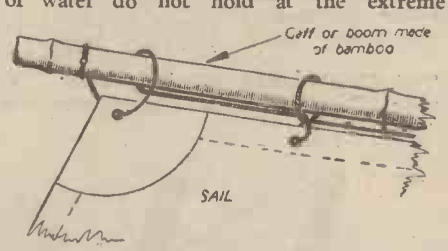


Fig. 4.—Method of lacing sail to gaff and boom.

Type of Sail to Use

There are several types of sails from which to choose, but I propose to deal only with the simple sail I have adopted with success for my own canoe (Fig. 2). It is called a gaff mainsail because the head (top edge) is supported by a spar called the gaff. The foot (or lower edge) of the sail is secured to a spar called the boom. A cord called the main sheet is secured to the boom and is held by the navigator in the cockpit. *On no account should this main sheet be secured to a cleat or other fixture on the boat. Always* hold it in the hand. Then if a squall overtakes you, you are in a position to let go the mainsail if you think it is likely to capsize the canoe.

The sail is laced through eyelets to the gaff and boom, but is left free on the luff. This is a benefit for quick erection or stowage.

As sailing experience is gained a jib may be added. This will complicate matters, as, besides the jib halliard for hauling up the jib, the tack of the jib must be secured to the bow (not an easy operation when once afloat), and there are two sheets attached to the clew for securing the jib when under way, one for the port tack and one for the starboard tack.

There are various other rigs available with which the reader may experiment. These are illustrated in Fig. 5.

Making the Sail

It is not feasible to specify any particular material for the sail, due to the present rationing restrictions. One complete piece of material is not needed. In fact, two or three pieces machined together are an advantage in keeping the sail to shape. Sail construction is an involved trade, and, whilst

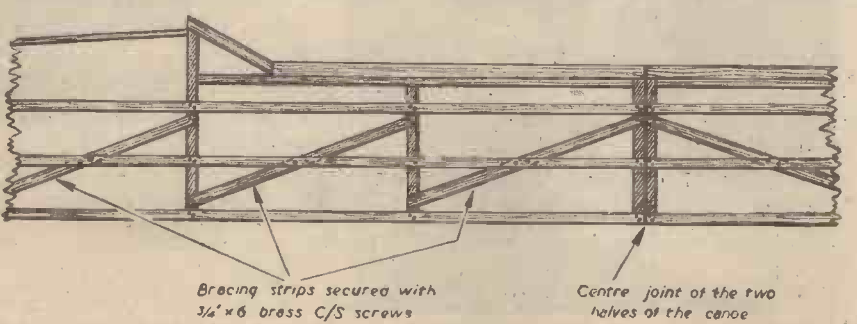


Fig. 1.—Bracing of canoe frame for sailing and heavy portaging.

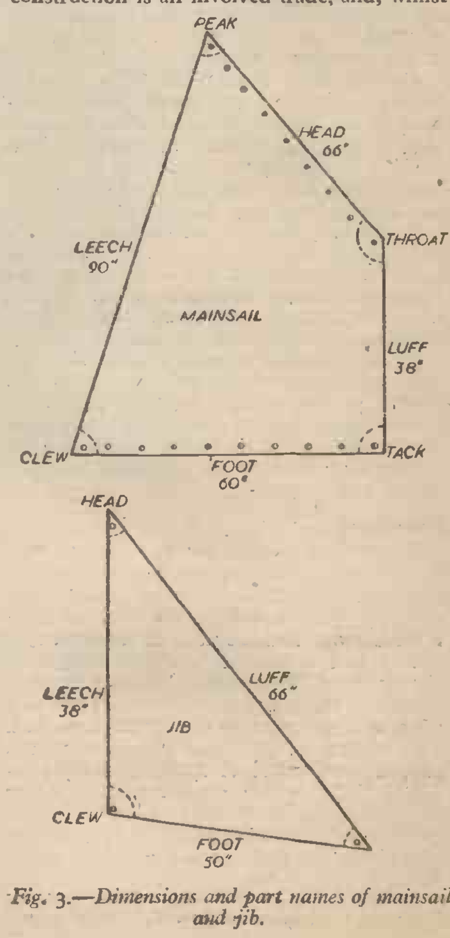


Fig. 3.—Dimensions and part names of mainsail and jib.

a sail properly designed and constructed from the proper material will enhance the canoe, a simple sail made from some disused black-out material will provide some good sailing.

When the sail has been cut out and stitched together, it is advisable to add an additional double thickness of material at the peak, throat, tack and clew, as at these points comes the greatest strain.

Eyelets are fixed 6 inches apart along the hems at the head and the foot of the sail (Fig. 3). Readers who have done some leatherwork will probably possess a punch suitable for fixing eyelets. Use brass eyelets to prevent rust spoiling the appearance of the sail.

The sail is made fast to the gaff and the boom by lacing on with some good quality fine twine. A detail of one corner and method of lacing is shown in Fig. 4.

The Mast

The mast (Fig. 6) is stepped as indicated in Fig. 7. The position of a mast in any craft is of some importance as regards distance from the bow. The result of experiment has proved that the front end of the front cockpit is both effective and convenient for stepping the mast.

A strong brass clip (Fig. 8) must be made and used to secure the mast on a level with the coaming strip.

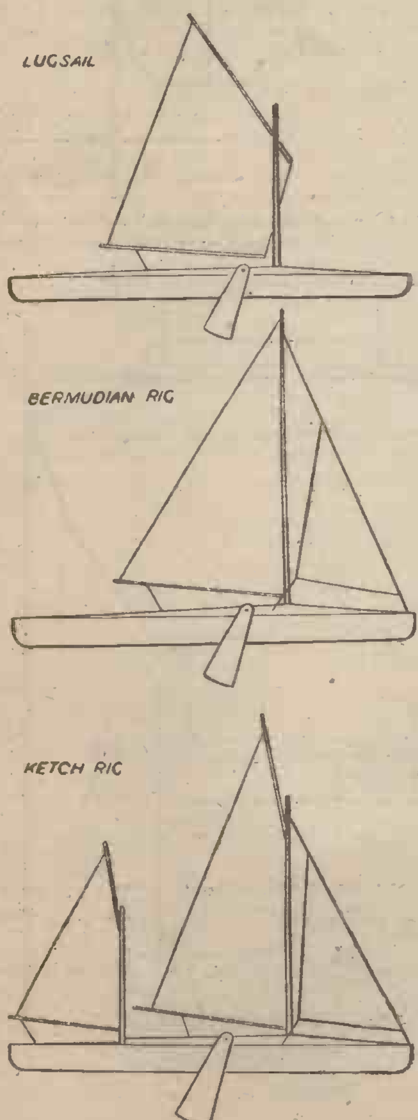


Fig. 5.—Types of rigs used on canoes.

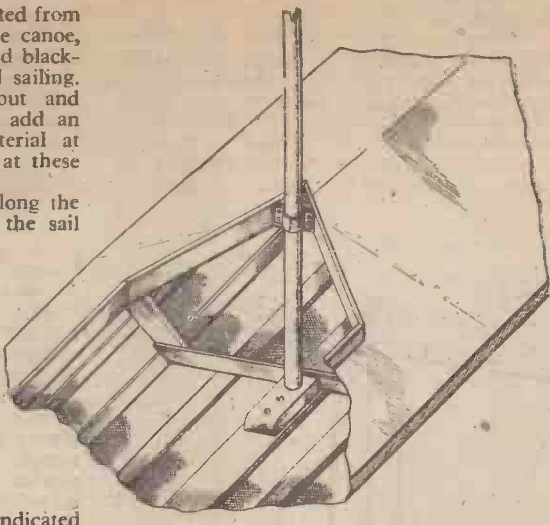


Fig. 7.—The mast is stepped securely to the keel strip.

The foot of the mast is stepped in a block of wood 6in. × 2in. × 1in. (Fig. 9), in which is bored a 1in. diameter hole for the mast. This step is securely screwed or bolted to the keel strip, arranging its position so that the mast is sloping a trifle forward. As the mast is not braced the weight of the sail will bring the mast back to a vertical position.

The mast is $1\frac{1}{4}$in. diameter at the foot, but can taper off to about 1in. at the top. For convenience in stowing, when not in use, the mast may be jointed in the middle like a tent pole.

Two brass pulley blocks will be needed for hauling up the sail from the cockpit. They are of simple construction (Fig. 10). The blocks are secured to stout brass screw eyes, which must be opened for threading on the blocks. The joint should be soldered afterwards for additional strength and to prevent the block falling out.

The Spars

The gaff and the boom are made from $\frac{1}{2}$in. diameter bamboo rods. Allow a little

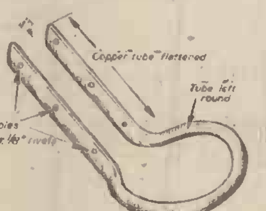


Fig. 11.—Clip to secure gaff to mast.

Fig. 12.—Showing section of gaff eye riveted to gaff.

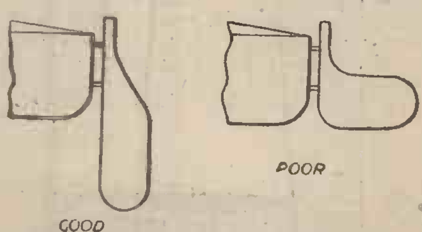


Fig. 13.—Rudder design.

longer length than the edge of the sail to which it is attached, so that the length may be stretched out taut (Fig. 4). The gaff will therefore be about 69 inches and the boom 63 inches.

It is necessary to have a sturdy clip on one end of the gaff and boom to fit loosely over the main mast. Satisfactory clips can be made up from some $\frac{1}{4}$in. O.D. copper tubing (Fig. 11). Both clips are substantially the same except that the one for the gaff has the two arms bent at an angle to the eye. The two arms are flattened with a hammer and drilled to take three $\frac{1}{8}$in. diameter copper rivets.

Before bending or flattening the copper tubes it is a good plan to anneal the copper. To do this, heat the tube to a cherry red heat and plunge into cold water.

Drill the bamboo rods to coincide with the holes in the flattened copper tubing and rivet together the assembly (Fig. 12).

Steering

Several methods of steering are available. For short outings a half paddle is quite serviceable if it is held and manipulated on the lee side of the canoe. Use it as you would in steering a punt or Canadian canoe.

For more serious work a properly fitted rudder is preferable, and it should be made removable. Depth in the water of the rudder is important. It is better that a rudder should be narrow in width and greater in depth rather than in the reverse order (Fig. 13).

The deep rudder is awkward in shallow water, so that it is usual to make the rudder movable in a vertical direction in its post. When shallow waters are reached the rudder plate may be conveniently hauled up.

A suggested arrangement is shown in Fig. 14. Readers may construct it all of wood or all metal. It may be easiest to use a

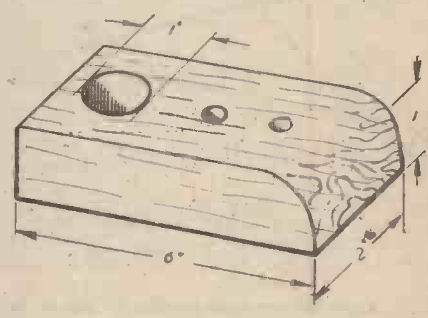
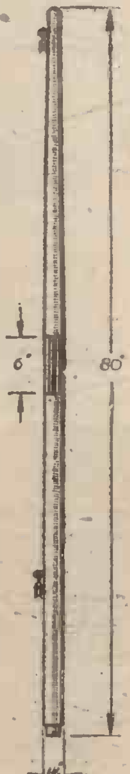


Fig. 9.—Block for stepping the mast.



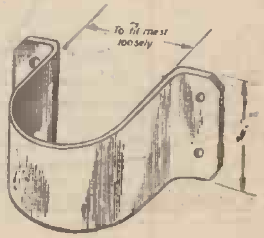


Fig. 8.—Clip for mast.

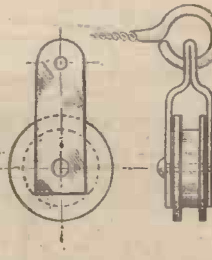


Fig. 10.—Pulley block for mast.

Fig. 6 (Left).—Dimensions of mast.

combination of the two—a wooden pillar and a brass blade.

Cords (blind cord) are led from the rudder arms along the decks of the canoe through brass screw eyes. It is possible to lead these cords down into the cockpit where they may be attached to "stirrups" (Fig. 15). The sailor's feet are put in the stirrups and used to steer. The hands are thus left free to handle the sails, or occasionally the paddles. Even more complicated "pedal" controls may be evolved by the reader if desired.

Lee-boards

When sailing with the wind on the beam there is a tendency for the canoe to drift with the wind, due to the craft being of so shallow draught (Fig. 16). In other words, the water does not provide much resistance to the movement of the boat. A sailing yacht has a keel several feet deep in the water to overcome this defect. Canoes use lee-boards instead of a keel and the principle of their use is shown in Fig. 17. Usually the board on the lee (side away from the wind) is lowered and the one on the weather side raised. For this reason each board is made to swivel independently on the cross-support. This swivel arrangement is shown in Fig. 18.

The cross-support is made from 3 in. × 1 in. timber, and is screwed to the canoe hull just aft of the front cockpit. The length is arranged so that when the lee-board is dropped it is vertical when rubbing the side of the canoe.

The lee-boards are streamlined in section in order to cut down resistance to the minimum. Finally, glass-paper thoroughly and give two or three coats of paint.

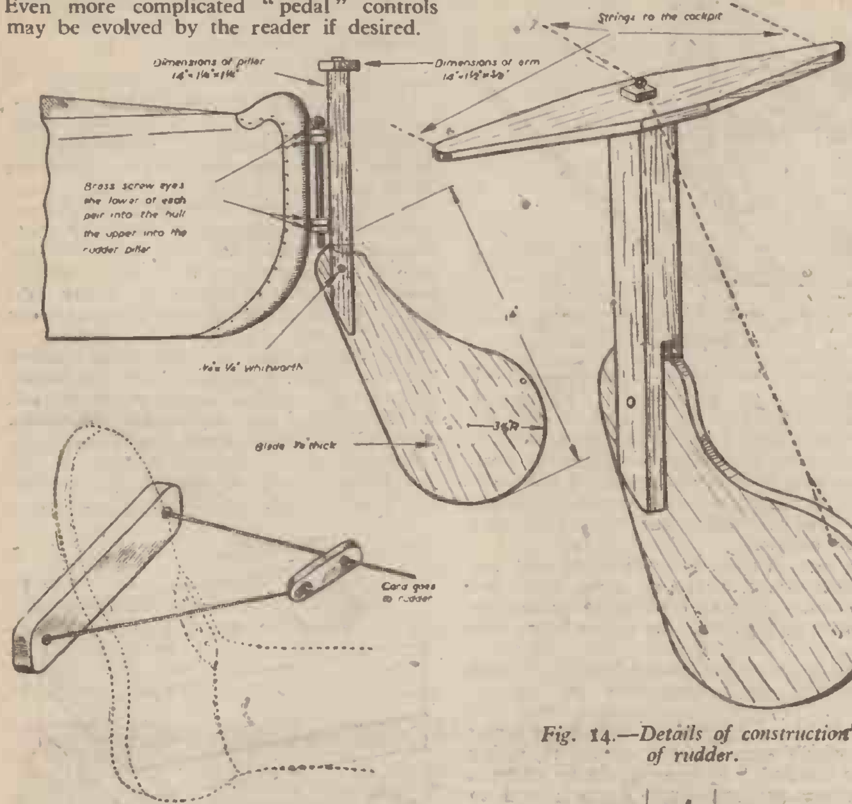


Fig. 14.—Details of construction of rudder.

Fig. 15.—Stirrup used to actuate the rudder.

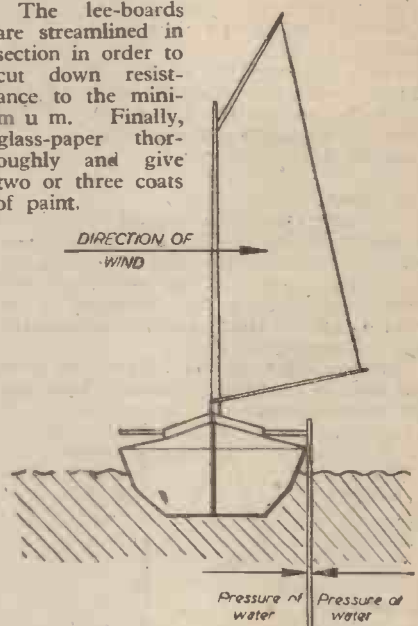


Fig. 17.—Illustrating the principle of the use of lee-boards.

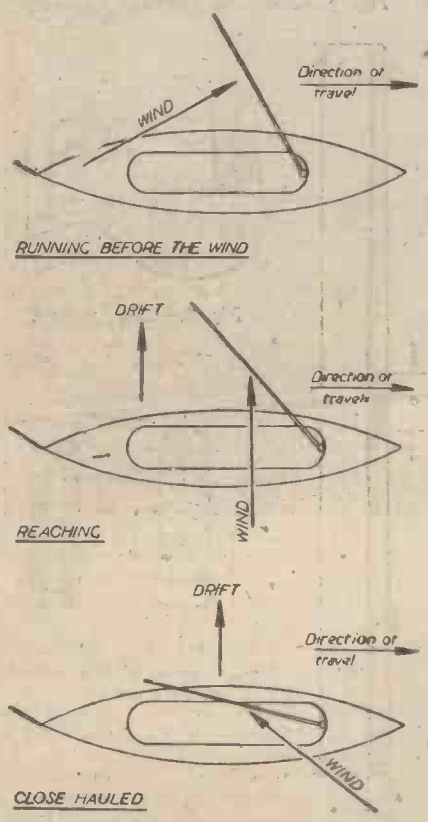


Fig. 16.—Methods of sailing.

