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PRACTICAL MECHANICS

EDITOR : F. J. CAMM

NOVEMBER 1947

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Elements of Mechanics and Mechanisms
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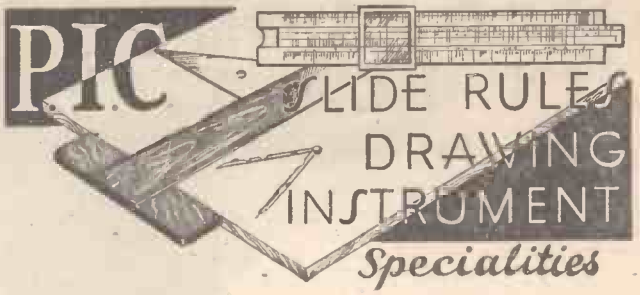

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XV NOVEMBER, 1947 No. 169

FAIR COMMENT——BY THE EDITOR

Physics as a Career

PHYSICS is concerned with the nature of matter and energy and how they react with one another. It includes such subjects as heat, light and sound, electricity and magnetism, with the strength, density, viscosity, etc., of different materials, their atomic and molecular structure. Hence every industry is concerned in some degree with the application of physics.

The science has advanced tremendously in the last 25 years. So great indeed has the advancement been that it is impossible for applications to keep pace with discovery. Opportunities for workers in applied physics are not only great, but they are fascinating, exciting, and provide a valuable contribution to human well-being.

Most large firms and certainly every branch of industry employs professional physicists, each of whom employs two or three assistants, whose qualifications must be that they have a fundamental knowledge of physics and some skill in experimental technique and in making apparatus and instruments.

There is here a satisfactory career for the right type of youth. The brighter ones may obtain full professional status without the necessity for a University degree. For such youths national certificates in applied physics are intended and they are awarded jointly by the Ministry of Education and the Institute of Physics. The training is in applied physics rather than in electrical and mechanical engineering. There must, of course, inevitably be some overlap.

The research worker plays his part in making and discovering new products, in improving existing products, and in controlling the process of manufacture by means of scientific instruments and apparatus. If the assistant is engaged in a Government research or testing establishment, from time to time he will be brought into direct contact with fundamental research. Universities and technical colleges employ experimental assistants. This is another avenue which provides an interesting career and good pay.

National Certificates

A student entering the course should have had full-time continuous education up to the age of 16, or have completed satisfactorily a junior part-time course of two years' duration after leaving an elementary school. The basis of all national certificates is well established. Study is part-time, extending for the Ordinary National Certificate over three years (junior course), and for the Higher National Certificate over a further two years (advanced course) of advanced study aiming finally at approximately to that of a University degree in the subject.

Ex-Service candidates may in certain circumstances attend a full-time intensive course of shorter duration. Part-time study makes it convenient to the student who obtains basic scientific knowledge of instruments and processes with which he is familiar in his daily work. The course which is being run by the Institute of Physics provides those with the right outlook and mentality with the means of entering this fascinating field.

Only sufficient mathematics is taught to provide an essential basis. It is not a scholastic study. The course in Workshop Practice acquaints the student with the use of simple workshop tools and processes, whilst the course in drawing enables him to prepare a drawing in a way clear enough to enable a mechanic to construct the apparatus. The student is also taught to read engineering drawings and electric wiring diagrams. There is also an elementary course in chemistry.

The third and final year of the course for the Ordinary National Certificate is designed to be strongly biased towards those branches of applied physics in which the student is actually engaged during the day. Topics such as spectrum analysis, measurement of illumination, vacuum devices, cathode-ray oscillographs, industrial temperature measurement and electrical relays are typical of the subjects which will be taught in the third year.

The course for the Higher National Certificate consists of physics up to degree standard, mathematics, and in the final year a special subject in relation to the student's work in a local industry, such as instruments for measurement and control, plastics, metallurgy, quality control or some branch of mechanical or electrical engineering.

The responsibility for the administration of the scheme for the award of the certificate rests with the Joint Committee of the Ministry of Education and the Institute of Physics. Any college or works which feels that there is a local demand for a course may make application to the Ministry for its recognition, although the Joint Committee will desire to justify itself that the centre has adequate facilities both of equipment and qualified teachers.

The examinations are assessed by senior members of the profession appointed by the Institute of Physics. It is possible to allow colleges to set papers based upon the particular branches of applied physics of interest to local industries, and at the same time to ensure that a uniform standard is attained throughout the country.

National Certificates as a real industrial qualification have been accepted in engineering and other subjects and the new certificates in physics will be equally recognised as a standard of education.

The holder of the Ordinary National Certificate has the prospects after further study and the award of the Higher National Certificate of acquiring full professional status as a physicist. Candidates for the Higher National Certificate who succeed in reaching a sufficiently high standard in the final examination will be granted exemption from the academic requirements for membership of the Institute of Physics. After a period of approved experience they will be eligible for the qualification of Associate Membership of the Institute of Physics.

The holder of an Ordinary National Certificate in applied physics might at the age of 18 expect a commencing salary of about £200 a year, reaching about £700 a year ultimately, especially if he obtains the Higher National Certificate.

Those readers interested should get into touch with the Institute of Physics at 47, Belgrave Square, London, S.W.1.

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Index to Volume XIV

INDEXES for Volume XIV will shortly be available, price 10d. each, from the publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Readers are recommended, whether they have their volumes bound or not, to obtain copies of these indexes which provide a ready means of tracing information which has appeared in past issues, and may save them the trouble of addressing a query to us.

Indexes for most of the volumes of this journal are still available at the price mentioned.

Model Diesel Engine Developments—2

The Baby Diesel : Model Flying Boats : A Small Racing Car

By C. E. BOWDEN, A.I.Mech.E.

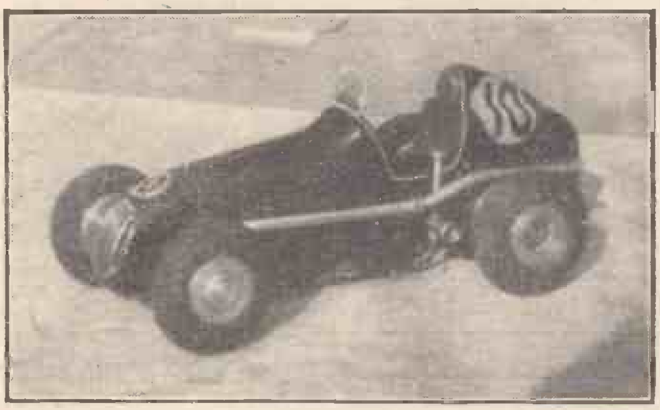


Fig. 3.—Mr. Baigent's 0.9 c.c. baby diesel car that travels at great speed around a special track. The model is a scale Austin 7 racer and is only 8in. long.

JUDGING by correspondence, discussion and usage, the model diesel engine is quite the most popular type of model internal combustion engine in use at the present time. Except in the larger cubic capacities, it appears to have rapidly ousted the small petrol engine from its popular place. This is not surprising when it is realised, as I explained in a recent article in PRACTICAL MECHANICS (August, 1947), that the baby diesel engine saves the out-of-proportion weight of ignition gear that its petrol brother demands. For the benefit of those who did not read my previous article it is as well to state clearly exactly what this means.

Let us consider, for instance, a 1 c.c. engine. A petrol engine of this small cubic capacity will require the following weights—to ignite the gases reliably: a coil 2oz., condenser ½oz., wiring 1½oz., time-switch and ignition timer point gear 2oz., flight battery or small accumulator 4oz. This tiny engine of 1 c.c. will therefore have to carry in the air, on the pond or around the race-track 10 oz. of ignition gear for really reliable results. If we cut this down to 6oz. by reducing the battery, etc., and sacrificing a certain amount of reliability, the weight of the ignition gear is still considerably more than the whole engine, and we must remember that unless we have a *really hot spark every time* we lose power. A baby engine of only 1 c.c. requires every ounce of power to fly a model, etc., and cannot afford to sacrifice any power whatsoever. Now, to fly an extra weight of 10 oz. or even 6oz. means that the whole model must either be made much larger if we are to keep a light wing loading, and this, of course, puts up the drag to serious proportions, or we must have a very high wing loading if we use a small model with such a heavy power unit weight. If we use a desirably small model that is easily carried about to the scene of action, then this "highly loaded" little model must be a very fast flying affair, because, as everyone knows, a high wing loading means speed. Much the same applies to water loading in the case of a speed vee planning type of hull, such as a cabin cruiser.

A fast model means a touchy model as regards stability, because any faults of trim are exaggerated. It also means a model that will possibly smash itself to pieces if it hits anything at that fast speed.

Is it therefore to be wondered at that these "new deal" little diesels are welcomed by the enthusiastic model builder who desires a small-sized model?

He can now make his models really small and portable and, in addition, he has up his sleeve the extra power per c.c. that the diesel produces in the small sizes.

When we come to consider that the *same minimum weight of ignition gear will also operate really large petrol model engines from 4.5 c.c. to even 30 c.c.*, and that these larger engines have a larger power weight ratio that can deal with the extra weight, it is quite understandable why the larger petrol motors are still popular for large models capable of carrying the weight.

Two examples of little models that I have produced for baby engines will serve to show what I am driving at.

Flying-boats

Fig. 1 is a small flying-boat of only 38in. wing span and fitted at the moment with a 1 c.c. Frog diesel. This model has also been flown by a 1¼ c.c. Mills diesel.

If the reader looks at the photograph carefully he will notice that this little flying-boat sits almost on top of the water's surface *because of its light weight*. Because its water loading is low, the engine has less to do in raising the model on to its steps for the take-off. If the model had a heavy water-loading it would be sitting comparatively deeply in the water. This would mean a great deal of power to make it squeeze the water from under the planing angles of the steps, and so rise on to the surface of the water and then "unstick."

I built this model recently (plans are commercially available through "B.M. Models," 43, Westover Road, Bournemouth) because not long ago I officially raised the British record rise off water flying-boat duration on a similar type of model, but of larger size, 4ft. 8in. span, and powered by a 3.5 c.c. diesel engine. This record was originally created by one of my petrol flying-boats, way back in the semi-dark ages, which was the first I.C. power-driven model boat in history to rise off the water and obtain an official record. On my recent boat, with the 3.5 c.c. diesel, I used the light water loading idea, and the model can be expected reliably to take off in any decent weather.

A number of people then asked me for a plan of a little flying-boat, as the baby model seems to be more popular.

I think, however, that it is always as well to say to enthusiastic modellers that the smaller the model the more care must be taken to get trim really right. Larger models are more tolerant.

There are two points of interest in connection with all my flying-boats. I always fit an extra step well forward of the mainstep, because I find that one can watch a model flying boat pick up its tail and after-step first, and then skid along on its mainstep with tail well up before the wings gain sufficient lift to take off. The high single engine mounted above the wing produces a high thrust line in relation to the low water drag of hull and sponsons. There is therefore a marked tendency to pull the nose of the boat down during the initial stages of the take-off, before the wings have gained flying speed. There is no pilot to ease back the stick and so pull the nose up. In practice, my special forward step hits the water and bounces up the nose, and after a few bounces off she comes.

The second point that I now include in my flying-boats is a really big angle for the leading edge of the two sponsons. This allows

Fig. 1.—C. E. Bowden's baby model flying-boat of 38in. span called the "WEE SEA BEE" is seen powered by a 1 c.c. British diesel engine. The model is sitting on top of the water ready to take off because of its light waterloading.

takes-off from fairly rough water, as it prevents water getting *on top* of the sponsons. It also helps landings when the model glides in rather steeply, although I always aim at as flat an angle as possible to glide in at slow speed. To this end I fit a special wing section of my own development with a pronounced bird-like undercamber allied to an elliptical wing form and the main hump on top of the wing a little farther back than is normal practice.

I find this gives a quick take-off, allied to slow flight and glide and yet low drag. My section is not thick, because a thick model section creates drag, although admittedly it provides the desirable slow flight. I find my compromise is the best answer in practice for small-engined models.

I should, perhaps, have also mentioned one other peculiar feature of my model flying-boats. They have a really long waterline, because a model tends to dig in its tail should it drift across or down wind when waiting for its master on the surface of the water. The wind often gets on top of the large tail, and blows the stern into the water. A generous waterline length and *plenty of water surface* at the rear step aft cures this fault. Practically every model flying-boat I have seen designed by fellow aeromodellers suffers from this fault; and it is therefore a point worth consideration.

Fig. 2.—The author's baby float plane fitted with three floats and powered by an 0.7 c.c. 1½ oz. diesel. This little model has the fuselage made from 1/16in. sheet balsa, and the wing span is 38in.

A Baby Seaplane

In the same category of baby diesel models comes the little float 'plane that I built around a tiny diesel of only 0.7 c.c.

The motor weighs about 1½oz., and it is fixed on a little detachable nose held to the fuselage by wire hooks and rubber bands. The fuselage is made from 1/16in. sheet balsa, and ⅛in. by ⅛in. balsa longerons and uprights, etc., are glued inside the sheet sides. It is then given a coat of banana oil to waterproof it. The wing is a fairly high aspect ratio elliptical wing of 39in. span. The floats are balsa framework, covered with 1/32in. sheet balsa and tissue paper. These have three coats of banana oil to waterproof them, and even then the little floats have my extra forward step incorporated.

The whole model has a very light water and wing loading, which is the secret of its success. If one pauses to consider the matter for a moment, the actual motive power weighs less than the 3 to 4oz. of rubber that a similar size floatplane of around "Wakefield" size would demand!

This gives a further indication of the possibilities of the baby diesel, for my tiny "Majesco Mite," of only 1½oz. weight and 0.7 c.c., produces more power than I could expect from a 3½oz. rubber motor, and that power is developed evenly over the whole duration of run, whereas the rubber motor starts off with a mighty kick and then rapidly dies down in intensity of effort.

A Baby Diesel Car

Before we leave the baby class of diesel engine I want to show readers what was one of the first tiny diesel cars to be built in this country. This "little wonder" was built by Mr. Baigent, and I have seen it whizzing around a small circular track in a room on several occasions. It is a model of one of the old Austin 7 racers.

The engine is of only 0.9 c.c. and screams around at about 8,000 r.p.m. I have one of these B.M.P. engines in a small aeroplane that I fly by "U" control, and I know of its great power for size. In my last article I explained that it is at present the only commercial baby diesel fitted with two ball races to the mainshaft to eliminate turning friction as far as is possible. It is interesting to note that most of the American petrol motors have now turned to ball races fitted to the crankshaft bearing.

The little car is 8ins. long and its most interesting feature is that the cylinder lies horizontally along the centre of the chassis. The crankcase forms the back axle with the crankshaft extending as a driving axle. On the end of the driving axle there is a tiny centrifugal clutch fitted in the "brakedrum" of the driving wheel, which takes up the drive evenly when the car is placed on the track with engine all out. The driving wheel is, of course, fixed to the driven member of the clutch. The chassis is made from wood, and the operator can start up the engine by flicking the driving wheel around by hand because of a simple ratchet engagement gear. It is therefore not necessary to use the usual starting cord or any special apparatus.

Fig. 4.—The Bowden White-Wings diesel model has a large wing area 6ft. 6in. span with central chord 16in. on an elliptical wing. The fuselage is almost crash proof and is covered with balsa sheet. The model can be flown by a 3.5 c.c. to a 5 c.c. diesel.

The fuel is carried in a tiny suction-fed tank, which is always more satisfactory than gravity feed for model work.

A Larger Diesel Model

I have now discussed the baby types at some length, and in my previous article I showed examples of speed-boats driven by diesels. Now let us look at the "larger" diesels for a moment.

There are a number of diesels on the market from 2 c.c. to 5 c.c., and some of these are excellent performers. As I remarked earlier in this article, my "record raising" flying-boat is powered by a 3.5 c.c. diesel, and I fly many models by the well-tried British 2.2 c.c. Majesco diesel. This latter size flies land models up to about 4ft. 6in. or 5ft. span, and propels speed-boats of around 38in. length.

There are many people who like the simplicity of the diesel and therefore want to use it in larger models. This is quite possible to do, as Fig. 4 shows. The model is one of my designs and is quite a large, heavy fellow, built to "take it." It has balsa-sheeted fuselage and balsa-sheeted leading, and trailing edges to the wings. I fly this model (and it takes off the ground, too) powered by a 3.5 c.c. diesel, and also various continental and British large diesels around 5 c.c. She glides in to land as all sound and stable large models do, steadily and like an old crow. There is something very fascinating in large models, and certainly the diesel does save a lot of battery paraphernalia, wiring and ignition troubles. The model shown is called "The Bowden White-Wings," and is now commercially obtainable as a kit, or a plan, because its robustness and stability, allied to simple construction, suits the novice builder and also the man changing from rubber to power.

At the Eaton Bray Internationals a few weeks ago I saw a good starting and sound power producer in the form of an Italian "Movo"—10 c.c. This is a size not yet generally on the model aeroplane market in this country, but will doubtless come. At the moment 5 c.c. seems to be the popular cubic capacity for larger diesels.

I have flown models of up to 8ft. span by 5 c.c. diesel engines when a slight push is given to start them on a rise off ground flight. I have also flown a 7ft. span flying-boat over Poole Harbour water powered by a 6 c.c. German "Eisefeldt" diesel.

An Interesting Query Answered

I have recently been asked an interesting question, and I feel the answer may help to get a new diesel owner going along the right lines.

The owner of a small diesel complained that frequently he found when starting, the propeller rotated clockwise, and that it "blows wind forwards, making the 'plane move backwards. Can you explain?" This owner is starting up on *slightly* too high compression, which makes the fuel fire before the piston can get over top dead centre. This reverses the engine, which carries on firing whilst running backwards. The compression cannot be very much too high, or he would find the engine not start at all. I have even known a diesel to collapse internally because of over-compression adjustment. The answer for this owner is to screw back the compression adjusting lever slightly, so that the engine runs badly on too low a compression. Then to screw up a little, so that the engine just fires nicely on *the minimum compression that causes good running*. In this way the engine will last much longer as regards wear.

Although one can often get a model diesel to start and run the correct way even though compression is over high, it does the bearings no good. Do not forget, a model diesel runs at over twice the compression ratio of a petrol model engine, i.e., somewhere around 16 or 20 to 1. Also, always remember that a model diesel automatically raises its own compression as it warms up due to the gases expanding. Therefore, most model diesels require a slight slackening back of the adjustable compression lever when they are warmed up. That is to say, if they are fitted with an adjustment lever and contra-piston. Most diesels are fitted with an adjustable contra-piston. Practically every baby diesel is so fitted. There are, however, a few "fixed head" diesels on the market. These have no compression adjustment.

I am struck by the fact that so many novices to diesel work ruin their chances of a quick start and good running, together with long bearing life, by screwing up the adjustable compression type of diesel too far. If it does not at once start, they seem to think that because it is a "compression ignition" engine the best thing is to really give it as much compression as they can. This is a very serious mistake and prevents a start. In my personal opinion, *provided the owner uses common sense and restraint*, I prefer the adjustable type of compression, because the owner can be sure that he is getting the best performance at the lowest possible compression ratio.

Science Notes

Interesting Facts About Everyday Topics

By Prof. A. M. LOW

Sound Effects

I WENT to a symphony concert the other afternoon and, as I listened, I thought how the origin of music is wrapped in mystery. As creatures whose ancestors crawled out of the sea and lived rhythmically according to the ebb and flow of the tides, we respond throughout our whole lives to rhythm. It is rhythm that rules music, which after all is merely the setting into motion of the regular waves of sound. Probably the first music was the wailing of primitive tribes as they swayed their bodies rhythmically, accompanied by hand-clapping in rhythm. In Greece, music was closely associated with astrology, and the seven-stringed lyre used to have each of its strings named after the seven planets. The ripple of the waves, the sigh of wind in the reeds, even our own breathing, are all part of the music, the rhythm of life.

The loudness of sound is measured in units called "decibels," one decibel being roughly the threshold of audibility. A whisper to your companion at the "movies" is about 10 decibels. The roar of an aeroplane engine at close quarters is about 120 decibels; and 140 decibels is about the limit of endurance of the human ear.

The noise of normal breathing is, at a distance of 1ft., 10 decibels. Average conversation is 65 decibels. The noise of a passing lorry 89 decibels. A lion's roar is 95; the gentle rustle of leaves is 20 decibels; and a small field-cricket shrills his call at such a high pitch that it is far beyond the range of human hearing.

Blotting-paper Clothes

WHEN rain, sucked up by the sun, falls down my neck, snow crystallised by cold enters my shoes, and fog, consisting of partially-vapourised water particles, helps to keep my volumetric efficiency, thought becomes disturbed. Besides, at this season of the year the subject of clothes leaps to the mind.

Clothes are absolutely monstrous. We know full well that the atmosphere is either full of sunshine or water, and neither of these conditions is met with in thé faintest degree by up-to-date attire. Nearly all cloth is composed of a number of threads placed close together and, as these strands are often twisted, it is evident that their shape and length depend upon the amount of water in them. So why pretend that the sky is always smiling or wear materials which are bound to be ruined by damp? It would really be nearly as sensible if we walked about in blotting-paper clothes.

When clothes are watered, the interstices can be observed to contain this liquid by holding various garments up to a powerful light and noting the lens-like effects of the cells, or even the separation of light which takes place. It cannot be good to use the same garments on the next day, but not because the moisture is internal. Let us suppose the sun is shining. Picture to yourself the stream of radiation from the sun. Imagine all the astounding colours, the invisible light, the cosmic rays, and then take up a large, thick, clumsily constructed chunk of cloth, and debar this life-giving light forever from your person.

About Flies

WATCHING workmen cleaning the face of Big Ben reminded me of flies. These interesting insects can walk up and down and all about because each foot has two small claws that cling to any tiny crack or crevice, and as the insect alights a sticky secretion on the footpads helps it to stick to whatever surface it happens to touch. Another queer thing about flies is that they have mosaic eyes that break up the world, as they see it, into innumerable spots, which must make it an even more bizarre affair than it seems to us.

Fireflies, too, have strange properties. They emit cold light, but a whole field full of them would hardly light a single room, for each insect only generates about one twenty-five thousandth of a candlepower! You can estimate for yourself how many would be needed if your electricity failed.

Dogs and Relativity

HAVE you ever been to the dogs? I have found that they are quite enjoyable. According to the late Dr. Coué, the system of mental control should be useful for training a greyhound. If the hare, during training, was made to complete its circuit by one ten-thousandth of a second faster each time, I am convinced the dog would not notice the change, but would always finish the same distance from its electric prey.

Perhaps I have inadvertently stumbled upon a means of training Slick the Slipper to break all records, but on second thoughts I realise that the dog would have to live several hundred years to complete its task. There always seems some difficulty in the way of these straightforward methods of making a fortune by relativity.

I am told by a well-known steeplechase jockey that, after concussion, the patient frequently thinks he can smell some strange odour. This does not appear extraordinary, because numbers of people have lost all sense of smell after a blow upon the head, and as this lasts for long periods it is clear that the portion of the brain which is actuated by the smelling and tasting nerves has been temporarily injured.

This is not another avenue of approach to the problem of "smellies" because certain notes of very high frequency often cause listeners to say that they can "taste" the noise. I daresay insects could tell us a great deal about this subject, but it rather looks to me as if some method of broadcasting a smell might be accomplished in the very far distant future.

Triple Portraiture

An Interesting Photographic Fake

By R. L. G.

A triple portrait.

THE camera can give the truest and the finest of detail of any subject it is called upon to record, both as regards perspective and tonal rendering. It can even go further than this when the stereoscope is introduced and natural colour emulsions are used, so that when viewing a stereoscopic slide in full natural colours one might be excused making the age old statement that, " The camera cannot lie."