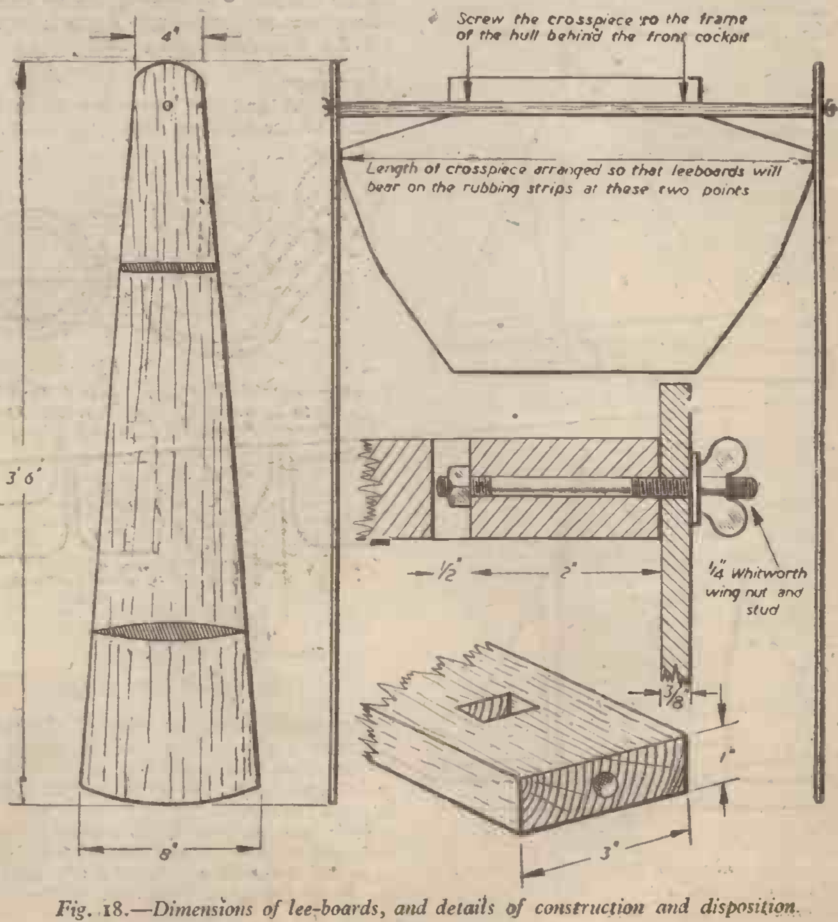


Fig. 18.—Dimensions of lee-boards, and details of construction and disposition.

Inventions of Interest

By "Dynamo"

Clothes-airing Cabinet

MECHANICAL methods of drying and airing clothes have for many years rivalled the alfresco clothes line. A new apparatus of this description has made its advent. And it is claimed for it that it is both efficient and inexpensive. If this claim be justified, the invention is an effective and economical means of literally preparing for a rainy day.

The device comprises a cabinet within which is a hopper mounted above a fan. This fan draws or propels air through a heater.

The clothes are placed on a perforated plate within the hopper, through which the stream of heated air is driven. The moving air has sufficient volume and velocity to lift and agitate the garments which are thereby rapidly dried and aired.

When the apparatus is in use, a sliding door in the upper portion of the cabinet is pushed back and the damp articles are laid on the perforated plate. The door is then closed and the fan and heater are simultaneously supplied with electrical energy by means of a suitable switch.

The resulting upwardly directed stream of heated air raises the edges of the clothes and sets up an undulating movement which speedily dries and airs the articles.

The moisture-laden air escapes through the louvred plate of the upper portion of the cabinet.

Watertight Knapsack

A NORWEGIAN has devised an improved means of closing haversacks, kitbags, etc., in a watertight manner. An additional aim is to provide a watertight haversack which will not only keep its contents dry but will also constitute a buoyant support enabling the wearer to remain afloat in water.

The invention consists of a metal strip round which the top of the haversack is rolled or folded, and has means for securing the ends of the strip together. The closure means which can be easily applied and excludes both air and water, comprises a pair of parallel strips of springy material such as steel. These are placed one on each side of the open end of the haversack. The strips are preferably of a length greater than the width of the haversack, and the means to secure their ends together may consist of string, wire or hooks.

It is maintained that a particularly satisfactory closure is effected when the springy strips are bent round to form a circle and pressure is exerted between the inner and outer blades, clamping the layers of the haversack. When the latter is made of an impervious material, the sack will be airtight and watertight. As stated, it may be made to form a buoyant article to assist a person to float in the water.

The device, for which a patent in this country has been applied, should be suitable for the Armed Forces, and would be useful to hikers on rainy days.

To Keep Razors Keen

YET another safety razor blade sharpener has made its appearance. Its inventor comments upon the fact that the expedient of using the inside of a glass tumbler, with its smooth, unbroken curvature, for sharpening blades is well known, and remarks that a number of people have faith in it. The consequence has been the marketing of specially shaped devices embodying the curved feature of the tumbler. He states that these have taken the form of glass pedestals having segmental upper surfaces curved to ensure the correct sharpening angle for the razor blade, and also of lengths of synthetic resin of segmental section of the correct curvature. Sometimes the former have been etched to give a greater grinding or abrasive effect, while the latter have been made with a rough portion for honing and a smooth part for stropping.

The information on this page is specially supplied to "Practical Mechanics" by Messrs. Hughes & Young, Patent Agents, of 7, Stone Buildings, Lincoln's Inn, London, W.C.2, who will be pleased to send free to readers mentioning this paper a copy of their handbook, "How to Patent an Invention."

The inventor in question affirms that all these devices serve their purpose to a point and enjoy a measure of popularity, especially at the present juncture when razor blades are in short supply. He further points out that, owing to the flexibility of the double-edged razor blade in general use, results vary according to the pressure exerted when a blade is sharpened. For example, if a strong pressure be exerted, so that the blade is made to conform to the shape of the sharpening surface, the cutting edges become set at the wrong angle. As a consequence, they hardly touch the sharpening surface.

The aim of the inventor is a form of sharpener of any desired curvature which will be effective for blades of all makes whether single- or double-edged, at whatever pressure the user exerts on the blade.

The characteristic of the device is that its curved surface is of wave or ridge formation. The ridges lie practically in the same direction as the longitudinal axes of the curved sharpening surface, and present to the blade a succession of convex surfaces.

Convenient Wardrobe

AN improved collapsible wardrobe is the subject of an application to the British Patent Office. It is stated that this article of furniture can be readily dismantled and collapsed in a flat and compact condition, and that it can be erected rapidly.

It includes a pair of wooden side frames, each consisting of a pair of vertical wooden side posts connected by upper and lower cross rails and by upper and lower transverse metal tie rods. There is a wooden roof frame adapted detachably to interlock with the tops of the side frames. Longitudinal means enable the two side frames to be detachably joined together near their lower ends. And a longitudinal metal tie rod detachably joins the upper cross rails of the side frames together. Rigidity is thus given to the structure.

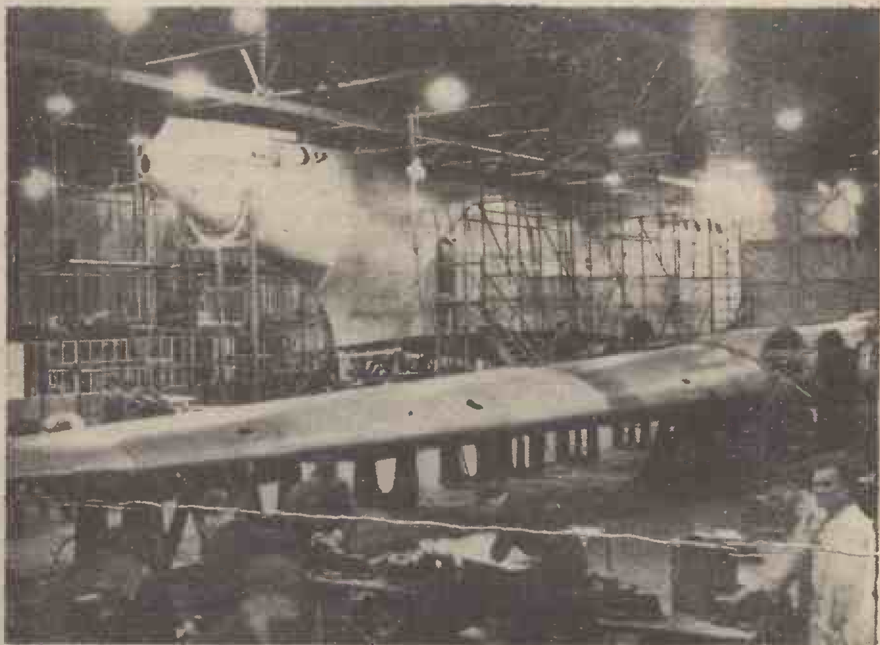
Obviously the *raison d'être* of such a wardrobe is its convenience for storage or transit.

Broom Handle Fixer

TO effect an indissoluble union between the handle of a broom and its business end is the aim of an invention which has been submitted to the British Patent Office.

The contrivance consists of a channel metal strip with a radially outwardly directed spike at one end, and a hole at the other end. Near to, but at an interval from the spike is a radially outwardly projecting lug. This lug is cut and bent outwards on each side of the spiked end of the channel strip.

In addition to securing a stick in a wooden socket of a broom-head, this device is useful in the case of the handle shaft of a games mallet, the leg of a chair and similar objects.



A new 58-ton air cruiser, the Shetland Flying Boat, largest British 'plane, has been built by Short Bros. and Saunders-Roe, and is completing its trials. It can carry up to 70 passengers, has a top speed of 267 m.p.h., and four engines of 2,500 h.p. each. Wing span is 150ft., length 110 ft. Our illustration shows the Shetland Flying Boat nearing completion.

THE WORLD OF MODELS

Not within living memory has there been so much discussion and interest taken in a post-war world as there is at the present time. In this connection the consideration of models of some of the ideals and schemes that are being suggested is becoming increasingly popular. Some of the uses to which architectural modelling has been applied in the present situation, which may give readers a glimpse of the future widened scope of this branch of modelling, are here given

By "MOTILUS"

Model Hebrew University

THIS year marks the twentieth anniversary of the inauguration of the Hebrew University of Jerusalem, and with it comes the news that a central hall is to be added to this great Jewish University as a memorial to the late Major-General Orde Wingate, of "Chindit" fame.

Wingate took the deepest interest in the Jewish revival in Palestine, and the fund for the memorial is sponsored by his family and friends, and famous statesmen like Mr. Winston Churchill and Field-Marshal Smuts have become Patrons.

Since the University was declared open by Lord Balfour on April 1st, 1925, it has grown from three small research institutes for Hebrew studies, chemistry and parasitology into a real centre for research, scholarship and teaching, with two full faculties—of the Humanities and of the Natural Sciences and Mathematics—a pre-faculty of Medicine, and a School of Agriculture. There is regular teaching in Hebrew, in which language all students must qualify. Very valuable work has been done in this University for the war effort. Intensive courses have been planned for medical officers of the Allied Forces, serums manufactured for the Russian and Polish armies, and the Science departments have assisted in making and repairing scientific instruments and attacked the wartime problems of public health and feeding.

The accompanying illustrations, Figs. 1 to 3, show a model of the university which was unveiled on May 28th at Palestine House, Manchester Square, London. The ceremony was attended by about sixty people, and Sir Wyndham Deedes opened the proceedings by introducing the Vice-Chancellor of London University, who performed the unveiling ceremony. Then followed an informal tea, after which the company adjourned to the drawing-room to hear a short talk by Sir Leon Simon describing the founding and work of the University.

The attractiveness of the model was several times mentioned, and certainly the University, with its white buildings, on hilly ground dotted with trees, lends itself to a picturesque miniature. It was, in fact, the uneven contours which presented the greater difficulties to the model craftsmen engaged on the work. At least five hundred man-hours were spent on the model, which was constructed almost entirely from photographs and details, without the assistance of drawings.

The buildings modelled are:

1. Mayer de Rothschild Hadassah University Hospital.
2. Henrietta Szold Hadassah School of Nursing.
3. Nathan Ratnoff Medical School Building.
4. Botanical Garden.
5. Rosenbloom Building of Jewish Studies.
6. David Wolfsohn Building of the National and University Library.
7. Museum of Jewish Antiquities.
8. Club.
9. Gymnasium with Playing Field.
10. Friedlander Memorial Garden.

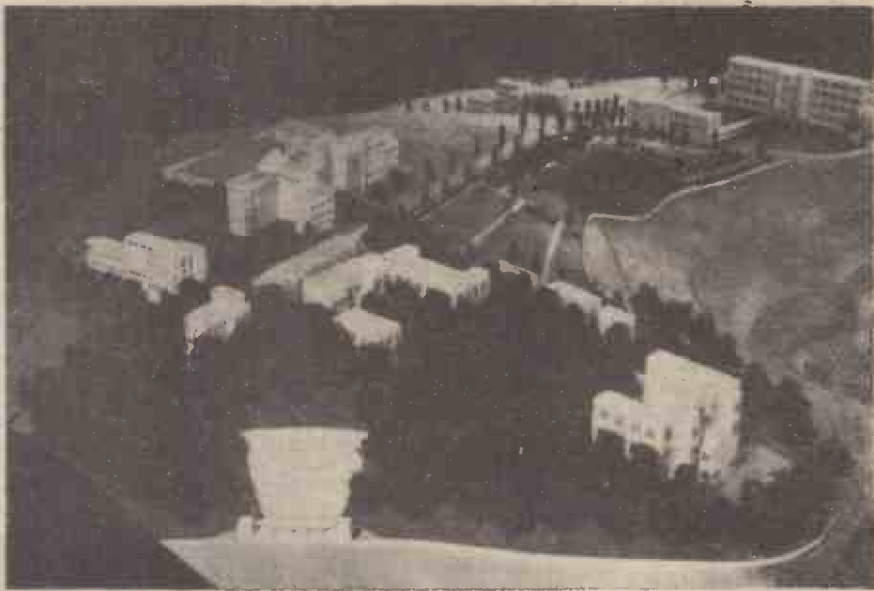


Fig. 1.—Photograph of the Hebrew University model, giving a general view on Mount Scopus and the various buildings which comprise the university. The open air theatre with Minnie Untermayer stage is in foreground.

Fig. 2.—A close-up view of part of the model of the Mayer de Rothschild Hadassah University Hospital.

11. Administration Building.
12. Chemistry Building.
13. Moshe Laboratory.
14. Philip Wattenberg Building of the Einstein Institute of Mathematics.
15. Part of Botanical Garden.
16. Deborah and Monnes Shapiro Building of the Einstein Institute of Physics.
17. Open Air Theatre with Minnie Untermayer Stage.

The model has been made for the Friends of the Hebrew University of Jerusalem, and its dimensions are roughly 4ft. 8in. by 2ft. 10in., made to a scale of 45ft. to 1in.

Dockside Model

Probably one of the most important projects being placed before Londoners is the scheme which is long overdue for a tideless Thames. The plan is being sponsored by the Thames Barrage Association led by their enthusiastic hon. secretary, J. H. O. Bunge, M.I.Mech.E. Here again a model has been brought in to help to make the scheme readily understood by those who have not the technical knowledge to visualise how the proposal will affect the river generally.

Fig. 5.—Scale model of one of the proposed new public houses in the Plymouth district—"Drake's Drum."

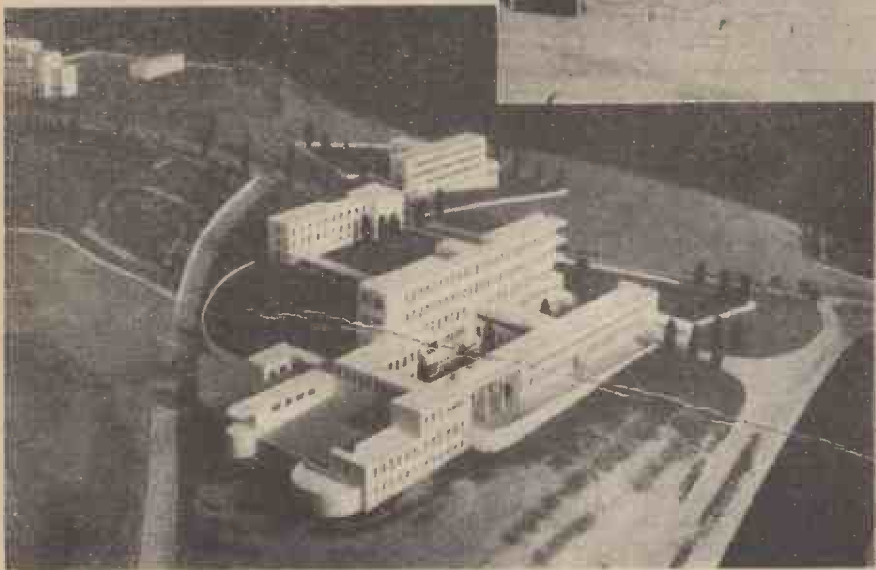


Fig. 3.—General view of the model of the University Hospital—the largest building in the Hebrew University.