Freak Photographs

Most people know, however, that the camera can lie, and often in a most embarrassing manner. What holiday maker has not by him one of those holiday " snaps " of some relation, lying on the beach, whose feet resemble an elephant's and whose head is apparently far away on the horizon and the size of a tennis ball. It is of no use explaining to this disgruntled individual that the camera was too close, too low, and the aperture too small. Such technical data would not interest him, and his only ambition in life would be to get hold of that negative by fair means or foul.

An example of a dual portrait.

Then again there is the converging building, making a four-storey building appear similar to a New York skyscraper, this effect being produced by tilting the camera upwards.

Then there are telegraph poles growing out of heads and the very small person standing on someone's hand, and many other freak results, with just the simplest of cameras. All such freak results are proof enough that light rays can play some queer tricks after passing through a camera lens.

This is not always as bad as it would appear, and in most cases can be very easily avoided. Some good use can in fact be made by controlling the light rays by various means to produce some quite amazing effects on the sensitive emulsions used in the camera.

Any photograph not giving a true image of its subject is generally looked upon as a freak or fake.

However, the cinematographer has for many years made very good use of this control in his camera, and where no other means are possible this control is adopted with truly amazing effects. Take, for example, the Dunning process, named after the inventor. This process allows an actor or actors to be depicted in front of a background in front of which the actual acting performance could not take place. This scenery is often thousands of miles from the studios. Both the scenery itself and the performance of the actors are taken on separate strips of film.

Dunning Process

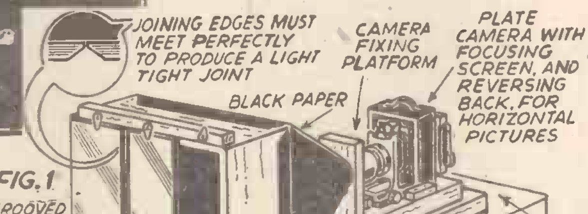
In brief, a positive print, from the negative of the background to be included is fed through the camera, with, and in front of, the unexposed film. The actors then make their performance in front of a plain background. Using a complex filtering system, both background and actors are recorded then automatically on the camera film, which is then processed, and positive films taken off in the normal way.

This is not to be confused with the *Dubbing* process, which is concerned only with re-recording of sound.

Then there is the dual role played by an actor where two persons of exactly similar features are desired.

This effect is accomplished by taking one half of the film only, the other half meanwhile being blacked out. The actor performs one of his dual roles in front of this section. This completed, the other section is exposed with the actor performing as the other identity. The camera, in effect, remains firm throughout the whole procedure, so that the background registers exactly in the two halves. There are many complications and snags, of course, and the final dual picture can be looked upon as a fine cinematographic achievement for both actor, director and process worker.

Whilst it is hardly likely that the amateur cinematographer will have attempted this latter method for one of his " takes," it is not unlikely that the ordinary amateur photographer will have expended a few plates or films in an attempt at producing some such dual role effect for his " still camera " with varying degrees of success or failure.



General view of the completed apparatus, and details of construction.

Triple Portraits

The author having himself produced one or two such photographs for the amusement of his friends decided to see what could be done, going one step further. In other words, a triple portrait of the same person. The results obtained from these experiments are seen in the accompanying illustrations. The home-made apparatus to produce the photographs, which are all quite untouched whilst admittedly somewhat bulky in size, was quite simple to construct and was made from easily procurable materials.

The general view of the completed apparatus is shown in Fig. 1.

It will be seen that the camera was mounted on a small platform about 18in. from a rectangular box having open ends. The front of this box was arranged to take three partitions of stout cardboard, each of which could be removed at will without disturbing the other two. The space between the box and camera was screened by means of four triangular sheets of black paper pinned to the box at the front, and secured by a rubber band to the tube on the camera platform.

Plate Camera Necessary

A plate camera having a focusing screen and reversing back was found most suitable, as a horizontally shaped picture was required. The three partitions were required, of course, to cut off the light rays to one-third of the picture area on the photographic plate. These were removed in turn and replaced again after making that particular exposure. Three separate exposures were, of course, required, the shutter being reset after each one, the subject moving to the appropriate position for each exposure.

Shutters

It is important that the three partitions should first be set up in the frame, edge to edge. Then one of the outer ones should be removed, carefully, without in any way disturbing the others, to make the first exposure. This shutter is then replaced carefully, and the centre one removed for the second or central exposure. This is again replaced before the last and opposite outer partition is removed for the final exposure. It will be noticed that the meeting edges of the partitions are bevelled. This allowed fairly thick card to be used, thus ensuring rigidity, and the bevel presents a knife-edge to the lens. Metal might be used for the partitions.

Fig. 2 shows the simple apparatus required with the approximate dimensions suitable for a quarter plate camera. The following points were found to be very important.

The whole apparatus was required to be on a solid support and to remain immovable throughout the whole proceedings. The partitions had to meet perfectly without gaps, and care was needed when replacing the particular partition not to move the others. Similar light conditions were vital throughout the three exposures. This point was found simple to control with the artificial light examples.

The same shutter speed for each exposure.

Stopping Down

Partial stopping down of the f 4.5 lens in the camera was found necessary, the approximate aperture being f 6.3.

This is advisable, both in order to give a sharp background, and to get as sharp an image of the partition edge as possible. Exposure time may have to be lengthened accordingly, but as previously explained, each of the three individual exposures must be identical.

The camera and apparatus must not be moved in any way during the whole proceedings.

Another example of triple portraiture.

Moving foliage in the background may spoil the effect and a more solid form of background, such as a building is preferable.

Positioning of the Subject

Preliminary positioning of the subject was necessary before the photograph was taken, and marks were made on the ground to indicate to the subject the position necessary for each exposure.

It was important to see that during each exposure no part of the subject's body was invisible, this being particularly important with the centre partition removed.

Changing Clothes

If light conditions can be trusted, and are not anticipated to vary between exposures, the subject being photographed can quickly change articles of clothing to add to the final effect of "Triplets."

In Fig. 3 is seen a representation of the three exposures, the same subject being photographed in each case. In these views the partition joins are seen, but, as explained, complete light tightness was essential at these meeting edges.

The final triple portraits were found to give a perfectly continuous background with no division lines visible.

Notes and News

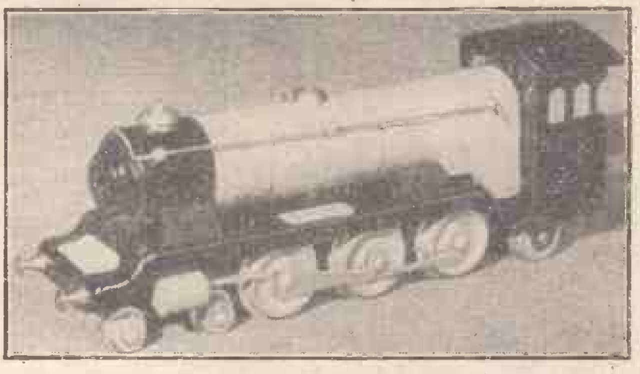
"Unitoy" Engine Unit

A NOVEL, constructional toy has been placed on the market by "Unitoy" Supplies, of Sutton Coldfield, Warwickshire.

The toy, which takes the form of a railway locomotive, is designed to resemble an actual engine, the "Flying Scotsman," and the various parts are so arranged that by simply giving the chimney and a wing-nut device in the cab a few turns, the engine is quickly taken apart, and as quickly put together again.

Robust Construction

A feature of this toy is its robust construction, the footplate, cab and bogie frame being of pressed steel plate. The wheel axles are of mild steel, the chimney and dome of solid brass, and the boiler of hard wood. The wheels are pressure die-cast in a zinc base alloy, and the connecting links are of colour anodised aluminium. The cab is made in one piece with spot welded joints.



This sturdy "Unitoy" engine can be taken apart and put together again in a few moments.

Altogether there are 69 parts which go to make up this interesting toy, and they are all interchangeable. As a unit set the engine is supplied in five parts, the chassis, frame, boiler, funnel and cab, which are easily assembled as previously mentioned. The engine is also obtainable as a kit set, all the various parts being supplied unassembled. Full instructions are given with each set. Further particulars can be obtained from "Unitoy" Supplies at the address given.

Johnson's Photographic Competition

MESSRS. JOHNSON AND SONS, of Hendon, have just issued a list of prizewinners in their July Photographic Competition which closed on July 31, 1947.

Two first prizes of £5 each are awarded to: Mr. C. H. Burrows, 21, Oak Road, Scarborough, Yorks, and Mr. F. Shuter, 10, Charleston Road, Eastbourne, Sussex. Three second prizes of £2 each are awarded to: Mr. G. H. Mapleston, 22, Friern Barnet Road, New Southgate, N.11; Mr. R. R. Bushell, 4, Marston Road, Hoddesdon, Herts; and Mr. Vernon D. Shaw, 29, Park Road, West Timperley, Altrincham.

In addition there are awards of ten third prizes of £1 each, twenty fourth prizes of 10s. each, and twenty-five consolation prizes.

Club Notes

The Edgware and District Society of Model and Experimental Engineers.

AN exhibition of members' work will be held on November 21st and 22nd at the Shakespeare Hall (opposite the Ritz Cinema), Edgware. The exhibits will include model locomotives, ships, aircraft, stationary engines and small tools, and some models of great historical interest will be on view. Hon. Sec., J. Reed, 60, Ennerdale Drive, N.W.9.

Andover and District Model Engineering Society.

THE Andover flour mills of Messrs. McDougalls were visited by members of this society recently. This was a very informative visit, as members followed the wheat through the various processes till it appeared in blue-and-yellow paper bags as flour. We hope that our winter programme will be as successful as our summer programme has proved to be.

Information as to venue and dates of meetings can be obtained from R. Pemble, 14, Weyhill Road, and F. Vallat, 8, Walnut Tree Road, Andover, joint hon. secretaries.

The Problem of Synthetic Fats

A Chemical Conundrum for the Present Age

By J. F. STIRLING, M.Sc.

THE world is short of fats. To some extent the shortage may be more apparent than real, because natural sources of edible fats and oils tend ever to replenish themselves. Nevertheless, it is the current shortage of these indispensable materials which is at the present moment impelling modern whalers equipped with the most up-to-date installations to steam out to Antarctic waters and not only to capture and kill these leviathans of the deep and to collect their natural oils, but also to process for subsequent utilisation in one direction or another almost the whole of the whale carcase.

No doubt, in time, and as a direct result of these super-efficient expeditions, the whale will become extinct. But, for the time being, it provides our margarine, our cooking fats, and various other materials of civilisation. And, of course, our friend the whale is particularly useful in these directions because there is such a lot of him!

Two major world wars between nations equipped with the latest resources of science have served to stress the utmost importance of a plentiful supply of fats to our modern civilisation. The human body needs fat as a food and as an energiser. Without fat it cannot function. Remove the whole of the fat supply from a nation or a group of people and those individuals will quickly languish and ultimately die.

We are not concerned in this article as to why this is the case. Our present interest is to survey the various attempts which have been made to produce these life-essential fats artificially without reference to animals or other natural supply sources. The problem, admittedly, is, at the present day, still an unsolved one. All the same, it is a problem of some urgency, and if it could be solved, not only would it ease our domestic position, but it would also in a very large measure render this country self-dependent so far as its edible fats, oils and greases were concerned.

A hydrocarbon oil, similar to the German "gatsch." By oxidation it can be transformed partly into fatty acids which, when combined with glycerine, are converted into fats.

Two Broad Divisions

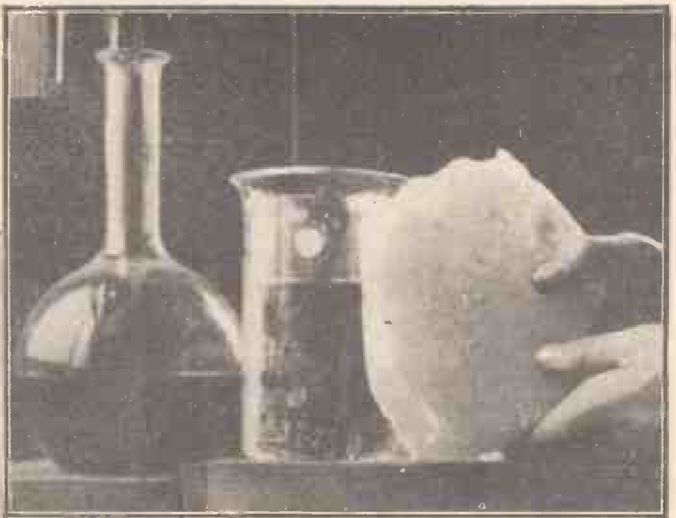
Fats, oils and greases might, at first sight, appear to be rather complicated substances as regards their chemical make-up. Indeed, some of them are, in point of detail, complex affairs. But they may all be relegated into one of two broad divisions, to wit: the mineral oils and greases, and the animal or vegetable ones.

The mineral oils and greases are called "hydrocarbons," because, chemically speaking, they consist of chains of carbon atoms having hydrogen atoms attached to them. They make excellent lubricating oils and greases, but they are utterly useless from a nutritional point of view, since they have no edible properties whatever.

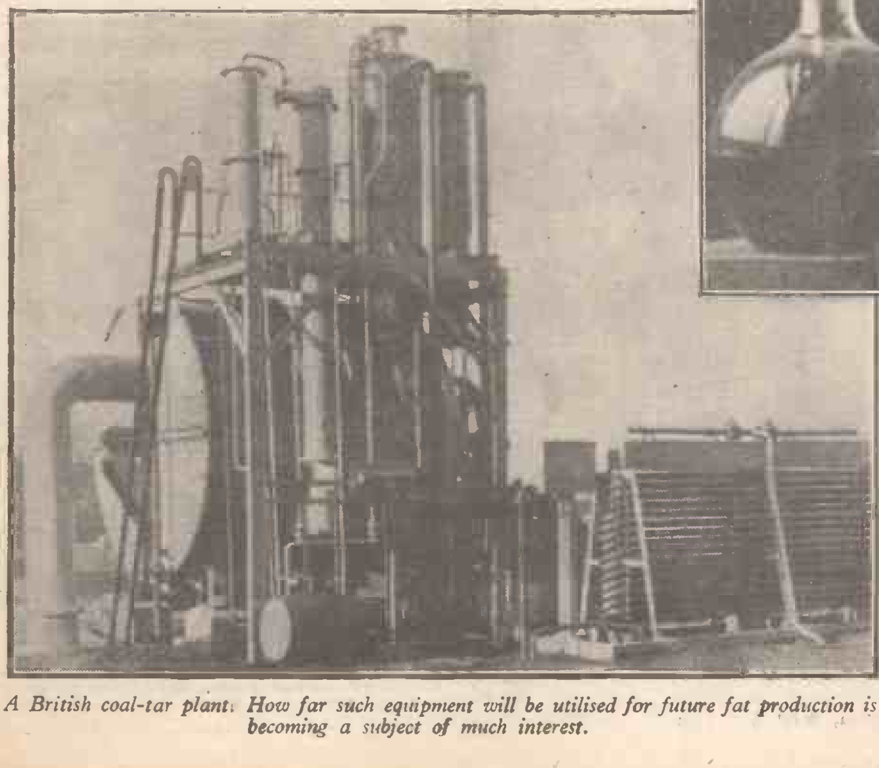
Now, the animal and vegetable oils, fats and greases have a very important difference from the mineral hydrocarbons in that they all contain oxygen. Some contain more oxygen than others, and their peculiar make-up often renders them chemically active, so much so, indeed, that they often tend to "go bad," that is to say, to generate other evil-smelling products which, naturally enough, at that stage render them unfit for consumption.

A non-hydrocarbon fat, oil or grease is essentially a chemical combination of glycerine with a special kind of acid, which latter, in consequence of its peculiar nature, is known as a "fatty acid." Stearic acid—the base of all cosmetic creams—is a solid fatty acid. Oleic acid, a liquid, is another fatty acid.

A fatty acid will combine with an alkali to form a soap. Ordinary hard, white soap, for instance, is mainly sodium stearate, i.e., the sodium salt or stearic acid. There are soaps of other metals, such as, for example, copper or zinc stearates. These are true soaps, but they are insoluble in water.



Paraffin wax—the raw material from which synthetic fat has been obtained.



A British coal-tar plant. How far such equipment will be utilised for future fat production is becoming a subject of much interest.

Glycerine an Alcohol

Glycerine is a member of the alcohol family and, like all alcohols, it possesses the property of combining with acids to form special compounds which are known as "esters." Thus, for example, we have the well-known celluloid solvent "amyl acetate." This is a combination of amyl alcohol and acetic acid. Ethyl acetate, again, is the product resulting from the union of ethyl alcohol and acetic acid.

Modern margarine, a hygienic product of chemical research in food science. It is based on natural fats. Can it be replaced by a product evolved from synthetic fats? The German "Prima" margarine (synthetic) was a failure.

In exactly the same way, glycerine (being an alcohol) enters into combination with the fatty acids to form these "esters." And in all such instances the glycerine esters are fats, all of which are edible.

If we boil a fat with an alkali solution, say caustic soda solution, the fat is split up into its constituent glycerine and its fatty acid, which latter combines with the alkali to form a soap. That is the essence of soap making.

Some fats are liquid, other are semi-liquid, whilst others still are hard and white.

Now any fat, no matter what may have been its source, may be converted to "higher" and harder fats by a simple treatment with hydrogen gas under pressure in the presence of a trace of nickel or some other metal to act as a "catalyst" or reaction-promoter. It is on this basic fact that the world's margarine industry depends. Bad-smelling, liquid and semi-liquid fats may thus be hydrogenised at definite rates, thereby purifying these low-grade fats and hardening them up to the highest of edible standards. Traces of flavouring substances, salts and vitamins are then added to the hardened fats, the whole being suitably emulsified, and by this means you have the present-day substitute for old-world butter. Indeed, modern margarine may, in some respects, appear as a superior product to butter, for it is cleanly, of pre-determined composition, germ-free, and its vitamin content may be very closely controlled, in addition, of course, to its consistency and flavour.

It is just because by means of hydrogenation that any type of natural oil, fat or grease containing oxygen may be converted into a high-grade, odourless and pure fat that the world is now being prospected for all types of natural oil and fat supplies. Part of the scarcity of linseed oil is due to its being used for hydrogenation purposes in order to produce better and harder fats.

It will now be obvious to the reader that if we could make fatty acids artificially or from some abundant product we should then be able to combine them with glycerine and so produce fats. There happens to be a fairly plentiful supply of glycerine because it is a product of soap-making, but even if this commodity became scarce, it can be produced artificially, so that the glycerine supply does not cause any future anxiety. It is the production of the essential fatty acid which constitutes the main problem, the problem which, for nearly a quarter of a century, has been the subject of intermittent attack by chemical workers the world over.

Fatty Acids

There are various ways in which fatty acids can be built up in the laboratory from simpler substances. But mere laboratory methods are not wanted in an industry which could be of gigantic proportions. What the future synthetic fat industry needs is some abundant source of material which it can readily utilise for the production of its fats.

Now, there happens to be two such sources of raw material for fat making. The first is the petroleum crudes, heavy oils, waxes and greases. The second is the common coal tar of our gas-works. Both of these contain products embodying long chains of carbon and hydrogen atoms—hydrocarbons. You have only to oxidise these—put oxygen atoms into the carbon-hydrogen chains at suitable points—and you get fatty acids, or. at least, something which can very easily be turned into fatty acids.

But, unfortunately, the problem of putting oxygen atoms into hydrocarbons has turned out to be a very difficult and a very intricate and perplexing one. In the first place, hydrocarbons are very resistant to oxidation. And if you do happen to hit on a means of forcing oxygen atoms into the carbon-hydrogen chains, it is more than likely that you will find that your atoms have gone into the wrong place in the carbon-hydrogen chains, or that too many of them have gone in, or that the oxidation has become so violent that the whole chain of carbon atoms has been entirely broken up and shattered.

It is, you see, a *controlled* oxidation which is so vital to the success of the process, and it is just the means of satisfactory control which is lacking.

As far back as 1919, the Germans attempted to oxidise hydrocarbons to produce fatty acids, but they were not successful. Furthermore, within a short time the world prices of natural fats fell enormously so that all industrial attempts to produce fatty acids synthetically lost the greater part of their economic attraction.

Then, about 1924, similar attempts were made in this country, the hydrocarbon materials being ordinary paraffin wax. It was demonstrated quite amply that by blowing oxygen (or air) into molten paraffin wax in the presence of a suitable catalyst, such as 1 per cent. of manganese stearate, the wax could be made to take up oxygen and become converted in part to a number of oxidation products among which were included a few fatty acids.

But, here again, the research was one of theory rather than one of practical import. World prices of natural fats, being low, were all against attempts at synthetic fat production.

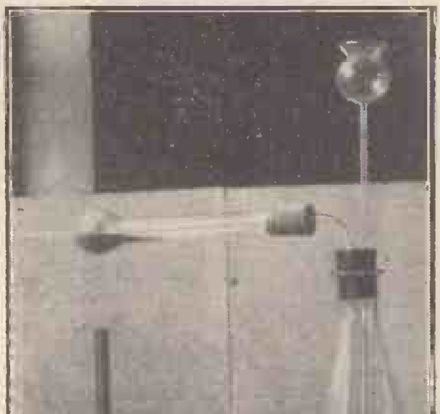
There was, however, one nation interested in artificial fat production. It was Germany. And, in 1928, a small plant was erected at Oppau by the big German chemical combine to manufacture synthetic fatty acids from paraffin wax or some other petroleum crudes. The plant was supposed to be able to produce three tons of fatty acid per day, but apparently technical hitches occurred and very little was ever heard of it.

"Gatsch"

Still, the Germans pegged away doggedly at their synthetic fat processes, so much so that about 1938 they were operating a synthetic fat plant which used as its raw material a heavy hydrocarbon oil which itself had actually been made artificially at a number of installations in the Ruhr. The synthetic hydrocarbon used was an oil boiling within the range of 320-450 deg. C. It was termed "gatsch."

In the latest German synthetic fat process, the "gatsch" was packed into cylindrical aluminium vessels holding about 10 tons of the material. A weak solution of potassium permanganate was also charged into the reaction vessel and, after heating, air was forced upwards through the material from an air-pipe coil situated at the bottom of the vessel. After about 24 hours of this treatment, some 30-35 per cent. of fatty acids were formed in the reaction mixture.

This material was then churned up with water to remove unchanged permanganate, after which it was treated with soda (sodium carbonate) which converted all the fatty acids into their sodium salts—in other words, into soap. The soap was dissolved



A simple laboratory experiment in hydrogenation. Here, hydrogen gas evolved from zinc and sulphuric acid is being passed over a substance in a heated glass tube in order to extract oxygen from the material and to increase its hydrogen content.

An oil-extraction plant of a type which may ultimately be used in the large-scale purification of synthetic fats or fatty acid products.

out and thus removed from the unchanged "gatsch." After purification, the soap solution was concentrated and then carefully treated with the calculated amount of dilute sulphuric acid. This decomposed the soap and liberated the fatty acids in their pure state.

Ultimately, the purified fatty acids were combined with glycerine in a six-ton stainless steel vessel, the chemical reaction proceeding at 120-180 deg. C. for six-eight hours.

"Prima" Margarine

The fat thus produced was quite edible, although dark in colour and not of good taste. Its colour was lightened by bleaching with fuller's earth and by charcoal filtration, after which the fat was given a slight degree of hydrogenation to harden it up a little and, in particular, to improve its taste.

From this fat, margarine was produced in the normal manner, the final product being termed "Prima margarine."

Appearing early in 1939, it was the world's first synthetic margarine, and although it was apparently withheld from the German populace during the war it was supplied extensively to the German armed forces in North Africa, and to the German U-boat crews—particularly to the latter.

Available reports on the subject of "Prima margarine" are not very glowing ones. They all agree "that the taste was not so bad that hungry people would not have been pleased to eat the fat." In general, the material appears to have been greatly inferior to our own margarine produced from natural oils and fats.