The model represents a portion of the River Thames from Barking Creek to Woolwich Reach, and shows the existing docks and river as it is to-day, while a removable portion demonstrates clearly how it would appear under two alternative schemes.

The first project is for a dam with sluices and seven locks—also for an overhead roadway with three lifting bridges. In the second it is proposed to dam the river about half a mile further downstream, incorporating four locks for small craft and a fixed road. This scheme plans for three separate locks for large craft, and a single span lift bridge. Alongside this would be a 500ft.-wide ship canal, with sea-going locks and non-tidal berthing. This ship canal is designed to feed the traffic to and from Woolwich Arsenal.

Mr. Bunge is using this model in an effort to initiate a Riverside Boroughs conference on the Thames problems. He used it on May 16th, at his address to the Richmond Borough Council, and certainly planning for civic improvement cannot be more clearly shown than by models. The model is to the scale of 250ft. to 1in., and Fig. 4 shows the second scheme with water-line ship models in the various ocean-going docks.

A Model Inn

Plymouth has probably suffered as much as any of the blitzed cities of this country, and the enterprising Plymouth Breweries, Ltd. are planning to erect new public houses to replace those damaged or destroyed. It is well known that before any new licensed premises can be built, the complete scheme must go before the licensing justices at the Brewster Sessions for their approval. How much more satisfactory to bring an explanatory model before the court rather than just an architect's drawing.

The illustration, Fig. 5, shows a model of one of the new proposed public houses for the Plymouth district. It is constructed to the scale of ¼in. to the foot and the top floor is made removable so that the planning of the various bars, lounges, dining-room, and other necessary layout and fittings downstairs can be viewed. Also the type of brickwork, stone facings, woodwork and general painting scheme have been clearly shown. The model shows the main road approaches, and also the garage accommodation.

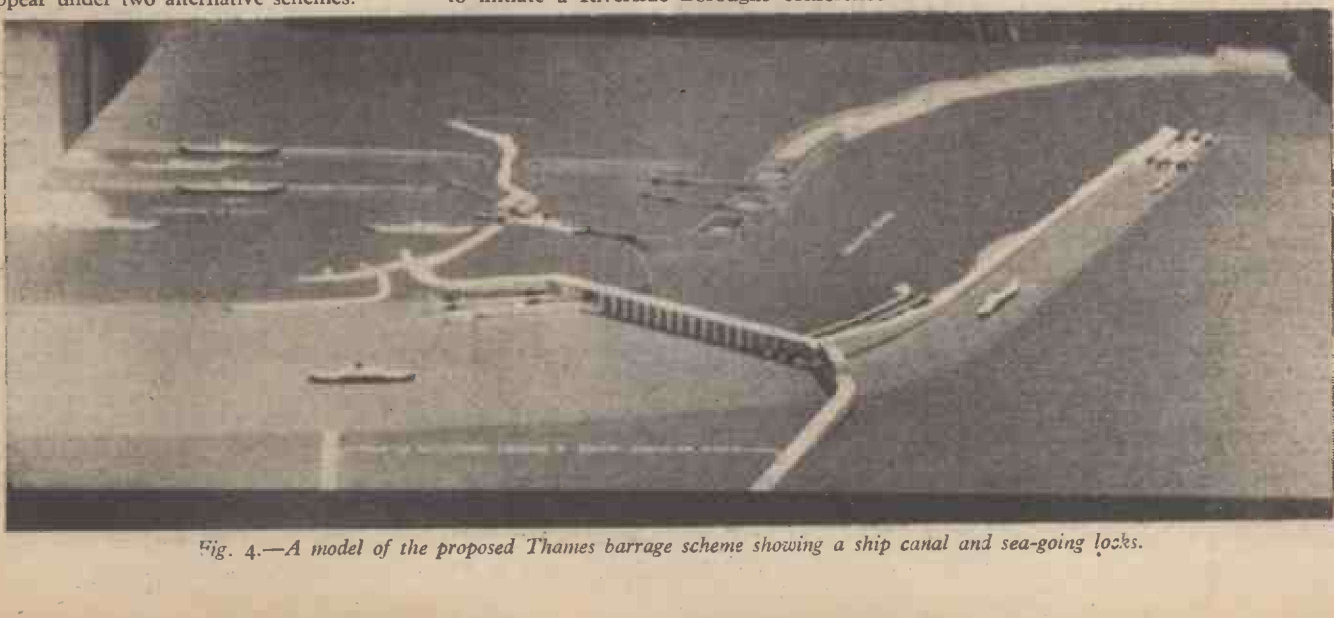


Fig. 4.—A model of the proposed Thames barrage scheme showing a ship canal and sea-going locks.

NEW SERIES

The Annals of Electricity—6

The Career of Charles Coulomb, Engineer and Electrician

THE illustrious Michael Faraday is usually credited with having laid the foundations of present-day electrical science. Such a contention, however, is only partially true, for before Faraday's time there lived and worked in France a gifted and original individual who, by dint of painstaking and accurate measurements, first determined the magnitudes and quantities of electrical and magnetic forces, thereby placing, for the first time, the study of both electricity and magnetism on a sound, measurable basis.

In the world of created matter you have to be able to measure a thing before you can deal with it properly, before you can control it and form an understanding of it.

Let us form an acquaintance, therefore, with a scientific celebrity, Charles Coulomb by name, the investigator who made the first electrical and magnetic measurements and who, by doing so, placed these twin sciences on what is nowadays known as a "quantitative" basis, that is to say on a basis of firm and indisputable measurement.

Before Coulomb came, electrical experiments, to a large extent, smacked of somewhat eccentric parlour tricks. But Coulomb, by devising a means of measuring electric and magnetic forces, changed all this. He was the man who, in the days before Faraday was born, established electricity, or, at least, the science of static or frictional electricity which was the only form of electricity then known and bequeathed to his posterity the means of entering more closely into the study of electrical forces.

Coulomb lived a busy and a somewhat fortunate life—fortunate because his lifetime stretched over the wild and politically tempestuous days of the French Revolution towards the end of the eighteenth century and because, despite his belonging to an "aristocratic" family, he managed to save his head from a fatal encounter with the revolutionary guillotine, it being almost as hazardous in those days to be anything of an "aristocrat" in France as, in our time, it was to be a Jew in the land which was once "Greater Germany."

A Military Engineer

Curiously enough, only about a dozen years of Coulomb's life—he lived to be 70—were spent in electrical researches. In a way, the "electrical inquiries" which subsequently made this investigator's name so famous were the products of his spare time. By occupation or profession, he was a military engineer. Electrical studies were for him a relief from other activities. They aided and quietened his mind, although they were only incidental to other affairs in his lifetime.

Charles Augustin Coulomb was born at Angoulême, France, on June 11th (some authorities give June 14th), 1736. His people were fairly well-to-do, and he went to a good school in Paris during his boyhood. Discovering a decided bent for mathematics and for all kinds of constructional activities, he entered the French army as a technical officer. After a short training, he was drafted out to the island of Martinique in the West Indies.

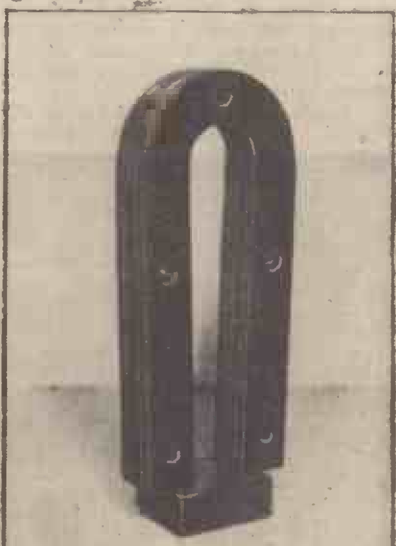
But the climate of Martinique was particularly bad. After a stay of three years there, half his men had died and Coulomb himself broke down in health. He was returned home, sick, broken and with defective physique from which he never afterwards recovered.

After a protracted period of leave, Coulomb returned to his army duties. He was engaged on fort constructional work, mainly at Cherbourg and Rochelle. But it may well be that these duties were merely nominal ones, for they gave Coulomb ample time to prosecute his own original researches, for which sort of work he was now beginning to develop a taste. We find him, for

Charles Augustin Coulomb (1736-1806).

instance, at this period of his life giving a paper on "Statical Problems applied to Architecture" before the French Royal Academy of Sciences, of which he was made a Corresponding Member. He shared, also, in a prize offered by the French Academy for a new method of constructing ships' compasses.

For a number of years Coulomb was stationed at Rochefort, well known in those



An original late 18th century "magnet battery" made by screwing half a dozen magnets together. These "magnet batteries" were much used by the early experimenters in electricity and magnetism.

days for its naval arsenal. Here he published an essay on the *Theory of Simple Machines*, which also won him a prize at the Academy of Sciences.

In 1781, Coulomb was transferred to Paris, where he quickly made a name for himself not only as an experimenter (for he was now beginning his electrical researches) but also as a consulting civil engineer.

The Brittany Canal Scheme

A scheme for a navigable canal, on the English model, was mooted for construction in Brittany. The "Minister of Marine" commissioned Coulomb to examine the scheme and to report technically on it for the approval of the King.

Coulomb went to Brittany, examined the project from all angles and ultimately reported most unfavourably on it. He condemned it as expensive and unprofitable.

The essential integrity which was so characteristic in Coulomb's character throughout his life earned for him much disfavour in this connection. The Brittany Canal scheme happened to be supported by influential people, and such was the corruption and "graft" of the times that these people were actually able to get engineer Coulomb incarcerated in a Paris prison on the absurd and frivolous pretext that he had accepted his commission to report on the Brittany Canal scheme without the express permission of his superior, the French Minister of War.

Highly indignant at this treatment, Coulomb sent in his resignation from the army. It was at once declined with some vigour. Instead, Coulomb was quickly set at liberty and ordered to report again on the canal project. He did so, but his second report was couched in similar terms to his first one, and it contained an equally emphatic condemnation of the whole scheme.

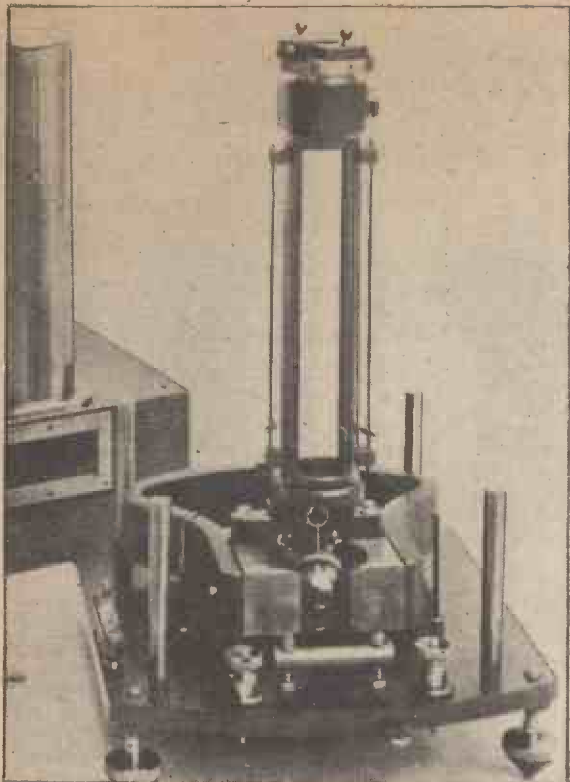
Eventually, Coulomb's views prevailed. The scheme was not put into operation, and the French Government tried to make atonement for the indignities which it had caused Coulomb to suffer by offering him a considerable sum. But Coulomb refused to accept this offer. He told the French authorities that, if they wanted to do so, they could give him a good, reliable "seconds watch" of the best make procurable, but that was all he wished to have.

Official Appointments

In 1784, Coulomb was made Superintendent of "Waters and Fountains" throughout France, a merely nominal position, no doubt, but two years later he was given the post of Conservator of Plans in the French Government. He was also promoted to the rank of Lieutenant-Colonel in the French Engineers, and was made a Member of the Legion of Honour.

Coulomb, by his very integrity of purpose and by his refusal to be dominated, had conquered the French Government, and now the French Government was almost feeding out of his hand. The Paris Academy of Sciences seemed to have unbounded faith in him, too. The Academy sent him on a semi-official commission to England to study hospital administration in our country. Coulomb returned from his mission but with little result, for the English hospitals were nothing to be particularly proud of in those days.

It was in the year 1784 that Coulomb



A modern highly-sensitive galvanometer. Like Coulomb's original torsion balance it employs a twisting line for providing its indications. Its protective cover is seen in the rear.

presented his first important paper to the French Academy. It concerned the elasticity of wires under a twisting stress. During his experiments on twisting or torsional stresses he noticed that a very slight force was sufficient to twist a long, thin wire through a considerable angle, and, as a result, he was led to invent that piece of apparatus which will ever be inseparably connected with his name, viz., the "torsion balance."

The Torsion Balance

In its simplest form, Coulomb's torsion balance consisted of a tall glass jar in which was suspended from a very thin wire a tiny needle or rod of shellac having a miniature gilt ball attached at its end. By lowering an electrically charged rod into the jar, the gilt ball was repelled and the wire was caused to twist. Its degree of twist was measured by means of an indicating needle traversing a semicircular scale, thus showing the strength of the repulsion of the gilt ball from the electrified rod. A balance working on similar principles was used to measure the strength of magnetic repulsion.

Coulomb was able to make torsion balances of very great sensitivity. One which he constructed was so sensitive that its needle could be twisted through a right angle by means of a stick of electrically excited sealing wax held at a distance of a yard from the balance.

Between the years 1785 and 1789, Coulomb worked intensively at his electrical and magnetic experiments. He did not try to discover new means of generating electricity. On the contrary, all his efforts were directed to the quantitative estimation of the electrical energy which was then available to him. He electrified his experimental objects simply by friction, and when he presented such bodies to the needle of his torsion balance he found that the force of repulsion or of attraction between positive and negative electricities is directly proportional to the quantities and inversely proportional to the square of the distance between them.

In other words, electrical forces obey the same law as does the force of gravitation. If the distance between the oppositely electrified bodies was doubled, Coulomb found that they exerted a quarter of their original force on each other, whereas if the distance was trebled, the forces were reduced to one-ninth of their original magnitudes.

Coulomb's "Proof Plane"

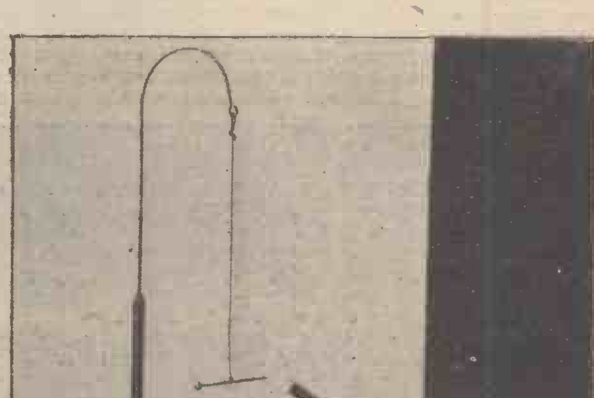
Coulomb, in the course of his now classical experiments in electricity, found that frictional electrical charges can be communicated from one conductor to another by contact, and that the charges reside on the exterior surfaces of the bodies only, so that if a charged conductor is turned inside out the charge will move its position so as to keep on the exterior "skin" of the charged body.

The "proof plane," an article of common use in electrical experimental work, is the invention of Charles Coulomb. It consists merely of a metal disc mounted in an insulating handle. By means of it electrical charges may be conveyed from object to object by contact.

An obviously simple and almost insignificant device the proof plane may be, yet, by its aid, Coulomb successfully and even brilliantly carried out a series of experiments on the density of the distribution of electric charges on surfaces of differently shaped conductors. He clearly demonstrated the fact that the density of electric charge is greatest on the *points* of conductors, and he showed also that the loss of a charge from a conductor always takes place at those areas of the conductor which are the sharpest or the most pointed. In other words, electricity "jumps off points" but tends to cling to rounded, ball-like bodies.

Coulomb's experiments in magnetism ran closely parallel with the ones which he made in electricity. He proved that magnetic attraction or repulsion (the "force of magnetism," as he called it) is directly proportional to the strength of the magnetic poles and inversely proportional to the square of the distance between the poles. He "invented" a new means of magnetising needles by placing them between the opposite poles of two magnets and by stroking them from centre to end (in opposite directions) with two other magnets.

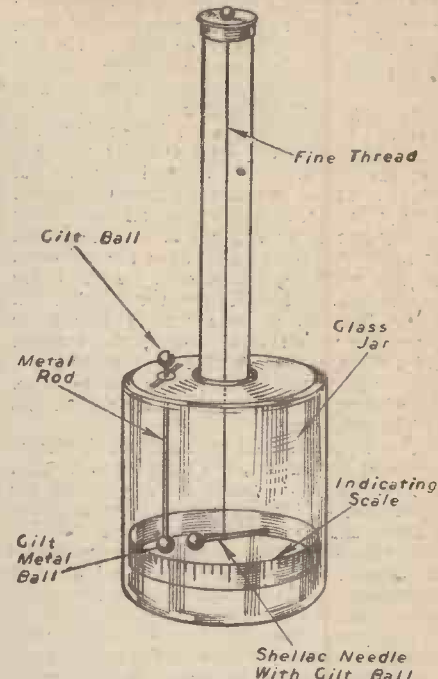
By clamping magnets together, he was able to increase magnetic intensity and consequently to make "magnet batteries." Coulomb showed that iron is completely demagnetised when it is heated to red heat. His explanation of the phenomenon of the magnet was that every magnet consists of tiny particles, each of which is a separate magnet itself and that the attractive or repulsive power of the magnet is merely the sum of the attractive or repulsive powers of its particles.



A suspended nail, slightly magnetised, used as an indicator of magnetic force, it being attracted to or repelled by a similarly magnetised body.

The French Revolution

Coulomb's experimental work brought him fame and influence in the academic world of France. But in the July of 1789 the upheaval of social revolution flared up in Paris, and, before long, was raging with fury and malevolence. Coulomb's reaction was to resign all his official appointments. He was expelled from Paris as an "aristocrat." The Academy of Sciences, of which he was



A sketch of Coulomb's original "Torsion Balance" for measuring electrical and magnetic attractive/repulsive forces.

so honoured a member, was suppressed, and, for a time, Coulomb's life seemed in danger.

But eventually, the Revolutionary Government which had guillotined the great Lavoisier, "Father of modern Chemistry," in consequence of his aristocratic tendencies, and because, as it announced, "France has no need of chemists," found that some sort of a scientifically trained individual was essential to its social scheme. So it dragged

(*Continued on page 427*)

Observations

A Discussion on Some Interesting Everyday Phenomena

By Prof. A. M. LOW

HAVE you read about Air Chief Marshal Lord Dowding's recent experiments? He has suggested the possibility of some new motive power or force. He has spoken in a purely tentative manner and has, in fact, invited observations on a particularly interesting set of phenomena.

Take a piece of ordinary fairly stiff writing paper and make the little cylinder which I have illustrated. It is a good plan to cut down both sides so that the joins will balance. Place this queer apparatus on the table where there is no draught of any kind, and then put your right hand *round* the cylinder, but not touching its surface. It is many oranges to a dry coconut that the cylinder will revolve just as if your fingers had some emanation which blew against the surface. It is, by the way, useful to perforate the cylinder from the inside before rolling it up. Use a blunt pin so that the outer surface has a slight roughness.

If you put a shield against the cylinder as shown in my sketch, the cylinder will again revolve. What is more, if you enclose the whole affair in, for example, a Cellophane box, it seems still to revolve, but if the shield is made of metal or glass, rotation can sometimes be stopped. It appears to make a difference whether you sit facing the north or facing the south, different hands affect the direction of rotation, and there are innumerable experiments which can be made, all of which leave you with the great question, why on earth does the cylinder move at all?

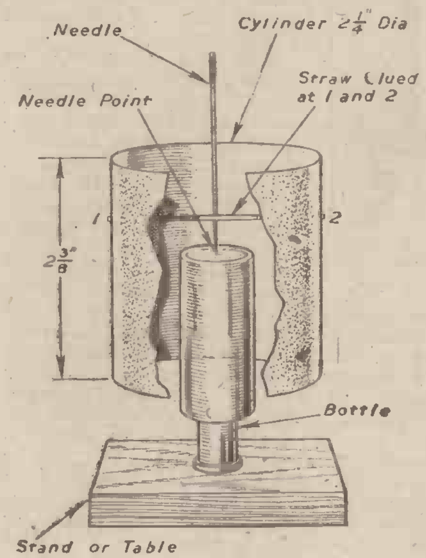
Lord Dowding has gone to the length of making an artificial hand heated by hot water in order to check the existence or otherwise of human emanations. I well know that there are such things as electrostatic effects, convection and other things, but I think you will not find it so easy to give, as I suggest you do, your explanation.

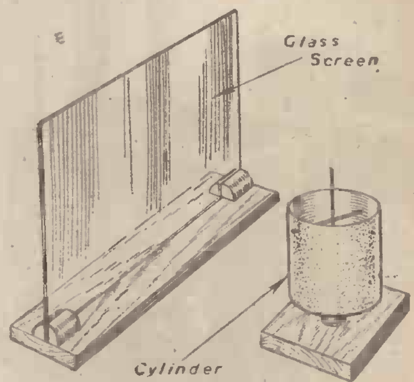
I think I know how it works, but that does not matter. It remains one of the most quaintly magical devices in existence. Try it.

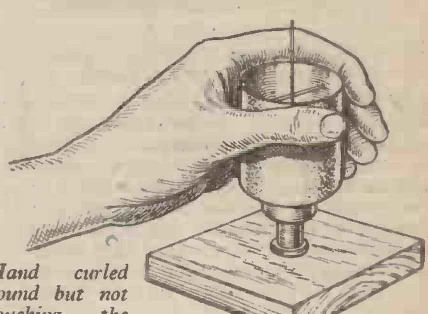
Flapping-wing Aeroplane

Once more I see the account of some clever man who has designed a flapping-wing aeroplane, and he has suggested that before long he will fly it by means of human power. I believe that the ornithopter enthusiasts are wrong, and that they have been influenced by watching birds with less skill at their disposal than that of the famous Alliott Verdon-Roe. It is remarkably difficult to imitate nature. Inventors often design queer-shaped cranks to increase the "power" of a cyclist, quite forgetting that a human being cannot put out any great exertion for long even if the necessary mechanism is available. So it is with wing flapping. A little observation will show us that the bird has an enormous power-weight ratio, and that if a man was to fly in like fashion he would need the strong, hollow limbs possessed by a bird, not to mention strong arms with "muscles" about ten inches thick, before any good could be done.

Yet again is this question of comfort an important part of efficiency. We all know the old case of the motor-car where people pay £1,000 to secure comfort, when £200 will carry them along the road with the same, or even greater, mechanical efficiency. High-speed photographs of birds, and even the human eye, will show that as the wings move downwards in their screw-like path, reaction humps the bird's body up and down in a way that would soon make you and me feel very queasy. Copying nature is a thankless task. Cars with feet have often been designed, but wheels are rather more modern.







Hand curled round but not touching the paper cylinder.

A simple experiment for demonstrating the action of a "new motive force."

"Bow Waves"

In the happy days when one drove in expensive motor-cars past beautiful houses surrounded by wooden palisades, did you ever notice that a recurring swish suggested a leaking tyre or a stone caught in the tread? This is the reflection of wheel noise or that of the bow wave of air which is pushed in

WINSTON CHURCHILL'S VOICE ANNOUNCING PEACE IN EUROPE

This record was taken by Prof. A. M. Low on the Low-Hilger audiometer. The instrument has been used to photograph almost every common noise and sound, and also the voices of Daladier, Tetrazzini and Chamberlain. It works at such high frequencies that every characteristic is shown. The audiometer was used as early as 1910, and in 1918 London's traffic noises, the electric railways and Imperial Airways were all tested.

Churchill's voice shows unusual character in its variations and "harmonics." A so-called pure voice is usually very dull—Mr. Churchill's voice is far from pure! It is quite one of the most exceptional records ever taken in this way—as exceptional as the man.

The occasion was the Prime Minister's first broadcast announcing peace in Europe. He was referring to the Allies at the moment concerned. "Allied Expeditionary Force."

front of the car. Wooden fencings are usually laid with the direction of the palings changed every ten yards or so, and the reflection note varies with the position of the edges of the wood stages. Notice it next time! Very reminiscent of radiolocation if sound be substituted for the movement of electrons.

Talking of bow waves, you will also find that when butterflies hover in front of a car they are quite commonly snatched away, and carried overhead as the bonnet reaches them. The cover of air does the trick. It is the skin friction of the air which causes it to be carried along beside the car, and that is why, when you throw a cigarette negligently through the window, it seems to stand still for a moment before vanishing backwards.

Travelling is greatly interesting in all these ways. Watch a train with a plume of white condensing steam streaming over it from the stack. The steam seems suddenly to end at the rear of the train, and I hope you have thought of a good reason for this vital phenomenon. It is, of course, because the slight vacuum behind the train causes the moisture particles again to evaporate into steam before being lost.

Frictional Electricity

It used often to be stated, now that we are moving so fast, that soldiers and ordinary mortals sometimes had a nasty shock when touching the body of a car that had been standing for a short time in a desert wind. This is nothing to do with H. T. leaks, ignition apparatus, neon-operated lights, or any other clever affairs. It is the old case of sand friction causing a charge upon the highly polished and fairly well insulated panels of a car. You will remember that airships used to lower a chain to the ground to discharge frictional electricity. Steam wagons are often highly charged, and need an earth chain for safety as the result of steam friction across the hot funnel top.

And now another problem. Supposing a balance has a bird in a box on one side, exactly balanced by a weight on the other. When the bird jumps off the bottom of its box and flies round inside, does the balance move?

Letters from Readers

"What Is Time?"

SIR,—The theory advanced in the article, "What is Time?" in the June issue, on space travelling at a speed equal to that of light or faster, is, to my mind, simply a support of the belief put forward by R. H. Wallis in a letter published in the May issue, and which, on the editor's request, readers were invited to examine for the obvious fallacy.

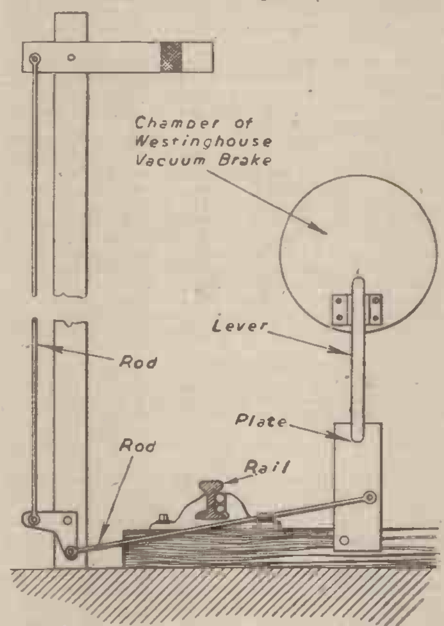
Space travel at speeds greater than that of light simply means darkness as early light waves are being overtaken and passed, which gives them no opportunity to strike the retina, and unless they impact the retina the sensation of light is not obtained. Travelling at the same speed as that of light could still mean darkness of view as no overtaking or impinging could still take place. Surely this is all very obvious to even those giving little thought to such problems.—C. J. WILLIAMSON (Scalloway).

SIR,—The author of the article "What is Time?" seems to have overlooked the relativity theory, which states that the time between two events is not a fixed thing. The particulars given of the Space Rocket are incorrect, for no matter what speed you travel away from or towards a light source, the measured velocity is always the same. This result was anticipated by Einstein and confirmed by practical experiment with light emitted from approaching and receding heavenly bodies. Although this at first sight seems absurd, Einstein points out that it becomes quite sensible if the observer's measuring instruments change with motion. To find a velocity you have to measure a distance and a time and Einstein says these alter in such a way with the observer's motion that the velocity of light always works out to the same value. Thus, distance and time are not absolute, but are relative to the motion of the observer. The way in which the measuring instrument changes lies in the fact that the mass of a body increases as its velocity increases. At ordinary speeds, this is imperceptible, but at speeds approaching that of light it becomes very apparent. At 9/10 the velocity of light the increase in mass is two and a half times, and at 99/100 the velocity of light the mass increase is seven times. The particles emitted from radium move sufficiently fast to test this theory. We find the increase in mass occurs in accordance to Einstein's theory.

I should like to take this opportunity to congratulate you on the fine standard your magazine has kept up during war time.—D. SADLER (Derby).

Preventing Railway Accidents

SIR,—I heard on the wireless recently that at an inquest on two railway men it was disclosed that the signal was at danger



Suggested trip-lever device for preventing trains from passing signals at danger.

and that the engine ran past, thus causing the accident.

This reminded me of an idea I sent before the last war to the then Midland Railway, and intended to prevent just such accidents, even in fog. I think the description, with rough sketch, may be of interest to your readers.

In 1907 I was employed on station work on the railway and my duty embraced signal lamps, moving passenger coaches in sidings by hand, and the usual station duties. I thus became familiar with signals and how they worked, and in the moving of passenger coaches in sidings, with the Westinghouse vacuum brake. I learned that if this brake was "on" on a standing coach, by pulling a wire at the side of the coach, air was let into the chambers of the vacuum brake, and so released it. Only 2in. of pull was needed.

Some years later a serious accident occurred to a passenger train, owing to it passing a signal, set at danger, in a fog. I therefore worked out the following device to prevent such accidents. I am told that a vacuum brake can pull up a fast train within 50yds.

The accompanying sketch shows a portion of a railway sleeper on which is shown a rail, in section, in its chair. Also attached to the sleeper is a plate, moved by rods, through a "bell" crank, by the arm of the signal, which is shown at danger in the sketch. In such a position the plate is upright, but if the signal was "down" so, automatically, would be the plate. As shown, at danger, if a lever was fixed to the vacuum brake chamber, where shown, capable of destroying the balance of the vacuum if it caught any obstacle, the train could not get far beyond the signal as the plate, being directly opposite the signal post, would automatically put the brake on. This inexpensive device might save many lives.—"SAFETY FIRST."

THE ANNALS OF ELECTRICITY

(*Continued from page* 425.)

Coulomb out of his forced retirement at Blois and commissioned him to assist in the planning of the new system of weights and measures which had been decreed.

After the social flare-up had died down and things again had become fairly normal, the Academy of Sciences was reinstituted. Coulomb was given a special position as an original member. His last official job was that of "Inspector-General of Public Instruction."

During this period of his activities, Coulomb investigated the friction of pivots, the viscosity of fluids and he endeavoured to work out some of the laws of mechanical friction.

Last Researches

Coulomb's last researches were on magnetism. He intended to return, also, to electrical investigations, but such intentions were never carried out. Broken in health, almost crippled in body, enfeebled, also, by his vicissitudes of fortune, the chronic ailments from which he had long suffered at last laid him low. He died at Paris on August 23rd, 1806, admired by the few, but unknown to the many.

To-day, the scientific world honours Coulomb's memory by naming after him the standard unit of electrical quantity, one *coulomb* being defined as "the quantity of electricity which, passing in a definite direction through a silver voltameter, deposits 0.001118 of a gram of metallic silver." In effect, the *coulomb* is the quantity of electricity conveyed per second through a conductor by a current of one ampere, for which reason it is sometimes known as the "ampere-second."

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back of cover, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Potassium Bichromate and Dichromate

BEING an amateur photographer I use potassium bichromate for the reversal and bleaching of films.

Having been given about 1 lb. of potassium dichromate, I am wondering if this can be used satisfactorily in the above processes; also, what is the difference between bichromate and dichromate?—J. Thompson (Southfields).

POTASSIUM bichromate and potassium dichromate are two names for the same chemical. Potassium *di*chromate is the correct name, although "bichromate" is the commoner use.

However, you may be quite sure that there is absolutely no difference between these two chemicals, and you can use potassium *di*chromate quite freely in formulæ which specify "bichromate."

Solidified Methylated Spirit

I SHALL be grateful if you can supply me with the following information:

(1) How to make methylated spirit into a jelly-like consistency, so that it can be carried about in a tin or carton for use in spirit stoves or a 'Primus" stove for camping purposes.

(2) Would I have to use an airtight container for the jellified spirit?—C. Chalmers (Stoke Newington).

"SOLIDIFIED spirit" of a satisfactory nature can be made according to the following formula:

Methylated spirit .. 1,000 parts (by weight or vol.)
Stearic acid .. .. 60 parts.
Caustic soda .. .. 13.5 parts.

Dissolve the stearic acid in 500 parts spirit. Dissolve caustic soda in the remaining spirit. Heat to 60 deg. C. Mix and allow to solidify.

In place of stearic acid and caustic soda, 30 parts of soap flakes and 2 parts of shellac can be used, but the stearic acid-caustic soda method gives a better product.

The jelly-like mass should be stored in containers having close-fitting lids, otherwise the spirit will slowly evaporate.

Silver Plating Solution

WILL you please give me some information on the following points:

(1) I have some electro silver plating solution from an old bath. How can I test for percentage of silver it may contain?

(2) How can I recover the silver? (I have a supply of LT convenient.)—A. Oakley (Halifax).

IT is quite impossible for us to answer the first part of your question fully because the method of estimating the amount of silver in a plating bath depends entirely on the chemical composition of the bath. If your silver bath is one of the cyanide type and you know the amount of silver cyanide which it contains, you can estimate the amount of silver which it holds from the fact that every 134 parts of silver cyanide contain 108 parts of pure metallic silver.

Assuming that the solution does not contain cyanide, you can add to it a solution of common salt drop by drop until a white precipitate is no longer formed. This white precipitate consists of silver chloride. It should be filtered off, washed, dried and weighed. Every 143.5 parts of silver chloride contain 108 parts of silver.