Experiments on fatty acid synthesis are now proceeding in other countries. Yet, peculiarly enough, up to the present, all fatty acids produced artificially appear to be in some way unpleasantly odorous. If, indeed, a mere trace of such fatty acid material gets on the hands, the odour persists for a long time even though the hands may be well washed.

At the present day, even if the German "gatsch" process of synthetic fat production were started-up in this country it would be too costly to compete with the natural fat supplies. And that, of course, is saying nothing regarding the unpleasant machine-oil taste of the German margarine and synthetic cooking fats.

We may take it, therefore, that the German process which was carefully built up in the years previous to the war was not a successful one, despite the fact that the German synthetic fat might be said to have been nutritionally efficient. Yet, from a chemical standpoint, the mass-scale experiment holds the greatest interest, since it has laid the foundations of future industrial processes on these lines.

A hydrocarbon grease which has been used as a starting point in the production of synthetic fats.

Replacing Glycerine

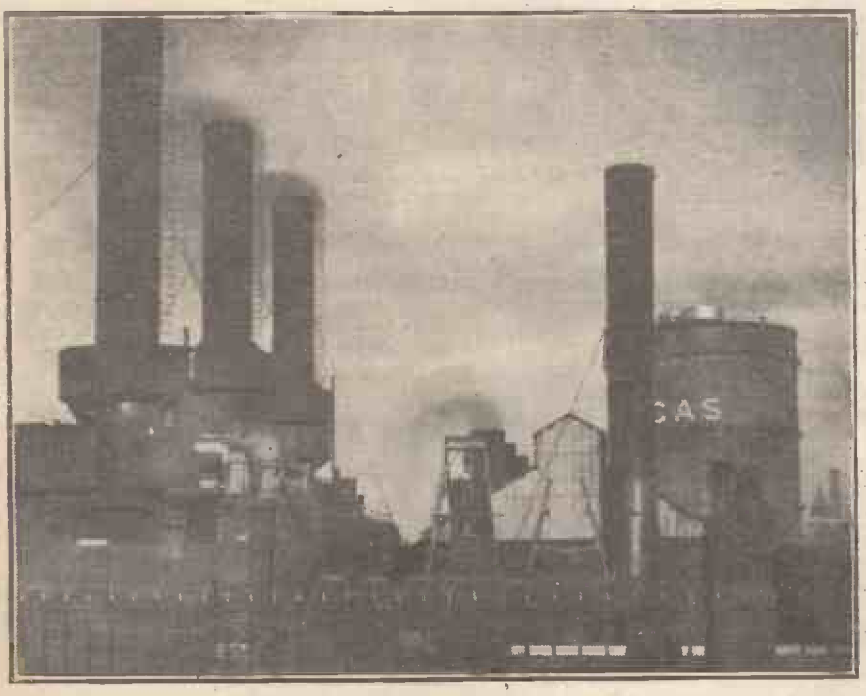
There are other alcohol materials besides glycerine which can be used to combine with fatty acids to produce true fats. The best known of these is mannitol. This is a naturally-occuring product which can also be made synthetically. Like glycerine, it is of a sweetish nature. It combines with fatty acids to produce mannitol fats—substances which are non-toxic and which can be assimilated by the animal body. But since mannitol is comparatively expensive and glycerine is comparatively cheap, the chances of the mannitol fats coming into production are very few.

In one of two ways synthetic edible fats may have a distinct advantage over the natural fats. It has been shown, for instance, that diabetic people do rather better on the artificial fats than on the natural ones, this being because the artificial fats have less tendency to produce acetone as the end-point of the chain of bodily reactions concerned with the ingestion of the fat.

Another interesting point is that a synthetic fat has usually better "keeping" properties than the natural product. Here, the synthetic fat is devoid of the innumerable traces of impurities which attract bacteria in the natural fats, and thus conduce to its decomposition. But, on the other hand, it is precisely these traces of impurities which impart the taste and general palatability to a natural fat. It would seem, therefore, that if any artificial fat, no matter how ingeniously it may have been made, is to succeed in direct competition with a natural fat, palatability and flavour will have to be imparted to it (in addition to any necessary vitamins and other trace compounds) by artificial means.

But, obviously, the whole subject of synthetic fat making is as yet in its early infancy. The problem still exists. For the greater part, too, it still remains an unsolved problem, a chemical conundrum which is likely to demand intense research investigation before any acceptable solution will be forthcoming.

Nevertheless, the problem has been tackled, and even industrially attacked. The beginning has been made. What may be the ultimate scientific termination of the technical and research work which is still being put into this field of industrial chemistry is a matter which even the most ingenious of modern chemical and food workers of our present time would hardly dare to predict. The future alone holds the key to this chemical puzzle.



A possible source of our future fats. A modern gas-works in full operation.

The Society of Inventors

THE Birmingham branch of this society is arranging to hold an exhibition of inventions from 15th to 21st December. Manufacturers and private individuals will be able to exhibit, as well as members of the various branches of the society throughout the country.

The main object of the exhibition is to make known to manufacturers (and the public, too) the numerous articles and devices that have been developed during recent years. The exhibition will also give inventors some idea of the progress made by other people and bring them into touch with the needs and requirements of both manufacturers and users. To further this object arrangements are being made so that inquirers can be put in touch with the inventors of any exhibit in which they are interested.

To be eligible for exhibition an article must either be patented, protected or of registered design. Drawings, models or replicas will be considered.

Further particulars can be obtained from H. H. Jones, 133, Handsworth Wood Road, Birmingham, 20.

The Elements of Mechanics and Mechanisms

A New Series Explaining the Principles of the Natural Forces and the Methods of Using Them.

By F. J. CAMM

A KNOWLEDGE of the natural forces and the units for measuring them is necessary to a complete understanding of mechanism. Power, force and energy are terms loosely used in conversation, but they are not synonymous terms.

We must therefore first define these terms.

Force is that which moves or tries to move a body or which changes or tries to change the motion of a body.

Diagrams illustrating the cohesion of ice, water and steam.

Power is the time rate of doing work or the capable time rate of expending energy.

Energy is that state or condition of a body when it is capable of doing work.

A machine is an instrument designed to alter the point of application, or the direction, or the magnitude of a force.

Man only possesses muscular force which resides in his body. But he has learned how to avail himself of the other forces which exist around him and which are known as the *forces of nature*. These include gravity, cohesion, heat, chemical force, etc. They may be divided into two classes—the *physical forces* and the *chemical forces*.

The physical forces are usually considered to be seven in number—gravity, cohesion, sound, light, heat, magnetism, and electricity.

The Force of Gravity

The force of gravity was discovered by Sir Isaac Newton, and thousands of examples of the way in which this force acts can be seen every day. If you drop a ball or pencil it falls to the ground. An examination after it has fallen shows that no *change* has taken place in the matter of which the object is made. No matter from what height an object is released it falls to the ground. From this we deduce two important rules, namely, that gravity can *act at a distance*, and that it *does not produce a change in the object*.

The force of gravity also acts on bodies which are lighter-than-air, such as balloons and airships, but in this case another force has been introduced to *overcome* the force of gravity.

Cohesion

All of the substances or bodies which form the world are composed of an infinite number of minute pieces called molecules, atoms, electrons, nucleons, etc., and these will be dealt with later under the heading of *matter*.

These minute parts are not free to move but are held together by the force of cohesion. If the molecules are separated from one another, as, for example, when a piece of metal is cut with a saw, the force of cohesion ceases to act. In this respect cohesion differs somewhat from the other physical forces because it can only act over the very small distances which separate the molecules. Cohesion, however, does not produce any change in the matter of the body.

In the case of solid water (ice), in which cohesion is strong, water, in which cohesion is weak, or gaseous (steam), in which cohesion is absent, it will be found that the composition is exactly the same—two parts of hydrogen and one of oxygen—H_2O.

A bell vibrates when struck.

A stone dropped in water causes radiating waves.

Sound

When a body is struck sound is produced. If a bell, for example, is struck it will be seen to vibrate. These vibrations can be felt, and are taken up by the air and disseminated in all directions in a manner similar to that in which waves spread away on all sides of a stone dropped in the water. These vibrations, when they reach the ear, produce the sensation we call sound.

The force exerted by some sound vibrations can be considerable, as, for example, when the clanging of a bell nearby may cause a vase to rock upon a mantlepiece, and even to fall over.

Light

Like sound light is caused by a vibratory movement of the molecules of the body which is producing the light. It is presumed that when light rays are emitted from a body its molecules are vibrating with enormous rapidity, and that these vibrations are carried away in all directions by a very thin medium called *ether*, concerning which we know very little at present. Ether is supposed to permeate all space and all matter. It is believed to fill the enormous space which exists between the earth and the sun, moon and other heavenly bodies, thus enabling their light to travel over the millions of miles which lie between them and us.

Although we cannot prove the existence of ether, it is very convenient, as will be seen later, to presume that it exists.

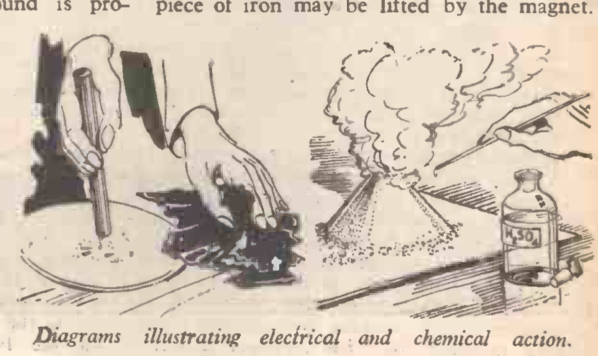
Heat

Heat is closely allied to the force of light since light cannot be produced without heat. It is true that *cold light* has been produced in the laboratory, but it is not entirely a heatless light. Heat is produced by a motion of the molecules of a body similar to that which produces light. The molecules of all bodies are presumed to be in a state of motion. When this movement is comparatively slow the body is said to be cold. As the motion of the molecules is accelerated, so the body becomes hotter.

Heat may be produced in a number of ways. If a piece of steel, for example, is rubbed against a piece of wood it becomes hot. It can, in fact, become too hot to be touched by the naked hand. This is heat produced by friction, from which we deduce the rule that *friction causes heat*. Heat, of course, can be produced in a number of other ways.

Magnetism

When a magnet is brought near to a small piece of iron the iron moves towards the magnet, and if they are allowed to touch the piece of iron may be lifted by the magnet.



Diagrams illustrating electrical and chemical action.

This indicates that the magnet must exert a certain power or force which we call magnetism. If we examine the piece of iron after it has been in contact with the magnet it will be found to be quite unchanged by the magnetic force. This indicates that magnetism is a physical force since it can act at a distance *without changing the properties of the matter upon which it acts.*

Electricity

Electric power or force may be produced by various means, as by friction, by chemical action, and in other ways. The Greek sage, Thales, first discovered that if a piece of amber were rubbed against a piece of silk it would attract small particles. Similarly, if a piece of glass be rubbed with silk and brought near some small pieces of paper they will be seen to jump towards the glass. A piece of sealing wax may be electrified by this means. The force of electricity is known to be very closely related to the force of magnetism.

Chemical Force

As an example of the chemical force, take an ounce of finely powdered sugar and mix with it 2 oz. of chlorate of potash. If the mixture is left alone it will remain unchanged for almost any length of time. But if the end of a glass rod moistened with strong sulphuric acid be brought near a portion of the mixture no change will take place; let the acid touch the powder, however, and the latter at once bursts into a brilliant violet flame giving off a dead white smoke. In a moment nothing remains but a few blackened cinders. We see here the difference between a physical force and a chemical force. *The physical force does not produce a change in the body upon which it acts, but a chemical force does.*

A source of muscular force.

As another illustration of a chemical force, dissolve a small quantity of bichloride of mercury in water in a glass and then treat a little iodide of potassium in the same way in another glass. The two substances may be held as close to one another as possible, but no change takes place. Let the one liquid be poured into the other, and instantly a beautiful salmon-coloured substance is formed, quite different in every respect from the two colourless liquids from which it was derived. This latter experiment proves quite clearly that chemical force, unlike the physical forces, *cannot act at a distance*, and that when it does act it completely changes the nature of the subject upon which it acts.

A further example of chemical force is the catalyst, where a chemical change is brought about by one agent, that itself remains unchanged, upon another agent.

Muscular Force

We are all familiar with the muscular force, which is the force possessed by the red flesh called the muscle, and by means of which we move our bones, lift weights, and perform *manual work*. A muscle exerts force by *contraction*. When, for example, we bend our arm it is easy to feel the muscle in the upper part of the arm becoming shorter and thicker. Muscles, of course, can only exert force when the being to which they belong is *alive*, and for this reason it is known as the *vital* force.

The Fireproofing of Fabrics

MUCH attention has been directed to the fireproofing of textile fabrics because of their inflammable nature. A very large number of fireproofing processes have been proposed, but there has been little indication of their relative effectiveness, their effect on the strength of the fabric or on its rate of deterioration during storage or exposure to light. Furthermore, no adequate explanation had been published as to the mechanism of fireproofing action, knowledge of which would assist largely in the search for improved fireproofers.

The information required is given in a report published recently for the Department of Scientific and Industrial Research ("The Fireproofing of Fabrics," H.M. Stationery Office, Kingsway, London, W.C.2, England, price 2s .6d. sterling). The text is divided into five main sections; (i) introductory, giving the range of investigations, the method of evaluation of fireproofers and the relative inflammability of textile materials; (ii) fireproofing with soluble deposits; (iii) fireproofing with insoluable deposits; (iv) the fireproofing of kapok; and (v) the problem of fireproof finishes for aircraft fabrics.

This research work was carried out at the Royal Aircraft Establishment, South Farnborough, under the direction of Dr. J. E. Ramsbottom. Some of the information in the report was given in the "Second Report of the Fabrics Co-ordination Research Committee, 1930," but has been re-written and extended.

Fireproofing does not make the material proof against fire, but prevents the fabric assisting in the spread of flames. To be efficient a fireproofing process should not only make the fabric incapable of propagating flame but should also prevent it from smouldering or glowing. The method of test employed throughout the research consisted in hanging a narrow strip of the material by its upper edge in still air and applying a standardised test flame to the lower edge. The subsequent behaviour of the strip of material gives an idea of the fire risk from the aspects of spread of flame or of glow. Tests show that woollen and silk fabrics are sufficiently fire resisting by themselves for most purposes, but that cellulosic materials such as cotton, linen, hemp and jute fabrics constitute a serious fire hazard.

Fireproofing with Soluble Deposits

Fireproofing with water soluble deposits is cheap and easy; it is popular and, where the proofed material is not subsequently exposed to the action of water, some quite simple and readily obtainable inorganic salts deposited in relatively small amounts on the fabric are shown to be effective in preventing flame and glow without detrimental effects on strength and handle. The salts chosen are not toxic and do not accelerate corrosion of metals with which the fabric may be in contact. Tests were made on many substances and mixtures and a review of the most effective of these shows that mixtures are better than single substances and that borax is an important constituent of them all. Examples are given of six proofings effective at small concentrations. The final choice is a mixture of boric acid and sodium phosphate, and a suitable composition and strength of solution is given.

Soluble deposits are removed by the action of water and are thus valueless for fabrics that have to be washed, exposed out-of-doors or otherwise brought in contact with water. Tests were made to see whether the loss of a soluble fireproofer brought about by rain can be retarded effectively by using a waterproof finish. No waterproof coatings were found to be permanently effective, but a few are of temporary value only, where the appearance, increase in weight and non-porosity of the fabric are unimportant. One method tried was the application of a metallic soap in an organic solvent after treating with a soluble fireproofer in the normal way. None of the treatments examined withstood washing in running water for 50 hours.

Many insoluble inorganic deposits were investigated. These deposits were generally formed on the fabric by double decomposition, the fabric being impregnated with a solution of one of the reactants and dried and then passed through a solution of the precipitating substance. In a few cases impregnation in single solutions, followed by drying and then immersion in boiling water, led to the formation of an insoluble deposit on the fabric. Many insoluble deposits hitherto claimed to be fireproofers were shown to be ineffective.

Two methods suitable for the flame and glow proofing of fabric are described. These cause no change in the flexibility of the fabric and no change in the tensile strength on exposure to the weather. Some loss in strength is caused by prolonged heating at temperatures over 100 deg. C. The fireproof and glowproof effect is not lost after prolonged exposure to the weather or on washing. These treatments consist in the deposition in balanced amounts of the oxides of iron, tin and tungsten in one method and these same oxides with the addition of silica in the second method. A successful ternary deposit of ferric oxide, stannic oxide and chlorpolyvinyl chloride is mentioned.

As in the case of the soluble deposits, a section of the report deals with experiments relating to the fireproofing action of insoluble deposits. The mechanism of their action is as catalysts in modifying the normal thermal decomposition of cellulose in the air and they cause the preferential formation of non-inflammable volatile products of decomposition.

The great fire hazard associated with kapok in its unproofed state is shown, for the flame travels over the surface with great rapidity, and is followed by flameless combustion which destroys the whole mass. This section of the report deals with the application to this fibrous material of the chemical principles found to hold good for fabric. The order of the physical conditions attendant on combustion are different, however, as are also the difficulties of processing due to the great bulk. It is also necessary in fireproofing to avoid the loss as far as possible of the valuable properties of resilience, buoyancy and thermal insulation possessed by the fibre in its natural state. Two methods are described. In one method an insoluble deposit of stannic oxide, tungstic oxide and alumina is after-treated with boric acid. The other method employs a simple deposit of alumina after-treated with boric acid.

Fireproof finishes for aeroplane fabric involve consideration of the nature of the tautening dope with which the fabric is treated in order to present an outer surface on aircraft having the desired aerodynamic properties. A general assessment of the fire risks associated with fabric-covered aircraft is given.

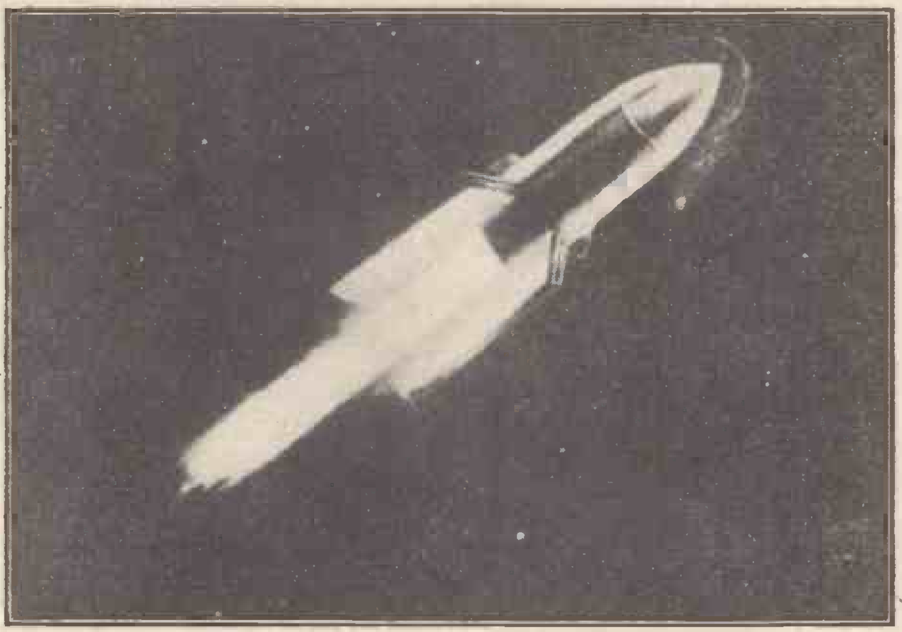
Rocket Propulsion

First Steps Into Space

By K. W. GATLAND

(*Concluded from page* 18, *October issue*)

ANY worthwhile discussion of the problem of freeing a rocket from the earth's gravitational field would occupy far more space than is available for this concluding article. Hence, it is proposed to place before the reader a summary of the types of rockets that may be expected to lead from V-2 research and, finally, to deal briefly with a possible means of harnessing nuclear energy for space-rocket propulsion.



A spaceship as conceived by Professor Oberth for the Fritz Lang film, "Frau im Mond."

The Embryonic Spaceship

Whatever may be the feeling about the rocket as a means of mass destruction, it must be conceded that Germany's V-2 was an engineering achievement of high merit, and its importance as the first positive evolutive link in the chain that produces the spaceship cannot be too greatly stressed.

Research with rockets now proceeding under Army supervision at White Sands, New Mexico, is daily adding fresh data. Hardly a week goes by but that a V-2 hurtles into the blue with recording instruments for some specialised investigation, perhaps to sample the atmosphere more than 100 miles from the surface or to test the nature and extent of radiation.

First Piloted Rockets

From work such as this, the guided missile may be expected to slowly improve in size and performance until it becomes practicable for a *pilot* to rise into the outermost reaches of the atmosphere and eventually to navigate his craft for short journeys into space. This is a stage that will almost certainly be reached in the course of military research if a proper international authority has not emerged within, say, five to ten years.

These first manned rockets will enable the physiological problems related to acceleration pressures and diminished gravitation to be studied in detail. They will make possible investigations of the pilot's ability to control his craft under the most adverse of these conditions, and improvements in the means already devised to counter expected ill-effects can be made accordingly.

The space-rocket may therefore be expected to evolve to a well defined plan and not, as one so often hears expressed, in a single "do or die" attempt to navigate moonwards. The moon expedition is not likely to be the awe-shattering event that some writers might have us suppose, for manned rocket flight will certainly have become commonplace before any attempt is made to land on our satellite.

Project 1

Already, a design for a manned rocket based on the German V-2, slightly larger but using the same engine, has been placed before the Government of this country. It is the work of two technicians of the British Interplanetary Society, Mr. R. A. Smith and Mr. H. E. Ross, who have evolved their conception on the basis of existing manufacturing techniques, and are quite satisfied that such a rocket could to-day propel its occupant to a height of 200 miles.

Not only is the scheme important in being the first workable design for a man-carrying rocket, but its construction would make possible *now* those physiological experiments which must be tackled before space-flight can become reality.

A cut-away drawing of the project appears in Fig. 97. The most obvious point about it is that there are no tail fins, the reason being that the jet vanes are adequate to maintain a vertical path, and, since the rocket would be far from the correcting influence of airstream vanes at the time of power cut-out, their fitment would incur nothing but unnecessary weight and drag.

It was a different case with the V-2 when it was important that the missile fell back to earth in a stable condition, though it was never really apparent why the Germans bothered to fit airstream vanes. As we have seen, the initial moments after take-off could not possibly have given sufficient speed for the external vanes to have any value and, again, they would have little influence in the low air density through which the V-2 moved in the last stages of power.

On the other hand, the graphite vanes in the jet-stream were masters of the situation throughout the entire thrust period; they were continually in action to deflect the jet against any movement of the rocket's axis from vertical.

The control arrangement specified for the manned rocket is rather different to the above. A tower is necessary for take-off and the manipulation of vanes in the jet-stream would impart *spin to the missile* and not the corrective influence of gyrovanes. This would immediately transform the craft into a "giant gyroscope" whose stability acts along the major axis as in the case of a bullet or shell. The reason for this will be apparent later.

Thrust will commence at 60,000 lb., giving an initial rate of acceleration of 9.8 feet per second. The consumption of propellant and the corresponding decrease in weight would naturally increase this figure as the rocket climbs higher and, after it has travelled for 110 seconds at constant thrust, the *effective* acceleration would be 2g.

Adding the natural gravity datum, the pilot would be exposed to an apparent acceleration of 3g. This is regarded as the safe limit for a man to be fully active to his controls and, when it is reached, the thrust would be progressively reduced so as to keep the value constant in conjunction with a g-meter. It might be mentioned also that should the pilot at any time lose consciousness control would be taken over entirely by an auto-pilot working on micro-wave pulses from the ground. Moreover, he would be brought automatically into a safe landing.