(2) The recovery of silver from the plating solution also depends on the nature of the solution. Usually this process can be effected by adding a few strips of clean zinc to the solution and then by pouring in some strong hydrochloric acid. After a time, silver in the form of a black powder will be precipitated, but if the silver bath be of the cyanide type, this process will be *exceedingly dangerous* owing to the generation of the *highly poisonous* hydrocyanic acid gas. We advise you to leave the process well alone, for, except when undertaken on a large scale, the recovery of silver from chemical solutions is never worth the cost expended on it.

Composition Flooring

I AM contemplating a flooring, of what in the building trade is called compo flooring.

This is something like a sawdust composition and it is used extensively in hospitals, can be polished, and does not strike so cold as a marbello or grano floor. Could you give me the formula for making this, with laying details, if any? I have ascertained that ¼in. is all that is required for thickness, and it needs a rough finish underneath for a "key."

In your May issue you gave two tile making formulas, one of which types used magnesite; do you think this would be suitable and possess any advantage over the cement and sawdust type in the "striking" cold effect?—H. R. Walford (Birmingham).

FLOORS of the "compo" type to which you refer are essentially mixtures of magnesium oxychloride and various scrap and filling materials, such as stone dust, brick dust, powdered rock slate, emery, scrap rubber, sawdust and various other materials. Their compositions vary enormously. Each manufacturer has his own "secret" formula which, generally, it pleases him constantly to change. To a large extent, however, the formula varies with the materials used. The following, therefore, must be regarded as an *average* formula which is capable of some alteration according to your own needs and the materials which you have available.

Calcined magnesite powder .. 50 per cent.
Fine sand .. .. .. 25 per cent.
Inert "filler" (stone dust, ground brick, etc.) .. .. 25 per cent.

One part of the above is mixed with approximately one part of sawdust or other fibrous material. The resultant mixture is then slaked with a 40 per cent. solution of magnesium chloride until it is of the consistency of mortar. It is then laid like concrete, or, for small jobs, a trowel may be used. The material takes about 30 hours to dry out and about three days to harden. It should not be laid around metalwork, particularly ironwork, (pipes, conduit, etc.), on account of its tendency to set up a hidden corrosion at these areas. Apart from this disadvantage, the "compo" material is very serviceable in actual use. It sets very hard ("as hard as a woman's heart," has, on more than one occasion, been an actual trade description). It can be made waterproof by adding a little bitumen emulsion to it. It can also be coloured by the admixture of earth colours.

The 40 per cent. solution of magnesium chloride above mentioned is made by dissolving 40 parts of commercial magnesium chloride to 60 parts of water.

All quantities given above are in parts by weight, not by volume.

The actual texture of the material can be varied by altering the proportion of fine and fibrous matter. If too much fibrous material is incorporated, the material will present an "open" surface, it will not lay smooth and flat because the fibrous material in the upper layers will tend to curl upwards. The same effect will happen if the fibrous material is too coarse. Such material must be fairly well shredded, but, given this requirement, it is surprising the number of scrap materials which can be incorporated in these "compo" floorings. materials, such as old boots, waste paper and card, waste tyres, waste rags, waste linos and oilcloths, etc.

The material may also be moulded and used for tile making.

It is best not to attempt to "key" down the material to an under stratum. In fact, the under floor should be as smooth as possible, and it is good practice to put smooth brown paper (or, better still, bitumen or tar paper) down first and to lay the "compo" flooring on top of this, the reason being that by having a smooth under-layer, the flooring is not anchored down tightly and is thus in a position to expand or contract freely under thermal stresses. Floors which are not laid with this precaution very often crack and become distorted. ⅜in. or even ½in. thickness is suitable for "light" floorings, but for heavy traffic a thickness of 1½in. is better.

Magnesium chloride and calcined magnesite are obtainable from Messrs. Harrington, Brothers, Ltd., 4, Oliver's Yard, 53A, City Road, Finsbury, London, but no doubt, you may be able to get such material locally, and thus save carriage costs. Try Messrs. Philip Harris and Co., Ltd., Birmingham.

Telescope Mirror: Silvering and Polishing

I HAVE a concave spherical mirror that I want to use for a reflecting astronomical telescope, and I would be glad if you can tell me how to find the focal length, for without this I cannot determine the length of the telescope barrel. The mirror is 6in. diameter.

Can you also tell me how to silver and polish the mirror and what chemicals to use?—Douglas Austin (Oldham).

WITH most concave mirrors, the diameter of the mirror is approximately equal to the focal length. Or, to be exact, the diameter of the mirror equals its focal length multiplied by the real diameter of the object multiplied by its distance. Since you do not possess any special apparatus your best plan will be to approximate the mirror's focus as being near to the value of its diameter. The length of the telescope barrel will, however, depend upon the type of reflecting instrument which you propose to build and, also, upon the type of eyepiece and its mounting.

Silvering and polishing a telescope mirror is an exceedingly difficult job for an inexperienced amateur. However, you can go about it in the following way by using Martin's process for the silvering of glass mirrors.

Four separate solutions are needed. They should be kept separately and only mixed immediately before silvering. They are:—

Solution A.
175 grains Silver nitrate.
10 ozs. Distilled water.

Solution B.
262 grains Ammonium nitrate.
10 ozs. Distilled water.

Solution C.
1 oz. Pure caustic potash.
10 ozs. Distilled water.

Solution D.
Dissolve ½ oz. Cane sugar in 5 ozs. distilled water. Then add 26 grains tartaric acid. Boil for 5 minutes. Cool and add 1 oz. of alcohol (rectified spirit). Dilute with water so as to make up the solution to 12 ozs.

The silvering solution is made as follows:—
Solution A, 4 parts (by vol.).
Solution B, 4 parts (by vol.).
Solution D, 4 parts (by vol.).

To this mixture Solution C is added, until the whole of the solution assumes a slightly brownish tint.

The glass surface to be silvered must have been rendered scrupulously clean, and if possible it should have had poured over it a 10 per cent. solution of stannous chloride just previous to the silvering operation, the stannous chloride solution then being washed away with distilled water.

The glass is levelled and the silvering solution is poured on or into it. In about five minutes the silvering action will have been completed. The silvering fluid is then thrown away and the resulting mirror is washed with distilled water and allowed to dry.

There are other silvering processes and most of them can be found in books of photographic formulæ, but the above method, Martin's process, gives a particularly bright and heavy silver deposit, which is most suitable for polishing.

Polishing is effected with a very soft chamois leather used dry. The leather can be charged with a little jeweller's rouge but this is usually unnecessary. The silvering must be perfectly dry before any attempt is made to polish it. All vessels used for silvering must be scrupulously clean, otherwise stains will result.

Inversion of Image: Mounting a Graticule

CAN you enlighten me on the following two points:—

(1) For what reason is the image seen in a surveyor's levelling telescope inverted?

(2) Is it possible to mount a graticule (or cross wires) in a "Galileo's" type telescope, i.e., with a bi-convex object glass and a bi-concave eye glass?—C. W. Ridley (B.L.A.).

(1) A "direct" telescope system consisting of object glass (or light-collector) and eyepiece (or magnifier) always inverts the image. Refracting telescopes are made on this principle, since, in such instances, the inversion of a stellar image is usually of little or no consequence.

In order to "right" the image an optical system known as an "erecting lens" must be placed in front of the ordinary telescope eyepiece. This system, consisting, as it does, of several lenses, considerably diminishes the brilliancy of the image. Furthermore, its presence necessitates a greater length of tube than would otherwise be the case. Since a surveying telescope has necessarily to be compact and portable and, at the same time, to give a bright image, the extra complication of the erecting lens system is ordinarily dispensed with.

(2) "Cross wires" are best mounted between the eyepiece lenses of an ordinary refracting Galilean type of telescope. You can use fine hair for the purpose, but the best cross wires for this particular use are made from strands from a spider's web. The exact centreing of the intersection of the cross wires is not an easy job. It calls for much care and patience.

Waterproofing Wood : Chromium Plating

(1) CAN you supply me with a formula for waterproofing wood-work? I believe such mixtures usually contain alum. (2) I would also like a formula for electrical chromium plating, I thought of using chromium sulphate but I believe that the addition of certain chemicals improves the result.—G. Ramsay (Edinburgh).

(1) There are several methods of waterproofing wood, the method employed depending upon the materials available and the type of wood under treatment. Wood may be waterproofed (a) with mineral salts or (b) by impregnation with waxes or rubber.

A formula using mineral salts is :—

Boric acid	..	6 parts (by weight)
Sal ammoniac	..	5 „ „
Borax	..	3 „ „
Water	..	100 „ „

The wooden article is best completely immersed in this solution for a couple of days. Alternatively, the solution may be brushed on to the wood, although this latter method only gives an outside waterproofing of the wood.

A more intense degree of waterproofing can be imparted to the wood by brushing on to it the following liquid :—

Paraffin wax	..	2/5 oz.
Gum Dammar	..	1/5 „
Pure rubber	..	1/8 „
Benzene	..	12 ozs.

It should be remembered, also, that impregnation with creosote oil also waterproofs wood to some extent, but perhaps this method might not be desired in your case, since creosoted wood cannot very well be painted over.

(2) Chromium sulphate is not much used for chromium plating nowadays since this salt is of somewhat uncertain composition. A modern chromium plating bath is as follows :—

Chromic acid	..	20 ozs.
Sulphuric acid	..	0.2 oz.
Water	..	½ gallon.

The plating bath should be contained in a glass vessel. It should be used at a temperature of about 40 deg. C. and with a current density of 80-100 amperes per sq. ft. of surface to be plated. The E.M.F. should be 4-6 volts. A carbon anode can be used, but the best anode consists of a lump of metallic chromium or a sheet of 8 per cent. antimonial lead. These materials, including plating salts, can be obtained from Messrs. W. Canning & Co. Ltd., Great Hampton Street, Birmingham 18.

Ferrotype Photo Process

WOULD you explain to me the method employed by photographers at the seaside and other places, who use a portable camera and take snaps that are quickly developed.

What I chiefly want to know is whether one plate only is used and prepared after each snap, and if so, the method and chemicals employed. —A. M. McCoid (Hull).

THE photographic process which you mention as being worked by street photographers is known as the "ferrotype process." Thin iron plates coated with a black or brown varnish are used. Upon this base is coated an emulsion rich in silver and one designed to give a contrasty image. Packets of the ferrotype plates are obtainable from large photographic dealers, as, for example, Messrs. Jonathan Fallowfield, Ltd., Newman Street, London, W.1, as are, also, special developing salts. They require a relatively lengthy exposure and are subsequently developed in a hydroquinone developer, development taking about 15 seconds. They are then fixed for a few seconds, rinsed and handed to the purchaser. Needless to say, such rapidly made photographs will fade unless they are properly fixed and washed.

These ferrotype photographs have a long history, dating back to about 1855. They are of American origin and were at one time designated somewhat contemptuously by the name of "tintypes." Carefully made, however, they are capable of giving good images.

The process requires, of course, one plate for each photograph taken. You will be able to read up the whole history and working of the process under the heading "Ferrotype" in any photographic dictionary which may be available in your local town library.

Electrical Discharge Tubes

I WANT to use discharge tube lighting for stage photography and for producing certain lighting effects on the stage. Do the regulations permit of its use indoors?

I also want to make a source of U.V. light of about 500 watts, and I should like to know if this is practical at a fairly reasonable voltage? Can you give me any details of construction of such a lamp or one of smaller size (e.g. 50-150 watts)? I have fairly good workshop facilities. R. C. Gilman (Cambridge).

THERE are various forms of electrical discharge tube. It is, of course, quite permissible to use the medium voltage hot cathode discharge tube, such as the usual 80 watt 5 ft. fluorescent tube, indoors. We presume, however, that your query refers to the cold cathode tube such as the neon tube which operates at high voltage. We are not aware of any authority which prohibits the use of such high voltage tubes indoors but would suggest you communicate with your local supply Authority, who may have applied some local restriction. There are, however, certain precautions which are very desirable in using high voltage tubes in this way, and in this connection we cannot do better than refer you to Regulations 801 to 814 inclusive of the "Regulations for the Electrical Equipment of Buildings," compiled by The Institution of Electrical Engineers of Savoy Place, Victoria Embankment, London, W.C.2, and obtainable from them or from Messrs. E. & F. N. Spon, Ltd., of 57, Haymarket, London, S.W.1.

Ultra-violet light is obtainable from electric arcs struck between carbon or tungsten electrodes operating with a volt drop of about 60 volts. You may require to use more than one arc to obtain the output required. Alternatively you could use a mercury vapour lamp having a quartz tube. An article dealing with the construction of an ultra violet lamp was published in the March issue 1945 of PRACTICAL MECHANICS. In this connection it should be noted that the glass used for the 400 watt lamps pass negligible ultra-violet rays in comparison with the 125 and 80 watt lamps of this type. You could, therefore, use four 125-watt lamps.

Telegauge Adjustment : Freezing Element

(1) Is it possible to correct an error in the recording of the petrol level in a Hobson telegauge—by topping up the fluid contained in the tube of the gauge itself? The gauge is giving me an error of approximately 2 gallons less.

(2) Can you tell me the chemical combination of the freezing element as used in a gas refrigerator?—N. Cockwill (Bletchley).

(1) It is not possible to adjust a Hobson telegauge by merely a simple topping up, as you suggest. The mal-adjustment may depend upon a number of causes, and an examination of the device will be necessary. In most instances, however, the trouble is due to air leaks in the system, these dissipating the air pressure upon which the instrument works. This seems to be the trouble in your case, since you are getting a low reading.

Remove the tank-filler cap, and then tighten the tank element connection. The air line must then be disconnected at the front, and, after the tank element has been cleared of petrol, the special Hobson red fluid may be added to the U-tube drop by drop with a fountain pen filler until it reads zero. The air line is then dried internally by pumping air through it, after which it is connected up and the gauge tested for correct reading.

(2) You refer to the "chemical combination" of the freezing element of a gas refrigerator. We take it you mean the chemical *composition* of the refrigerating substance. These refrigerants vary a good deal in composition according to the make and type of the refrigerator. For instance, the "Electrolux" refrigerators employ hydrogen gas and ammonia as the refrigerant, whilst other refrigerators use a liquid known as dichlortetrafluorethane ("Freon"). Still other appliances employ sulphur dioxide gas.

Fitting Hairsprings

COULD you please inform me how to tell different sizes in hairsprings, and how to ascertain what size hairspring to fit different balance wheels? I have balance wheels with no hairsprings, and want to know how to order the correct hairspring for same.—A. R. Bradley (Newport, Mon.).

FROM your query it is difficult to tell whether the balance wheels are for clocks or watches. Whichever type they are it is incorrect to order hairsprings in a haphazard manner. Before ordering a hairspring you should know the number of vibrations that the balance is required to make. The number varies, but the normal number is 18,000 per hour. The diameter of a hairspring is also important. The distance from the hairspring stud to the top balance staff pivot will give the approximate radius of the spring at rest. It should also be remembered that the coils have to be concentric when the spring is expanded.

Assuming that the balance is for an 18,000 train it means that it will have to vibrate five times per second. Select a hairspring about half the diameter of the balance wheel and attach it to the balance staff in the following manner. Take a *tiny* knob of bees-wax, press the inner end of the hairspring into it and then push the top staff pivot into the bees-wax. To make the balance vibrate five times per second a position has to be found on the spring which will ultimately be the position which is embraced by the regulator pins. This is known as the count point.

If you do not possess a vibrating tool try to obtain a watch with large seconds hand and a flat crystal glass. Next hold the spring with a pair of tweezers and let the bottom pivot touch the glass. With a slight movement of the wrist start the balance vibrating and count the movements of the balance arm at the same time watching the seconds hand. If the balance vibrates too quickly, hold the spring nearer the outside end, if too slowly hold the spring further from the outside end. When you have arrived at the correct point, mark the position with a scriber. An extra quarter of a turn should be allowed for pinning to the stud.

"Ageing" Compound

COULD you please supply me with information on how to prepare "ageing" compound? I have a model galleon to which I desire to give the appearance of being old.—J. S. Hall (Newcastle).

APART from an "antique" lacquer, there is no such thing as an "ageing" compound which can be applied universally to a model ship or galleon in order to give it an old appearance. Metal, wood and fabric components of the model have all to be treated separately if the best results are to be obtained.

The metal work should be swabbed over (after being cleaned) with a solution made by dissolving 1 part of sodium sulphide in 20 parts of water. This will darken all brasswork, copper and iron. The solution may be used weaker if a less intense darkening of the metalwork is desired. Sodium sulphide is usually obtainable in ounce bottles from photographic dealers.

Woodwork and fabric material, such as sails, are best treated with a cellulose lacquer. You can either get an "antique" cellulose lacquer from your nearest woodworking and model stores, or else you can obtain some clear cellulose lacquer and work into it some "old bronze" powder until you obtain the shade you require. We advise using the ready-prepared article, since the mixing of paints and lacquers is by no means as easy, and as satisfactory a task as it appears to be. Apply the lacquer *sparingly*. Do *not* use heavy coats. In this way, the effect will be much more realistic than would be the case if a thick painted coat of the lacquer were applied.