The pilot occupies the space in the rocket's nose and, within his pressurised cabin, has no external vision during the first two minutes of flight.

It will be seen from the drawing that the cabin is a loose fitting inside the nosing and that the external skin local to it is split into separate panels; the design is such that after a predetermined distance has been travelled, *a compressed-air device will catapult it away from the body of the rocket.*

Before the Cabin Separates

It is reasoned that separation should occur just after the climax of the thrust period when the speed has risen to about 4,700 m.p.h. From the moment power cuts out, the controlling vanes will be incapable of producing reaction in the rocket nozzle so that the torque offered by the turbine (which is positioned to rotate about the rocket's major axis) would be relied upon to build up spin. The turbine unit would, of course, continue to be fed by the steam generator despite the fact that the propellant pumps which it normally drives are no longer required to operate.

The rate of revolution would thus steadily increase until it reaches a predetermined figure at which the centrifugal force acting on a datum line passing through the pilot's body produces 32.2ft./sec. radial acceleration. At this point, the steam supply to the turbine would be cut and the rate of spin would decline slightly owing to bearing resistance in the turbine. When the spin is at maximum, the nose fairing sections will part and be thrown off due to the inertia forces acting upon them so that at any moment, subsequent to their removal, the pilot may operate the control which drives the cabin away from the rocket.

This control would also initiate the operation of a time mechanism for the ejection of the hull parachutes.

The cabin would be constructed almost entirely in light alloy, the walls embodying two ports with self-sealing conical gaskets for view and access; they would be glazed and provided with shutters as protection from the fierce and unrelenting glare of the sun.

It is suggested that the pilot's personal equipment should be a g-suit, a standard high-flying suit, parachute and oxygen apparatus. A specially designed cradle-seat is provided in the scheme on which all instruments and control boxes are grouped so that it is possible for him to change his attitude in the cabin and still have all controls ready to hand. This is important in view of the experiments to be performed and one of the new devices embodied is a "stroboperiscope," which renders a stationary external vision when the cabin is rotating.

Artificial Gravity

Once the engine has ceased thrusting, the pilot will no longer be pressed down into his seat and he will become subject to a very changed condition of gravity. Travelling in a high trajectory and freed from appreciable air-drag he may be regarded as moving in uniform obedience to the combined forces of momentum and gravitation and, if the spinning of his cabin were completely annulled, the pilot would experience a condition of "weightlessness"; nothing in the cabin would displace relative to anything else.

The nearest approach to "zero gravity" so far experienced is in the parachutist's "delayed drop." He jumps from a height at which the air density is small and incurs this same condition of reduced weight when, for a short time, his body is accelerating freely. However, as soon as air-drag builds up to a significant figure, "free-fall" no longer obtains, and as terminal velocity is approached, the sensation of weight slowly returns to normal. The critical period is short-lived, and in no way can it be taken to infer that the problem of changing gravitation on the human system is non-existant.

What would be the result of prolonged periods of zero-gravity or even of a reduced gravity is simply not known; biologists on the whole are doubtful whether man could long remain conscious where gravity does not exist, and, indeed, many are ready to predict a paralysis of the nervous system with even fatal results. That digestive disorders would be caused is fairly certain.

If the biologists are right, then it seems likely that the solution is largely mechanical, though a combination of the mechanical and the biological may ultimately provide the ideal space-piloting conditions. It is the former solution—that which results in an "artificial gravity" stimulated by centrifugal force—that Messrs. Smith and Ross have set out to provide in their manned rocket, and this explains more readily why it is necessary to impart the axial spin.

It is obvious that during those periods when the pilot in his cabin was either ascending or descending through air of very low density he would be able to conduct experiments with varying degrees and periods of "weightlessness." Small peroxide-permanganate motors firing tangentially from the cabin at right angles to the major axis would provide the means of rotational control. One pair would thrust in the direction of spin to increase the rate of revolution while the other, at another time, fired in the opposite direction to reduce the spin or even to stop it altogether.

The time available for test would be about seven minutes, after which the parachute, stowed above the cabin, would release and bear the pilot gently to earth.

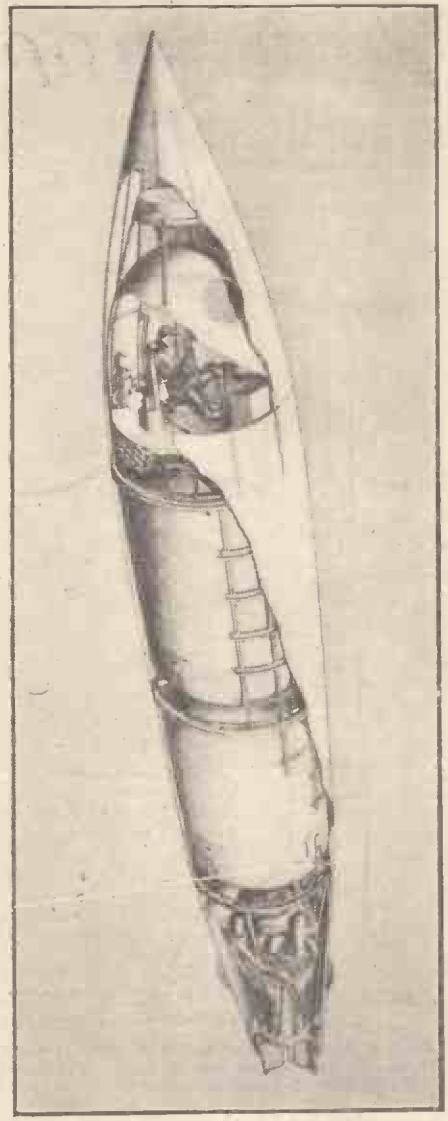


Fig. 97.—Two technicians of the British Interplanetary Society combined to produce this design for a piloted research rocket. Its operation is explained in the article.

Some General Particulars

Calculation has shown that the cabin could ascend to over 225 miles, but, as 180 to 190 miles is considered the limit from which a safe return could be effected using parachute braking, the apex of the flight would be timed to occur around the 180 miles mark. This, of course, is not to infer that safe descents from higher altitudes is impossible to rockets equipped with *retarding motors* and parachutes.

The rocket would have an all-up weight at take-off of 20.9 tons, of which 17.2 tons is contributed by propellant—alcohol and liquid oxygen—and 1.292 tons by cabin and pilot. Thrust is timed to last for 148 seconds, followed by a period of ascent under momentum of 228 seconds, so that peak trajectory is reached after 6 minutes 16 seconds.

At his greatest altitude, the pilot would in clear weather be able to see for 1,300 miles in every direction, and if the ascent were made over London he could observe Iceland, Norway, Sweden, Finland, Estonia, Latvia, Poland, the Carpathian Mountains, Rumania, Greece, Sicily, the Mediterranean seaboard of Africa, Gibraltar, Spain and Portugal. The area within his vision would be in the region of 5,300,000 square miles.

The Way Ahead

Such rockets as this will pave the way for still more ambitious flights into space itself, and eventually we shall arrive at the stage where gravity is defeated by missiles which reach "escape velocity."

The powers that rockets must achieve to obtain this condition may be explained as follows. The earth exerts a pull of 6.95 miles per second and any body released into its gravitational field at a sufficient distance from the surface will fall into the atmosphere at that speed, no more, no less. It is true that meteorites often enter the atmosphere at a higher velocity, but that is because they already possess a high velocity at the time of being influenced by the earth, and some run headlong into the planet as it speeds on its orbit at 18.5 miles per second.

Hence, it seems that for a rocket to fully escape the earth, the minimum speed it must attain is in the region of seven miles per second—and yet this is not necessarily so. A space-rocket with *unlimited* propellant could travel to the moon at a steady 30 m.p.h.

However, to bring the problem down to a practical level, it is essential that the necessary energy for the journey should be imparted as quickly as possible, not so rapidly as to destroy the crew nor so slowly that energy is needlessly wasted in raising a great bulk of propellant. The slower a rocket travels, the longer it remains near the earth's surface and the more propellant it will need to push upwards against gravity.

This is the essence of the problem. A compromise has to be found in which the rocket may attain "release velocity" as quickly as possible with a rate of acceleration that does no harm to its occupants. This means that working to the "safe" acceleration of 2g., the rocket must travel a distance of something just less than 1,500 miles before the engines can be cut out, when it will coast out of the earth's field without any other expenditure of power.

So long as the missile achieves the release velocity of seven miles per second, it matters nothing how close it is to the earth when power ends; theoretically, it could attain the figure when a few feet from the surface and still escape.

For a manned space-rocket to achieve gravitational release, it may be necessary to wait for a form of atomic propulsion, though, if necessary, there is little doubt that one employing a chemical propellant could be made equal to the task. It would, however, be excessively massive and composed of several "steps," having in effect a series of large boosters which jettison one after the other as each becomes spent.

It is even likely that the earliest *atomic* space-rockets will be large and multi-stepped.

Popular Science

Whenever world affairs fail to produce a headline, it is frequently the case that fantasy replaces fact in the feature pages of our papers. Currently it is sought to embellish the magic words "atomic energy" with irritating flights of fancy into the "Utopia of to-morrow," and all too often are we told that our most ambitious journeys, by ship, aircraft or even rocket, will require no more fuel than is inherent in a "tumbler of water."

Statements such as this should not be taken too seriously. The employment of the actual recoiling nuclei in a propelling jet (which the above implies) is really quite fantastic, since the production of so high a velocity stream would involve the dissipation of energy so vast that complete and immediate vaporisation of the vehicle could be the only result.

A marked rise in combustion temperature is the inevitable outcome of improving the jet velocity in any rocket system, and, as its effects have been held down by liquid cooling in chemical rockets, so in a reverse manner is it proposed to transfer the energy of nuclear reaction to a "working fluid," preferably of a low molecular weight such as hydrogen or helium. In this way, the heat energy of the fissible element would be absorbed by the "fluid" which flashes into a jet of rapidly expanding gas and out through a propulsive nozzle.

What exactly does this mean in practice? First, the combustion chamber with its convergent-divergent nozzle would be no great departure from that of the chemical unit. Instead, however, of injecting into it a fuel and oxydiser as separate components, an "atomic" engine would embody its fuel in the form of graphite-fissile material actually *inside* the chamber. This would be conveniently sectioned up to allow the greatest possible area of the substance to be exposed to the inlet of "working fluid," which for the example we may take to be liquid hydrogen.

A steam jacket in the combustion chamber might be employed to supply superheated steam for driving the pumps, both for feeding the propellant fluid and for working a continuous liquifaction plant to prevent pressure building up in the tanks, thereby overcoming one of the greatest problems associated with liquid hydrogen. In this case the tanks might be quite light with comparatively thin walls.

Performance Estimates

Some interesting figures for a propulsion unit of this type have been given by L. R. Shepherd, B.Sc., Nuclear Physicist at the Cavendish Laboratory and Technical Director of the British Interplanetary Society. A thousand ton spaceship is conceived whose propulsion units work with an exhaust velocity of 10 km./sec., and discharge some four tons of propellant per second. He adds that the initial heating of the working fluid involves the utilisation of energy at a rate exceeding 2×10^{11} watts and that, assuming a small number of units, each element must generate some 10^{11} watts of useful energy and discharge something of the order of one ton of propellant every second.

This implies that the chain-reacting system of graphite and fissile material must be capable of withstanding a temperature of about 3,000 deg. C., in the presence of hydrogen under high pressure.

The assumption that some 100 watts per square centimetre can be transferred from the fissile material to the gaseous propellant implies that about 10^9 square centimetres of the former must be exposed. A means of obtaining such a large area, Mr. Shepherd has suggested, would be the division of the graphite-fissile substance into spherical beads 1 mm. in diameter, which means carrying 40 tons of the solid alone. For circumnavigating the moon and returning to land on the earth, it would take at least 700 tons of liquid hydrogen occupying 10,000 cubic metres of storage space.