Quick Setting Casting Material

I AM wanting a hard, durable composition with a quick "set," suitable for casting small toys from moulds. As paper pulp as a base is prohibited, the composition will have to be made with something else. Will sawdust take its place?

Can you suggest a simply way of reducing sawdust as received from the saw mills to wood flour?—T. Morgan (Swansea).

SINCE you require a *quick-setting* casting material we can only suggest ordinary plaster of Paris mixed with a proportion of fibrous material such as sawdust, powdered asbestos, scrap rubber, or hair cuttings. The presence of the fibre will render the plaster less brittle than would ordinarily be the case, and, if desired, the plaster articles, when set, can be brushed over with a solution made by dissolving 3 parts glue or gelatine in 97 parts of water, and, after drying, again brushed over with a solution prepared by mixing equal parts of water and commercial formalin solution (the latter obtainable at any druggist or pharmacist shop). The absorption of the glue or gelatine tends to strengthen the set plaster, and the treatment with formalin insolubilises the gelatine or glue so that it will not wash out or become mouldy in damp situations.

The simplest way of reducing sawdust to fine "wood flour" is to have two revolving stone wheels (rotating in opposite directions) nearly in contact and to force the sawdust between them. The resultant material should then be passed through a very fine wire mesh—preferably a 200 mesh, but certainly not coarser than a 100 mesh sieve.

For small amounts of wood flour you can use two medium coarse sandpaper blocks with the sawdust between them.

Eliminating Dirt from Cleaning Solution

COULD you please advise me on the following subject :—

White spirit, with liquid soap added, is used for cleaning clothing—"dry cleaning" or "French cleaning," it is called. This spirit soon becomes dirty. Is there a method to *precipitate* this dirt, leaving the spirit clear again? I would like to eliminate the use of mechanical clarifiers. —D. Holland (Birmingham).

THERE is no means of actually precipitating the suspended dirt in the spirit cleaning solution. The only methods are by filtration or by distillation, both of which methods are in common use. Another method would be to stir a quantity of activated alumina into the solution and then to filter it. The action of the alumina (aluminium oxide) would be to "hold" the dirt powerfully so that the fine particles of dirt were prevented from going through the filter. There is, however, no special chemical means of removing the dirt particles from the liquid, so that either distillation or some type of mechanical clarification is essential.

Beryllium Alloys : Flashlight Powder

(1) Can you supply me with the following information. I have some beryllium copper alloy from which I wish to obtain the beryllium. Can you suggest a chemical process by which this can be done?

(2) Also, how can photographic flashlight powder be moulded into pellets for convenient carrying? Is there some form of adhesive that can be used for this purpose without impairing the powder's efficiency?—A. C. Large (Chichester).

(1) Beryllium alloys are American products. At the most, they usually contain merely a fractional percentage of beryllium, which it would be quite impossible for you to extract by any ordinary means. You would have to dissolve a large amount of the copper in nitric acid, evaporate the solution to dryness. Re-dissolve in water, precipitate the copper as sulphide with hydrogen sulphide, evaporate the residue to dryness, extract with hydrochloric acid, precipitate with caustic potash and re-dissolve the impure beryllium hydroxide in hydrochloric acid, finally evaporating this solution to dryness and electrolysing the beryllium chloride. The task would be a very formidable one for even the most expert chemist.

(2) Flashlight powder cannot be compressed or moulded, since if it is fired under such conditions, it becomes liable to splutter dangerously, and even to explode. If you want to make experiments in this direction you can use a little dry dextrine as a binder, but we do not think you will have any success. To be efficient, a photographic flashlight powder should be spread on its tray as far as is conveniently possible, for, under these conditions, a better light distribution is obtained.

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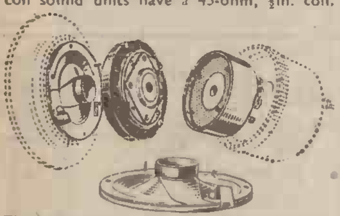

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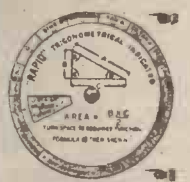

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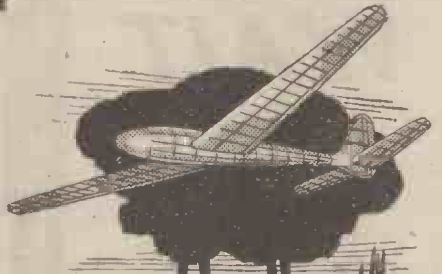

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THE Cyclist

Editor: F. J. CAMM

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Comments of the Month By F. J. C.

"Worse Than The Luftwaffe"

LAST month we reproduced *in toto* the pamphlet issued by the C.T.C. under the above title, dealing with the question of road safety, and it intended to sway cyclists to vote for any prospective Member of Parliament who would support the C.T.C. policy.

Now, any document or any scheme, no matter by whom propounded, which has as its object the elimination of road accidents and making roads safe for all, must be carefully and impartially examined, and it was for this reason that we reproduced the C.T.C. statement last month, so that our readers might have time to study the various arguments and consider them in the light of these later comments.

In the first place, we deplore the attempt by the C.T.C. to make this a party problem, for, no matter what party was returned to power, they would have to wrestle with the problem as previous Governments have attempted to do. Of course, it is right that at the time of the General Election public grievances should be brought to the notice of politicians, but it would be entirely wrong to tendentiously suggest that a section of the public should vote for a candidate who would agree to support a sectarian interest, It would be impossible to obtain true representation in Parliament if particular sections of the public are determined to impose their will on matters which are non-political.

Wide Publicity Necessary

WE repeat that it is proper to give the widest possible publicity to this grave social evil—road accidents—and to draw the attention of politicians to it. In presenting the case, however, we must be particularly careful not to provide a handle for the opponents of cycling, and in this respect we deplore the comparison made between the deaths caused by enemy bombs and those caused on the roads, for a fair comparison cannot really be drawn. It can be said, for example, that in spite of the precautionary measures taken by the Government to prevent injury and loss of life by enemy bombs, tens of thousands of people refused to adopt those methods, and many who are now dead would be alive but for their own carelessness and folly. Our opponents may use that same argument, namely, that while safety measures have been introduced, cyclists and pedestrians do not take advantage of them. They are even advised by the national bodies not to do so. Let us deal with the document which appears beneath this tendentious title. We do not agree with the first paragraph, which states that little attention is paid to the major national problem of 200,000 accidents a year on British roads. The widest publicity has been given to it, and the Ministry of Transport has spent years in endeavouring to eliminate it. Why it should be presumed that politicians can succeed where the M.O.T., with their specialist knowledge has failed is not stated. The fact is that the problem will never be solved until all sections of road user agree to make concessions. We can all find solutions which leave us free from any restrictions whilst imposing further burdens on others. Numbers of accidents are due to carelessness, and, as the law of average applies, there are four times as many careless cyclists as motorists, and many more careless pedestrians than motorists and cyclists added together. But mutual recrimination and endeavour to lay the blame on someone else is not a solution. We might here remark that we have not observed any increase in the number of accidents as a result of the fitting of rear lights, as was anticipated by the national bodies. We agree with the C.T.C. that "such needless and tragic slaughter is a disgrace to the country," but can the C.T.C. and the N.C.U. claim to have done anything useful towards a solution? Have they not confined their attention for many decades past to pouring out opprobrium and abuse upon other road users? Cyclists were loud in their clamour for the fitting of rear lights to horse-drawn vehicles and yet opposed the fitting of rear lights to bicycles. We are not here arguing for or against them, but merely drawing attention to C.T.C. inconsistency. The pamphlet goes on to say that the origin of the present evil cannot be disputed and lays the blame at the door of the motor-car, and successive governments who have failed to provide appropriate facilities for the newer types of road user. It is true that motor traffic has greatly increased during the past forty years, but then the number of cyclists has increased from about 1,000,000 to about 12,000,000 in that time. The steady growth in all forms of traffic has contributed to the problem, not the growth of one section. If the roads are fundamentally unsuitable, in spite of the great increase in the number of miles of roads during the last century, a case can be made out for segregation, and the only point at issue is whether motorists should be segregated or whether cyclists should be so separated from the main stream of traffic. It would take at least 20 years to build special motor ways, whereas cycle paths of an approved type could be made within a few years over many of our main roads where accidents are known to be heavy. We are not arguing for or against cycle paths, we are merely pointing out the fallacy of the C.T.C. argument in pressing for a road policy which would permit the present accident rate to continue, and of opposing any measures, even of a temporary nature, which would have almost immediate effect. The roads of England cannot be rebuilt in a day, and we agree that the logical answer is to make room, and the quickest means must be adopted of making that room. A high proportion of motor traffic consists of commercial and public service vehicles. The roads of England cannot be given up to cyclists and pedestrians for purposes of pleasure as the C.T.C. imply. We agree that in certain instances special roads for motor-cars are desirable, and motorists have contributed through the Road Fund some tens of millions of pounds for those roads to be made. A dual road system is a possibility, but with the National Debt standing at the extremely high figure it is, we cannot believe that any government during the next 10 years will be able to divert any of the national revenue to this purpose, so half-way measures which are stop-gaps must be resorted to.

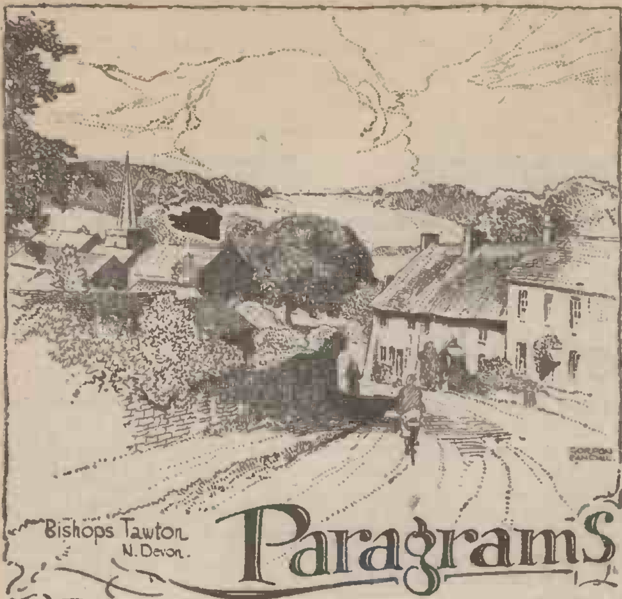
Special Highways

WE also agree that special highways, when they are constructed, should not be intersected at frequent intervals by other roads. The cycle path along the Great West Road is a good example of how not to do it, and cyclists are perfectly justified in refusing to use such paths which increase the risk of accidents. That is an objection to method and not to principle. That good roadmanship should be taught and enforced is a sensible argument, although it is open to debate whether a thing which must be enforced is a solution. Good roadmanship should be a natural thing, like good manners, and that cannot be enforced. It is either there or it is not. Human nature being what it is we do not think that it is possible to change the character of the human race. Altruism is only the pipe-dream of unpractical people.

We concur in the statement that existing laws are quite adequate for the enforcement of decent behaviour on the roads and that they are not always applied, or applied with sufficient severity. Unfortunately, it is not possible from short reports which are necessarily abbreviated to form an accurate judgment of the merits of a case, nor what were the mitigating circumstances which caused magistrates to give a judgment and inflict a penalty which seems too light. Some cases occupy the court for at least an hour, whereas the reports in the newspapers confine themselves to the charge, the penalty, and the main facts of the evidence. We suspect that the C.T.C. (judging from the fact that a feature in their journal was entitled "Scissors and Paste") form their opinions largely from press cuttings, for they boast of the success they have in the courts when *they* defend cyclists. It is part of their propaganda to refer to this when inviting membership.

C.T.C. Change of Policy?

We agree that the training of road users should commence in the schools and that it should be supported by all of the road users' organisations and we find it refreshing to hear the C.T.C. state that it should not, as at present, consist in the lecturing and condemnation of one class of road user by another. This is such a startling change in C.T.C. policy, which hitherto has done little but criticise motorists, magistrates and coroners, that we are entitled to presume that the C.T.C. is having second, if belated, thoughts on the matter. Whilst, therefore, there is a great deal in this pamphlet which we support, we are constrained to say that it could have been a little more carefully edited to remove the impression it gives that it is directed against motorists.



Women's Champion

EILEEN SHERIDAN, Coventry C.C., won the second Women's R.T.T.C. Championship at 25 miles by clocking 1 hr. 8 mins. 38 secs. She beat the holder, Susie Rimmington, by nearly one minute.

Competition Record Beaten

THE Scots Champion of 1944, David Scott, Crawick Wheelers, broke the Scottish competition record for 50 miles when he clocked 2 hrs. 4 mins. 6 secs., to win the West of Scotland Clarion "50."

A Fast "100"

A NUMBER of fast 100's have been riden this year: among them that by J. Allison, Musselburgh Road Club, whose 4 hrs. 26 mins. 8 secs. in the Douglas "100" was the fastest so far then recorded this year. He was 18 minutes faster than the next best.

Cyclist B.E.M.

A MEMBER of the Glamorgan Road Club, Sergeant J. C. Evans, Royal Air Force, has been awarded the British Empire Medal.

An Indian "50"

INTEREST is attached to the report of a 50-mile ride accomplished in Ceylon, where G. J. Waller covered the distance in 2 hrs. 26 mins. 33 secs. It is reported that his machine was made up from a twisted sports frame: water-piping handlebars and 28in. by 1⅜in. wheels and tyres.

L.M.A. Revived

THE Lightweight Manufacturers' Association has met for the first time since 1939 and has decided to renew full peace-time activities. The hon. secretary is P Ellis, and E. Stephens has been elected chairman

Mentioned in Dispatches

"BERT" HOUGHTON, Twickenham C.C., and well-known West London official, who is at present with the R.A.F. in Malta, has been mentioned in dispatches for his meritorious work in the island.

New Tandem Record

NEW figures for the R.T.T.C. 50-mile tandem record were set up by R. J. Maitland and R. W. Bowes, Solihill C.C., when they clocked 1 hr. 47 mins. 15 secs., to win the Archer Road Club tandem "50."

Club Re-formed

THE Dundee Road Club has been re-formed. Commencing its period of useful activity as the Clepington Athletic Club in 1908 it fell into abeyance during the war. A progressive policy for the immediate future is planned.

In Memoriam

THE Priory Wheelers have opened a fund to perpetuate the memory of the late Val Viel, hard-riding vice-president and road rider and record holder of repute.

Accidentally Drowned

AFTER serving for nearly five years in the Forces, J. Atkinson, Glasgow Ivy C.C., was accidentally drowned while bathing in the Mediterranean. He came safely through Dunkirk, and was accepted as a long-distance rider and hard-riding clubman of distinction.

New 100-mile Champion

H. L. SMITH, Yorkshire Road Club, is the National 100-mile champion: an honour by virtue of his ride of 4 hrs. 30 mins. 30 secs. in the Calleva 100-mile event.

Veteran's Brilliant Ride

J. B. AUSTIN, Oxford City Road Club, won the Marsh Road Club's Veterans' "25" with the outstanding time of 1 hr. 3 mins. 58 secs. He is over 40 years of age.

New 12-hour Record

SUBJECT to formal acceptance, the National 12-hour competition record has been raised by A. Overton, Kingston Road Club, to 251 miles 1,560 yards. The ride was done in the South Western Road Club's event: the previous best was 251 and ⅝ miles by C. Heppleston.

Another Forces Club

AMONG the latest Forces Clubs is the R.A.F. Dunmow C.C., which has become fully affiliated.

Tom Groom Dies

THE last surviving founder member of the National Clarion C.C., Tom Groom, has died. He was 74 and retained his interest in the Club to the end.

Twenty-four Hours Awheel

DESPITE one of the worst storms during the night for many years, Southgate Cycling Club's 24th annual 24-hour ride was held to schedule and all entrants stayed the gruelling course of 214 miles.

Dunlop Deputy Chairman

SIR CLIVE L. BAILLIEU, K.B.E., C.M.G., has been appointed Deputy Chairman of the Dunlop Rubber Company, Ltd.

Won by Wong

WONG LING KOWK won the 25-mile event held in the Merseyside area. His time was 1 hr. 14 mins. 6 secs., and he was the only rider inside an average of 20 miles an hour. There were 20 names on the start sheet—which was printed in Chinese.

For the Forces

"DUSTY" MILLER and John Burbidge, Southern Paragon, have been called to the Forces: their clubmate Edward Nippard anticipates an early call.

Home Again

WILFRED BILLINGS, former Time Trials Secretary of the King's Lynn C.C., who has been a prisoner of war, lost no time in getting awheel again and returning to his old hobby of assisting on club record attempts.

New Champion

HAROLD MAXFIELD, brother of the late W. W. Maxfield (who lost his life while on air operations over the Atlantic) won Lincolnshire's first N.C.U. Championship since 1939.

Dunlop Secretary Knighted

CHARLES TENNYSON, C.M.G., secretary of the Dunlop Rubber Co., Ltd., has been knighted in recognition of his work as chairman of the Central Institute of Art and Design and the National Register of Industrial Art Designers, in bringing designers into touch with industry for the improvement of standards at home and exports abroad.

Gift of Trophy

THE brother of N. Holmes, a former Hon. Treasurer of the Bramley Wheelers who was killed in action, has presented the club with a memorial trophy for competition.

Celebrations in Haifa

THE first annual dinner of the Appian C.C. was held in Haifa with representatives of the Haifa Wheelers, Crusaders C.C. and Appian Wheelers present and Major N. J. Stevenson as the guest of honour.

King's Lynn News

FROM Austria, C. Wright, King's Lynn C.C., states that the cycles there are poor when compared with those he saw in Italy: T. Carman of that club is still in Italy, and has met clubmate H. Vanderloo. A. Leggett has crossed the Dolomites from Italy to Austria.

Fast Times in Hants

A FEAT never before achieved was experienced in the Southern Paragon "50," when the first two finishers beat 2 hrs. 10 mins. for the distance. The winner was R. Barfoot, who clocked 2 hrs. 8 mins. 23 secs., he being followed by S. Boulter, with 2 hrs. 9 mins. 48 secs.

Among His "Ain Folk"

AFTER four and a half years in prisoner of war camps in Italy and Germany, J. Gourlay, Hamilton C.C., is back home in Lanarkshire.

Track Possibility

THERE is the possibility of the immediate construction of a first-class banked asphalt track in South Yorkshire. An official of the Rossington Colliery A.C. has stated that inquiries were in hand as to the best possible surface—hard cinder or asphalt.

Record Attempt Fails

G. GARSIDE, King's Lynn C.C., failed on his attempt to lower the King's Lynn—Norwich and back tricycle record, which stands at 5 hrs. 30 mins.

J. Curwen Clague

SERGT. J. CURWEN CLAGUE, referred to in our last issue as having been released from prisoner-of-war camp, has now been "demobbed" and is back on his old job on the reporting staff of the "Isle of Man Examiner," Douglas. No doubt Clague is already considering the possibility of a massed-start cycle race being held next year, for which the Government will grant financial and legislative support.

GLOUCESTER CATHEDRAL
A glimpse of the lovely cathedral from the River Severn.

Around the Wheelworld

By ICARUS

The Cycling Marathon

THE undoubted success of the five-day cycle race from Brighton to Glasgow is a complete answer to those misguided individuals who have opposed mass-start racing and organised racing on the open roads and who wish to continue the hole-and-corner methods which were necessary when the police took notice of cyclists. The sport, the pastime, and the industry have had greater publicity out of this race than anything that has happened in the field of cycling since the days of the Cuca Cup and similar races on the track. The race has been extraordinarily well supported by the press, and one newspaper whimsically stated in its report that the N.C.U. was opposed to it! The *Evening News* for Thursday, August 9th, said, " . . . . the race, which has probably done more good for British cycling than any other organised road event." Cheering crowds lined the roads of every town through which the 60 competitors passed. Flags were waved in welcome, and the mayors of towns cheered them on their way. When they reached Olympia the competitors paraded through London and delivered a message to the King at Buckingham Palace, from the Lord Mayor of London. The race was won by a Frenchman. There have been no accidents or incidents throughout the race, and I am wondering how the apostles of the past in the N.C.U. and C.T.C. and the R.T.T.C. are going to save their faces. A journalist, who takes some interest in cycling, said at a dinner some time ago, that cyclists wanted hole-and-corner sport. I do not believe it for one moment and certainly my inquiries do not support it. The undoubted success of this road-race has caused many of the opponents to change their views. I wonder what the N.C.U. will do about it now? There is little they can do, for all possibilities of "healing the split" have vanished. They can, of course, write to the Home Office, but I can inform them that the Home Office and the M.O.T. are kept well informed on these matters. I hope that there will be more of these races, and I offer my congratulations to the Ealing C.C. and all those who had a hand in the successful organisation of this race. The British League of Racing Cyclists have done a first class job of work.

Meeting of Champions

ALL clubs, private members and associates of the N.C.U. are asked to bring as large a party as possible to the Meeting of Champions at Herne Hill Track on Saturday, September 8th, at 3 p.m. Details of the programme have not been completed, but will include some great international events between champions. Invitations have been accepted by Switzerland, Belgium and France, each of whom are sending their reigning amateur champion for the occasion for matches against our own men. A further most attractive event will be a pursuit match between a team of star riders of the Buckshee Wheelers, against a selected N.C.U. team and there will be a very strong supporting programme which should be a memorable climax to the season. Tickets will be available before the day, and where grand stand, enclosure and side stands are concerned, early booking is advisable. Prices are: Admission, 1s. 9d.; Grand Stand, 4s. 6d.; Side Stands, 3s. 9d.

No Show this Year

THE management committee of the Manufacturers Union have very carefully considered suggestions made for an early Cycle Show, and wish to make it clear they do not consider it is possible to organise such an event this year. Mr. George Wilson, President of the Union, has informed us that it is problematical whether a full-scale Cycle and Motor Cycle Show can be arranged for the autumn of 1946.

N.C.U. Headquarters Form Cycling Club

ON Wednesday, July 18th, a meeting was held at the N.C.U. Headquarters, 35, Doughty Street, London, W.C.1, at which a cycling club was formed. This club is to be known as the National Cyclists' Union Headquarters Wheelers C.C., and membership is open to Headquarters Staff (past, present and future) and Headquarters and Centre Hon. Officials. The annual subscription is 5s., including affiliation to the N.C.U.

At the inaugural meeting the following officials were unanimously elected: President, Mr. "Dick" Taylor (chairman of N.C.U. Emergency Committee); chairman, A. P. Chamberlain (secretary of the National Cyclists' Union); general hon. secretary, I. R. Frood-Barclay; hon. treasurer, Miss I. E. Russell; hon. minutes secretary, Miss D. A. Stevens.

Bidlake Memorial Plaque

ON Saturday, July 21st, there occurred at Pear Tree Farm of Billingshurst, in Sussex, the home of Frank Patterson, a real cyclists' ceremony. The occasion was the presentation of the Bidlake Memorial Plaque to the artist as a recognition of his great work on behalf of the sport and pastime. Some 50 riders were present when G. H. Stowers, chairman of the Memorial Committee, made the presentation, and after "Pat's" kindly response, the whole company sat down to tea in the hayfield as the guests of Mr. and Mrs. Patterson.

Amalgamation

ONCE again the question of the amalgamation of the C.T.C. and the N.C.U. is being raised—this time by the N.C.U. It will be remembered that this condominium was discussed before the present war, when we, ahead of all our competitors, gave the facts. A similar recklessness was exhibited on that occasion when other journals, surprised by the promptness with which we gave the news, claimed to have been in the know all the time, but had refrained from giving the information "because they were tied to secrecy."

Readers will remember that we issued a challenge to the C.T.C. Council—we were prepared to attend any C.T.C. Council meeting and explain how we got hold of the information, and our methods of keeping ourselves abreast of our competitors, if the editors of other journals would attend that meeting and explain who it was that had informed them of the suggested amalgamation and tied them to secrecy; we also require to be told why it was that we were not equally informed. *That challenge was not accepted.* The reason is obvious—the other journals had not been told.

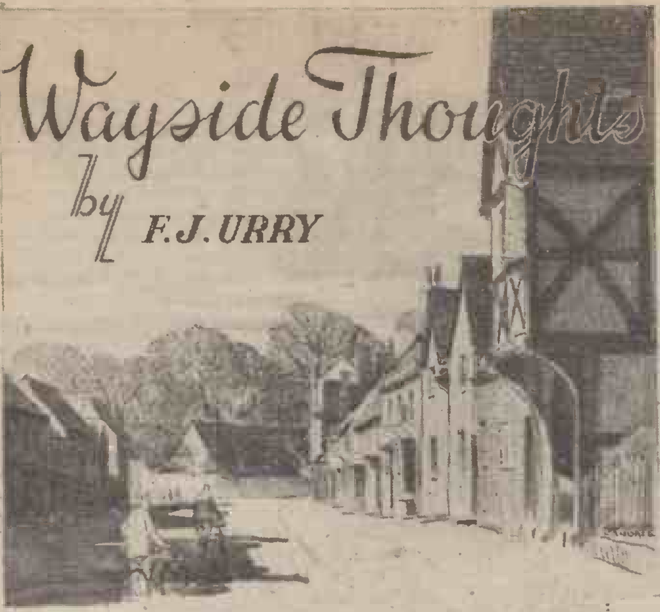
The argument in favour of amalgamation is that two bodies can speak with a stronger voice than one. That is a fallacy. If there are 30,000 members of the C.T.C. and 50,000 members of the N.C.U. an amalgamation would not produce a membership of 80,000, for many are members of both. It is doubtful whether the two bodies combined could produce a membership of more than 40,000. It is obvious, therefore, that strength in this case is not in unity, although the Minister of Transport has been made aware of the fact that the two bodies have not an independent membership, and for all practical purposes speak with one voice as it is.

It is apparent that an amalgamation would produce less in membership fees than at present under two independent managements. But, in any case, the time has long passed when these two bodies either separately or combined can speak with any authority for 12,000,000 cyclists; nor is it right that this tiny minority—say 50,000 out of 12,000,000—should be permitted to impose its will on the majority, especially when those two bodies have not taken a referendum of their own members.

Cyclists partaking in the five-day cycle race leaving the Mansion House for Barnet, where they started the second lap to Wolverhampton.

Wayside Thoughts

by F. J. URRY



Give Us the Goods

NOW that the shouting is over and we must, willy-nilly, settle down to wear rear lamps when we go out in the dark, may we ask in all humility for decent rear lamps, lights that will function, containers that will not shake to pieces over rough roads, rattle and rust? We have had more than enough of this type, and the war has been the excuse for poor quality; though, to be candid, I do not seem to remember that battery headlights or rear lights were beyond the suspicion of junkiness in 1939, even though my knowledge of the latter was extremely small. Now that there is going to be a ready market for well-made lamps, I wonder if our makers will appreciate that every rider of a bicycle does not want to buy in the cheapest market, but is prepared to pay the fair price demanded for reliability and longevity. No doubt the dynamo will go ahead, and I see that some unknowledgeable people are wondering why a bicycle is not fully equipped with a lighting set when offered for sale, like a car. The answer is we don't all need to ride after dark, and many of us who do, prefer the battery lamps because they are lighter in weight and can so easily be removed when not required, which is generally more than half the year. Why carry about extra weight for no purpose? That surely is handicapping mobility. But we do want, very badly, good dynamo head and tail lamps designed for quick detachment, rattle-proof, rain-proof, and fitted with positive and steady contacts. And we want better batteries, for some of the wretched wartime things have been elevenpen'orth of delusion and creators of tempestuous words.

No Fear for Cycling

I WAS talking to one of the big cycle manufacturers a week or so ago and was rather surprised to find him a little dubious as regards the prospects of cycling (and, of course, the trade) when this war is over. It struck me as curious that so well-informed a man should imagine we are all going to become motorists whether we can afford it or not, and that we all want to become motorists, with the result that the few of us who still ride bicycles because we like to will be driven off the roads. I know that road traffic will increase considerably when petrol is released; I know many main roads will become intolerable at week-ends, and will be a mere parade of olfactory machinery; but I also know cycling too will increase, and that the cyclist will have the happier leisure time because he is more road knowledgeable. We can't all be motorists, and many of us do not want to, for motoring is only speed perambulation at best, and cycling is muscular activity—that throb of the blood which is life fully lived—sight, scent, sound and observation, simple natural values, the major portion of which are lost to the motorist when he takes his values from the ever unsatisfied zest for speed. In this age of speeding-up, the fever has made men forget many fine things and forgo much beauty; but because it doesn't add a minute to existence, and costs a lot of money and trouble, I can't for the life of me see its virtue outside the one point—speed—which may be exciting for a time in its restlessness, but has no sense of complete and lasting happiness. No, cycling is the best of all forms of mechanical travel; it is cheap, simple, silent and healthy, gives exercise to every sense and every muscle, makes a man manly and keeps him fit. The bicycle is one of the greatest inventions of the world, and has probably made and kept more men happy and healthy than any other single thing. It will never die, but grow great in its service to pleasure and utility as folk grow wise to the recognition of its enormous values. That is the story that needs putting over, for health and happiness are the jewels of life, while speed and the money to buy it is an ostentation, and often enough a very rude and sometimes dangerous one.

The Way of the Seasons

APART from the week-ends, when I am always out to sample the air of freedom, once or twice a week I take a frugal tea in the office and go the long way home, just over 20 miles, 16 of them the open country where fields slope in velvet verdure to the little rivers, and often the ridges are crowned with the tender greens of late spring. I notice other men of my years are developing the same habit, and it is interesting to talk to them and sometimes discover how delightful they have found this leisure hour to be when one can stroll, as it were, well beyond the doorstep in quietude and with ease and see the sunset light the stars. Twice recently I have met a man of my years or more, and on the second occasion we not only exchanged a greeting, but sat on a tree trunk and talked. When he found the nomenclature I wore the conversation naturally turned to cycling, and he asked my opinion of the best touring districts, since he had visions of a long summer holiday, and having found the plentitude of cycling in his short excursions could not conceive a happier way of spending it. Naturally I agreed, but I warned him that in my opinion a lonely holiday had its limitations, and those impressions were most pronounced during meal times, and in the evenings when the day's journey was over, unless you were a very good mixer. Still he seemed satisfied to be lonely, and I suppose there are people who are so self-contained; though I confess I become rather tired of my own company after a few days of idle wandering. While we sat there and smoked some half-dozen lads went by at infrequent intervals, quite evidently on training bent, and my friend asked why they were in such a hurry. When I explained to him the sport of road racing he seemed amazed that such things were happening every week-end, and was enlightened to know that when he met these urgent boys on his Sunday morning trips they were hurrying for a purpose. Strange is it not, that so many people, are utterly ignorant of the sporting interests of their very neighbours, and can grow grey and philosophic yet still collect knowledge of youth.

Clock Tinkering

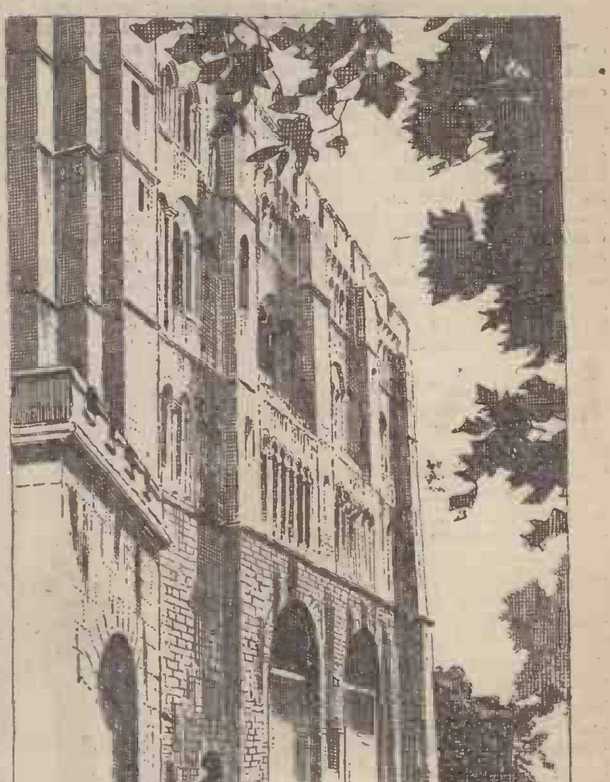
I SUPPOSE most cyclists applaud Summer Time when the extra hour of daylight gives them an added measure of happy wandering; but I'm not sure we all agree that the double dose of this clock measurement of time is good for us, however excellent it may have been in assisting the war effort when its urgency was imperative. Speak to farmers on this subject of Double Summer Time, and be ready for an explosion, for most of them dislike the single dose, but having swallowed that packet with more or less grace, they shudder at that additional hour, and the agitation is violent. Personally, I don't mind either way—you can get used to anything providing it does not interfere with meals; but if you ask me for a preference it would be named in a return to the application of Summer Time as it was before the war. In the long days we could do well enough without the extra hour lately imposed, and during the short days a return of sun time would save me some weeks of morning illuminations, and even though I may have to go home in the candle-light, it seems a more natural process. I like Daylight Saving, yet think we can have too much of a good thing at periods when there is so very little daylight to save. I find that this Double Summer Time makes me hungry if I stop to see the sunset to bed, and that is tough on the rations, and is inclined to make a man domestically unpopular.

Food

I NOTICED that my friend, Mr. H. W. Elty, had a paragraph on food for the rider in a recent issue, and, like me, has discovered that dieting just leaves him cold. Actually, I have never been a vegetarian or possessed the slightest inclination to test the type of fare that eschews meat and finds apparently untold pleasure in the merry vegetable. Years ago I knew the late Harry Light—as famous a veg. as ever kicked a pedal—fairly intimately, and he told me on one confidential occasion, that his conversion to the creed was due entirely to health reasons, and so having discovered surcease of pain by the process he automatically became a crusader on behalf of the cult. Now I can understand that position and applaud it. In other words, the man found out the things that suited his digestive organs and proceeded to tell the world. I have another friend who is a fine cyclist and a man of some learning. He suffered many pangs because, like me, he was fond of his food, and looked upon eating as a pleasure in life. But having the misfortune to own a stomach that revolted at meat, he wisely turned to vegetarian and thereby now enjoys life more vigorously than would otherwise have been the case. He, however, does not wear the mantle of the disciple, and if you are with him one has to notice his vegetarianism. Yet he told me only recently that when he sees a healthy, hardy crowd of riders discussing that now somewhat rare meal containing a meat dish, he has the greatest temptation to warn them of the possible consequences to them, and the certain ones to him. I greatly admire his reticence on a subject which so easily lends itself to crusading: for it is the things that touch us personally that leads so many of us adown the narrow paths of sectarianism, often to the boredom of our friends.

Signalling Not Enough

CYCLISTS will do well to get out of their heads any notion which may be there to the effect that signalling is "the whole duty of man." It is all very well to indicate, by holding out an arm, that you propose to change your course, but that action does not confer on you the right to carry out your declared intention. Surely it is elementary that you must first make sure it is safe to do what you propose. Listen to this: I was riding the other day, through suburban roads, with a man of long experience. On reaching the point where he was due to turn to the right, he said "Cheerio," held out his arm, and commenced to move away from me. I instinctively looked round—though my course lay straight ahead—and was horrified to find a hurrying motor-car almost on top of him. I gave a frantic yell, and my friend, suddenly realising his danger, returned to his old course, to the accompaniment of squealing of motor-car brakes. No! my friends. Signalling is not enough. You must make sure that you can safely alter course before doing so. It may be too late afterwards.



Looking up at the great tower of NORWICH CASTLE. Built between 1120 and 1130 AD From the 13century until 1880 it was used as a prison.

CYCLORAMA

By H. W. ELEY

The old FISH INN BROADWAY, Worcestershire. A unique little stone building standing on the top of Broadway Hill.

Safety First

THERE is still much need for propaganda on the safety first scheme, and it is good to know that the Royal Society for the Prevention of Accidents has a vigorous campaign planned. I gather that this will take the form of a national "drive" to reduce the number of road accidents, and that the campaign will be "localised" with the aid of committees and organisations in the various towns and villages. "Safety First" weeks are not new; many towns have held them fairly regularly . . . but I think that they could be made more interesting. In Preston, a safety first week included a competition for the most roadworthy bicycle. What is needed is more enthusiasm for the whole question of reducing accidents; whenever I talk about the matter, I am surprised and grieved at the apathy shown. Every road user should feel that the matter has something to do with him or her personally, and that there is an obligation on all of us to try to improve the situation.

"Coming off the Assembly Line"

THAT is a phrase which we now see with increasing frequency in the advertisements of cycle and component manufacturers . . . and how welcome it is! It means that Britain is getting back again into her normal industrial stride. . . . and that the needs of the civilian are now being considered. It means that the red hand of war no longer grips us quite so fiercely or completely. Soon, I trust, the whole cycle and allied industry will be off "war-work" and catering, in the good old way, for cyclists all over the world. Soon, I hope, those patient retailers will have good supplies of machines and parts, and the cyclist will be able to enter a shop, be greeted with a smile, and come away with whatever he needed. Great days are coming!

Export . . . Our "Life Line"

THE British cycle industry is very much alive to the vital need of increasing export trade. It does not need a politician to tell that vigorous industry that export business is vital. I have just been reading some interesting figures about the export side of the industry, and some of them are not calculated to make one feel too happy. . . . although there is no need for pessimism. For instance, as compared with the year 1937, when the Indian market took some 194,000 machines, the figure fell the following year to 122,000. Again, South Africa took 153,000 machines in 1937, but only 103,000 in 1938. Now, there are probably good and logical reasons for these decreases . . . BUT! It is obvious that the industry in dealing with overseas business needs to undertake a lot of research. It needs to know more about the potential in various territories. And it will need expert and vigorous sales policies in the immediate years to come if the old flag of British Export trade is to be kept flying.

Heat Wave

AS I write these notes, South England is sweltering 'neath a genuine heat wave. My dog, usually so full of vigour, lies listless on the parched lawn. Somewhere near by, in an oak tree, a wood pigeon coos, and along the border of the lawn a bee flits from flower to flower, and his droning fits in with the lazy afternoon. Under a fine elm I have set my table and typewriter . . . and I am determined that no heat wave shall spoil my good record for promptitude in sending in these random jottings to an indulgent editor. But I do not care for heat waves; for me, the cooler days . . . when the wind tastes clean and zestful; for me, those days when the air has a "tang" in it. This sultry heat is enervating, and I look anxiously at the barometer and the unflecked blue sky. But the heat does not deter the keen cyclist . . . and all morning, happy groups of riders have been passing through the streets . . . on their way to quiet woods, and green glades, and little villages where there are still signs to be seen—"Teas Provided."

Touring in the Poets' County

I REFER to that delightful county of Buckinghamshire, where the noble beeches grow so abundantly. For, verily it is a county of literary associations, for we may journey therein in the good company of Milton, and Cowper, and Thomas Gray. We may muse afresh on the immortal "Elegy" when we visit Stoke Poges, and if we are in historical mood, then we must remember that in this leafy county we can walk with the noble spirits of John Hampden and William Penn. Hampden's home was a few miles from Great Missenden, whilst Penn, of course, lived at Hordans. Buckinghamshire is a small county, being but 749 square miles in extent, but none can deny its loveliness, and I am glad to think that in a few weeks' time I shall be riding through its leafy lanes, and viewing again its old towns—like ancient Aylesbury, where there is that famous inn "The Old King's Head"—and when within that house, we are keeping touch with antiquity indeed! Its fine fifteenth-century window, with its oak mullions and rich stained glass, is something worth travelling far to see. And whilst in beechy Bucks I shall try to visit Little Missenden and Ballinger, for those places typify the county at its lovely best.

He is Still With Us

YES, the bicycle thief is with us yet, and owing to the carelessness of cyclists he still "gets away" with plenty of good machines. I wonder why it is so difficult to persuade riders to take common-sense precautions in this matter? A few weeks ago I was sitting by a bathing and boating pool near to a Midland town, and I watched numerous cyclists arrive, "park" their machines in the most unsuitable places, and leave them unattended. And I saw something else—a "sneak-thief" on the prowl. Had I not been there, and emerged from behind a tree just as he was contemplating stealing a machine, another cyclist would have bemoaned his "bad luck." After all, whilst perhaps there are few completely safe locks, there *are* devices which make it infinitely more difficult for the thief to "pinch" a mount.

Slogans

IN the course of my work in the advertising world, I am sometimes asked to act as judge in "Slogan competitions"—and I always find the task full of interest. Slogans have played a big part in sales promotional work, and have formed the very backbone of many excellent and successful campaigns. We are all familiar with such "winners" as "Born 1820—Still going strong," which has done such yeoman service to "Johnny Walker." And we all know "It beats—as it sweeps—as it cleans," which is the happy "Hoover" phrase. Turning to the manufacturers of cycles, I wonder which slogan would be awarded the palm? I fancy that possibly the most *famous* is "Made like a Gun"—with which the name of Royal Enfield will ever be associated. "The All-Steel Bicycle" is world-known too, and I think that in more recent times folks have grown very familiar with "The Better Bike," which is the happy phrase used in all the "Armstrong" advertising. But I somehow feel that the cycle and allied industries have not yet made the fullest use of the slogan as a sales builder. Maybe the active post-war years, with their bigger advertising campaigns, will produce some "big hits."

Tyre Inflation

I AM very glad to see that the tyre manufacturers are continuing to stress, in their advertising, the vital importance of pumping up cycle tyres *hard*, and of keeping them hard. It is the golden rule if one would avoid tyre troubles; and in these days, when there are few repairers with time to deal with puncture mending, it behoves all of us to keep clear of the puncture fiend!

Notes of a Highwayman

By LEONARD ELLIS

Britain's Touring Grounds (10)

IN one minor respect the Derbyshire Dales are like the Cotswolds. In both cases there is a relatively small area, more or less easily defined, containing an unusual amount of superlative scenery of one particular type. Here, however, the similarity ends. Whereas in the Cotswolds most of the countryside is enchanting, or at least attractive, the high spots are the villages. In the Derbyshire Dales the countryside can be quite depressing. I often think that if one could view Derbyshire from a distance one would label it drab. Just a mass of rolling hills intersected by miles of dry-stone walling. But wherever that top skin has cracked and gullies have formed we find some of the scenic gems of the North Midlands. The Dales, although similar in a general sense, are all different, and there is not a single one that can be skipped because we have seen one just like it. Just one or two, like Darley Dale, are unlike the majority, and are more akin to the wider dales of Yorkshire. Most, however, are of the tight landlocked variety; just two cliffs enclosing a turbulent little stream. Although generally called the Derbyshire Dales, Staffordshire people are very jealous of the fact that one bank of the best-known dale, Dovedale, lies in their county. Dovedale is a sheer joy from end to end and can be visited in summer or winter. It is probably true to say that the Dove is England's loveliest river, at any rate from its source on Axe Edge until it emerges into peaceful pastoral country beyond Thorp Cloud. It can be approached either by a footpath from the rear of the Peveril Hotel, or by way of a steep little road and then by a drive skirting the Isaac Walton Hotel.

A Rock-bordered Stream

EITHER brings us to the entrance, guarded by Thorp Cloud, but in the first case we find ourselves in Derbyshire, and in the second we shall be on the Staffordshire side and must cross by the stepping stones in order to follow the usual path through the Dale. Whilst here, by all means travel another mile up the lane to see the charming village of Ilam. A track wanders along the river Dove for three miles and the scene changes and the character of the river varies with every few yards. As we approached Thorp Cloud the stream ran placidly between green meadows, as peaceful as the Avon, but once inside the dale it changes to a rushing torrent between two opposing cliffs. Then the gorge widens, the stream quietens, every few hundred yards pouring ceaselessly over miniature weirs. All the way along the path one will notice outcropping masses of limestone jutting above the trees. These, in the passing of centuries, have become weathered into fantastic shapes, and as a consequence names have been bestowed and those names still cling. We can see the Watch Box, Tissington Spires, Lion Rock, Twelve Apostles, Lover's Leap and many others. Reynard's Cave can be seen high up the cliff and visited by means of a rope hand rail. At Lode Mill the river passes under the road bridge and beyond, although still the Dove, the Dale is called Beresford.

Derbyshire Delights

MONSAL Dale is sometimes called the Arcadia of the Peak, and although the railway has been driven through it, the wonderful vistas from Monsal Head still remain. It should be noted that although many names will be found, it is possible that the same river runs through several of them. It happens that the Wye and its tributary, the Derwent, flow through the Ashwood, Chee, Millers, Monsal, Darley and Matlock Dales. They are all different and all are worth seeing. Darley is of the open strath type, Monsal and Matlock Dales are wide, and others are very narrow and enclosed. For many years Lathkil Dale, near Over Haddon, was almost unknown, and although to-day it is more popular, it is none the less very beautiful. The Via Gellia is a good road running from Cromford, near Matlock, and although not usually classed as a dale is particularly pleasing. It is sometimes difficult to know where the Dale country properly ends, but while in the district the opportunity should not be missed of seeing the Manifold Valley and Thor's Cave. The Churnet Valley is also delightful although marred by one or two very grubby spots. At Alton, where the old castle stands perched on the cliff overhanging the river, there is some fine scenery, and no doubt the tourist will not leave without seeing Chatsworth House and Haddon Hall.

Winster, in the heart of the Dales.

My Point of View: By "Wayfarer"

Food for Thought

LT.-COLONEL H. E. MILBURN, of the Institute of Automobile Engineers, said recently that he had spent seven years dealing with road accident claims, his conclusion being that "70 per cent. of the accidents need not have happened." Personally, I would place the percentage much higher; but, in any case, here is food for thought.

Hills Preferred

WHEN enjoying a brief holiday in the Cotswolds a week or two ago I had a conversation with a motorist who said that, if he were a cyclist, he would not choose that district for his operations. "Because of the hills," he added in response to my instant inquiry. But, as I told him, hills are a great attraction, whether in the Cotswolds or elsewhere; and I repeated to him what I have often said previously, namely, that if I were tied down for life to one particular locality and not allowed out of it I would choose a hilly one—North Wales, for example, rather than Cambridgeshire. It is as well to remember that hills don't all go up all the time—despite one's occasional impression to the contrary! The delirium of a fast downhill run is over all too quickly, but is jolly while it lasts, and it constitutes some recompense for the uphill graft which precedes or follows such swift movement. Where there are hills there is scenery, I told my acquaintance, and, so far as I was concerned, hilly country had my vote as a cycle tourist.

Desirable Lightness

ONE of the newspapers recently told the story of an African boy who, when cycling to his work at some place in Northern Rhodesia, found that he was being followed by a lion. Despite the extra speed achieved (not at all unnatural in the circumstances!) the king of beasts gained on the cyclist, who then took off his heavy boots and threw them, one at a time, at the lion. The animal was momentarily interested, but, the footwear not being edible, the chase was resumed, and the boy felt that the emergency required a further sacrifice. Dismounting, he hurled his bicycle at the lion, and then took refuge in a motor-car. There the story ends. The moral would appear to be an argument in favour of light bicycles, which can readily be flung about the countryside, at lions and things.

Mighty Edifice

IF ever it could be said of a man that "he builded better than he knew," surely John Boyd Dunlop was the man to whom the remark applies with full force. The pneumatic tyre revolutionised cycling, and no invention, before or since, in connection with our pastime can "hold a candle" to the air-borne wheels which Dunlop gave to us. Yes! he surely "builded better than he knew." Cyclists were the first to benefit by his great gift, but there are others who, in duty bound, must join their voices with ours in a mighty "Thank you!" Motorists, airmen, mothers (for the pneumatic-tyred pram eases *their* load), draught-horses, and even the humble pusher of a hand-cart or a wheelbarrow—all these are among the many who benefit by Dunlop's great invention. The bearded Scots veterinary surgeon made cycling what it is to-day. He erected a mighty edifice.

[*In the interests of historical accuracy it should be pointed out that the invention of the pneumatic tyre was covered by Thompson's patent dated many years before Dunlop.*—ED.]

The Word "Machine"

FOR some reason or other I was ruminating on the use of the word "machine," which most of us—probably all of us, without exception—employ from time to time as an alternative to "bicycle." I imagine that the word "machine" dates back to the days of the old ordinary bicycle, and probably it derives from the practice of the gentry who called their dog-carts "machines." Be that as it may, the word strikes me as being a curious one to apply to a bicycle, having regard to the normal meaning of "machine," which, strange to say, is "an apparatus for applying mechanical power"—just as an archdeacon is a clergyman who performs archidiaconal functions! Highly lucid! Nothing can be done about it, particularly as my dictionary defines "machine" as, amongst other things, a bicycle or tricycle. No doubt we shall all continue to apply the word "machine" to our bicycles—as an alternative to bike, grid, bus, mount, steed, iron, barrer, etc. I can hardly suppose that the freak pronunciation "bi-sigh-cl," which one used to hear occasionally, survives to-day. I hope not, anyhow!

Lip-service

THE next few weeks or months should reveal to us the depth of the enthusiasm for cycling as professed by those motorists who came into our ranks owing to the conditions set up by the war, and for whom motoring is again available. I believe it will be found that a sturdy selection of those temporary cyclists intend to remain with us, appreciating that the pastime provides them with something which motoring cannot give. For the rest, I fancy there will be quite a number of cycles for sale now and in the immediate future, despite the large volume of lip-service which has been accorded to the pastime of pastimes.

It must be admitted, sadly, that cycling is not everybody's "cup of tea," and it most certainly is not going to be "the only wear" for people who have been accustomed to roll about the countryside in effortless ease. I am not out to crab motoring (even if I could), but it is commonplace that the motor-car does not, and cannot, give what cycling provides. Motoring is not a substitute for cycling. It helps to assuage travel fever: it gets you to distant places quickly and comfortably. The bicycle does things which are foreign to the motor-car. The difficulties which are inherent in our glorious pastime are part of "the fun of the fair," and the sense of achievement which belongs to the cyclist after he has done his 50 or 100 miles—after he has fought against and triumphed over trying conditions—is not otherwise obtainable.

The Tank Type

THE heavy and ill-balanced single bicycle which I came across recently, and mentioned on this page as not likely to fire its owner with cycling enthusiasm, has given second place to a lady-back tandem I saw a week or two later. It was an attractive machine, well finished and in excellent condition, and, as I gazed at it from afar (having a weakness for tandems) I wondered how much it weighed. I am still wondering! Walking over to the machine I took a firm central grip with both hands—*and failed to lift it off the ground.* I am aware, of course, that lightness in a bicycle is not everything; I know, too, that it is easier to roll an object than to lift it. But the thought of all that weight which two humans had to propel, uphill and down dale, and often against the wind, and which sometimes they might want to lift into a railway train, was an appalling one. Personally, I am a great believer in lightness, but lightness in a bicycle is not the only desirable feature. Nevertheless, the tank type of bicycle, whether single or tandem, will never induce cycling fever.

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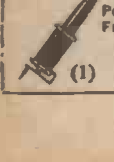

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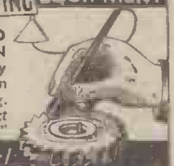

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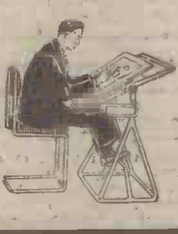

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