The "Atomic" Spaceship

The magnitude of the problems to be overcome in the design of spacecraft will be apparent from the above, and, while the atomic engine may provide the main solution, there is little doubt that, initially, the chemical engine will remain important for supplementary use. It would, for example, be ideal as a first stage booster and, indeed, may prove highly necessary in the most powerful atomic spaceships owing to the radioactivity they would otherwise leave behind in the lower atmosphere.

Such a combination of power is represented in Fig. 98. The vessel here conceived is a three-step arrangement in which the first step "A" is a chemical boost rocket. This section is complete in itself and has its purpose in raising the entire craft to a height of sufficient safety for the atomic engine to take over.

As soon as "A" is empty of propellant it automatically drops off to expose the nozzles of the atomic engine in the second step "B."

From this point, the sequence is rather different to that normally followed in "step" design. The section "B" is the main propulsion step and houses the one engine group. The third step "C" is nothing more than a tank and from the time the booster jettisons, the nuclear engine will be drawing on propellant in this section, so that as soon as escape

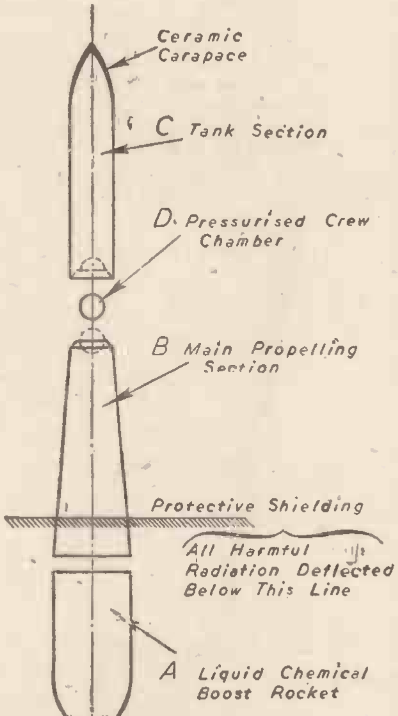


Fig. 98

A SUGGESTED SCHEME FOR AN EARTH-MOON SPACE-ROCKET

A—is a chemical booster section of which it might be necessary to employ two or more. The vessel is driven from its launching tower by thrust in the lowermost section which jettisons automatically as soon as the propellant exhausts and fires the second. This continues until each of the boost sections are cast off, when the engine of step "B" operates. B—is the main propulsion section and derives its power from the expansion of hydrogen by a fissile substance in the combustion chamber. It draws on propellant in the tank section "C" to reach "release velocity" so that its own propellant remains intact during the outward journey.

C—has no other purpose and when empty at the climax of power, it is detached and propelled away by rocket charges.

D—is the spherical cabin which houses the crew, controls, provisions and equipment. It is normally attached at the extreme nose of section "B" but can be jettisoned and landed by parachute once the vessel has returned to the earth's atmosphere.

velocity is reached, it is empty and of no further use. It is therefore detached from the main body and driven away by rocket charges.

This leaves the main step "B" travelling alone at the velocity of gravitational release. All its propellant is intact and it will coast at slowly decreasing speed out of the earth's field. A spin would previously have been imparted to the vessel to stimulate a gravitation within the spherical cabin (which is now exposed at the nose of the section) and also to provide directional stability. The rate of revolution would not need to be more than about once every three seconds for the centrifugal force to approximate normal earth conditions of gravity and the crew would lie horizontally on extended "chairs," their heads towards the axis.

Having passed beyond the so-called "neutral zone" of the two gravities, earth and moon, the vessel would again be subject to acceleration, and if allowed to continue it would eventually crash into the surface at a velocity of about 1½ miles per second.

The headlong rush would most effectively be checked by turning the rocket completely round so that ultimately the aft end faces forwards and the engines can retard instead of propel; this could probably be accomplished by a system of jets firing from the sides, synchronised with the rotation. It has been suggested elsewhere that rocket motors firing from the nose would provide a more simple solution, but this is not too obvious. Not only would the additional space and weight mean a sacrifice in the amount of propellant carried, but the simple fact is that there is no practicable means of landing a rocket without the presence of atmosphere when it does not approach the surface stern first.

Landing

The rearward approach, therefore, greatly facilitates the landing and hydraulic legs, retracted during flight, which are provided in the rear of the section. As the surface is approached, a radar transmitter will send out waves which reflect back from the surface of the proposed landing area, giving a constant check on height and speed.

The final descent is controlled to balance out gravity a few feet from the surface. It would, of course, be necessary to nullify the vessel's rotation during this time and to employ a means of deflecting the exhaust in conjunction with gyroscopes for stability.

"Blind Approach"

The absence of any appreciable atmosphere means that from the time of cutting in the engines to retard, the full force of their exhaust will remain to blast down on to the surface so that if, as is now believed, volcanic dust is much in evidence on the moon, the vessel's arrival will be preceded by a dust-storm of some violence. Though this may have the advantage of clearing the landing area of loose matter, it would certainly obscure the surface from the crew and so make the alightment a largely automatic process. However, instruments are highly developed and in many ways more reliable than the human controller, so that where navigation is accurate and the vessel is retarded on to pre-selected ground which is reasonably flat, landing should not present too great a problem.

The return is effected simply by blasting the craft off directly from its legs. Its weight at this time would be less than one-third that which obtained at the moment of departure from earth, and the fact that the Lunar gravity is small and there is no atmospheric drag means that the flight back to the Mother Planet would be made with a much less prodigious consumption of propellant. It nevertheless remains to retard the rocket so that it may re-enter the atmosphere at a reasonably slow velocity, and again it would be necessary to turn the craft through 180 deg. for the motors to act.

The spherical cabin is detached from the hull as soon as a safe velocity has been reached and special "air-blown" parachutes are then released to bring the crew into a safe landing.

Conclusion

To the reader who is sufficiently interested in the subject to desire more information, it is suggested that he contacts the British Interplanetary Society which is now established as the National group with headquarters in London. The Secretary, Mr. L. J. Carter, has kindly offered to supply a complimentary copy of the Society *Bulletin* to anyone sending a *4d. stamp* to cover postage, and all inquiries should be addressed to him at 157, Friary Road, London, S.E.15. The author will be pleased to reimburse his Society for postage incurred by readers applying from outside the sterling area.

Magnetism and Gravity

A New Scientific Law to Explain Magnetism

By "TECHNICUS"

AN announcement was made to the Royal Society on May 14th of this year, which promises to be one of the most important scientific pronouncements yet made in this century. Professor P. M. S. Blackett placed evidence before the Society, to show that a rotating body is inherently magnetic. The concept is not new, for Schuster suggested the idea 50 years ago, but the significance of Professor Blackett's announcement lies in the fact that he can provide corroborative data showing that it holds, with mathematical exactness, for the earth, the sun, and a star called 78 Virginis. And so one witnesses the destruction of the popular hypothesis about the earth's magnetism, which has been with us for a century. No longer is it necessary to imagine that the core of this earth is made up of a magnetic ore, such as iron, to explain the origin of terrestial magnetism. It would seem that this magnetism is due to the rotation of the earth about its axis.

History of Magnetic Theory

As with most other branches of science, progress in the knowledge of magnetism has come slowly over the centuries. Socrates and Pliny were aware of some form of magnetic flux, and called it "Samothracean rings." It is to Lucretius, who lived in the time of Julius Cæsar, that we owe the word "magnet," for he noticed that the property belonged to minerals coming from Magnesia in Asia Minor. A thousand years were to elapse before Peregrinus, in 1269, discovered magnetic lines of force, although he did not define them as such.

To an Elizabethan Englishman belongs the credit for the first really scientific examination of the subject of magnetism. William Gilbert, of Colchester, Essex, was a doctor of medicine, and in 1600 he published a monumental work called "Magnetism," in which he cleared away the mumbo-jumbo that had grown up around the subject during the previous thousand years, and placed it on a scientific footing. More rapid progress was then made in the study of magnetism, dip and variations in declination, being observed. When John Mitchell invented the torsion balance in the middle of the eighteenth century accurate measurements of magnetic effects became possible. He found, for example, that magnetic poles repelled one another with equal force at equal distances apart. The now famous Square Law was enunciated, in which attraction or repulsion of magnetic fields was stated to vary as the square of the distance from the poles. Robison towards the close of the same century showed that it varied as the power of 2.06, and not as the exact square.

Oersted and Faraday

With the turn into the 19th century there came the great men, beginning with Coulomb, and followed by Poisson who laid the foundation for the modern theory about electrostatic and magnetic phenomena. It was Oersted who then discovered in 1819 that current produces magnetic fields, Faraday, in 1831, uncovering the phenomen of magnetic induction. It is not possible to do more than mention other distinguished contributors to the subject, such as Ampère and Henry. As a culmination to two centuries of scientific progress in knowledge of magnetism came the brilliant electro-magnetic theory of light of Clerk Maxwell, which took the world of science by storm.

The Approach to the New Conception

Physicists have known, for many years, that magnetism is connected with electron activity, and a great deal of mathematical theory has been developed around the subject. The work of J. J. Thomson on the structure of the atom helped a great deal, while the classical work of Rutherford, which subdivided the electron yet further, brought science nearer to an understanding of the origin of magnetism. It is to be noted here that most of the work described above was concerned with the measurements of magnetic phenomena, and not so much with the origin. Clerk Maxwell was, perhaps, the first to probe the meaning or origin of a physical occurence, as opposed to measuring and predicting its behaviour.

It is generally held to-day that the angular momentum of electrons in the atom, that is to say, their orbital movement, accounts for magnetism. If one treats the electron as a particle with finite mass the magnetic moment due to the electrons in the atom can be expressed by the relation

$$u = \frac{e}{2mc} j$$

where u is the moment and j the angular momentum of the electron.

The Blackett Concept

Since Newton announced gravitation theory science has sought a detailed explanation of gravity. Professor Blackett has put forward a formula which constitutes the first stepping stone towards the identification of gravity with electrical properties; or, the connection of mass property and electricity. He has expressed a relation between the angular momentum of a body and its magnetic moment, for large bodies, such as the earth and sun. As stated above, this relation has been found to be valid for three terrestial bodies, and scientists now await the results of observations of other heavenly bodies. Should they conform to the Blackett relation they will prove that this relation is a new Law of fundamental importance.

It is early yet to express an opinion on the validity of this discovery, if one can call it that. If confirmation is supplied then the world of science can hail it as one of the landmarks in knowledge comparable with other classical laws, which have passed into text-books and become the bedrock of physics. The interesting feature of Professor Blackett's announcement is the linking of magnetism with gravity. In other words, that mysterious entity, revealed to the world by the genius Newton, may have an electrical origin. As it is gravitation has been expressed quantitatively, and exactly, without any proven clue to its origin.

At present it is known that the relation between the angular momentum of the sun and its magnetic moment is the same as that for the earth, despite the fact that the corresponding values for the sun are 100,000,000 times those for the earth. This suggests that the new idea propounded by Professor Blackett is fundamental, in the same way as, for example, the value of g is fundamental.

How It May Affect Science

In ascribing magnetic forces to any large spinning body, as an inherent property of that body, Professor Blackett has opened a new avenue for the theoretical physicist and mathematician. New light is thrown on gravitation, and with it, a fuller understanding of the universe as a mechanical system, or at least, that part of it which has been explored by the astronomer. The history of science has been punctuated with discoveries that have, to all appearance, at the time, offered little practical gain to the world of industry. From Newton to Einstein there has been that lag following each discovery, which may have rested in the archives of scientific papers, unnoticed for years. Who would have imagined, for example, that Newton's Law of Gravitation, announced to the world two hundred years ago, would eventually prove, absolutely necessary to the design of aeroplanes? At the time it was hailed as much for its philosophical significance as for its practical value, which was recognised only by a very few people.

We must, therefore, give due importance to this new concept of Professor P. M. S. Blackett, in the knowledge that it may, tomorrow, open up new possibilities in engineering, and prove as great a practical blessing as it is now a largely mathematical feat. Professor Blackett holds a chair of physics at the University of London, and many readers will recall that he was one of the scientists who contributed to the rapid development of atomic energy. That Britain can continue to add such valuable knowledge to the world is an indication that this country is still virile. In Blackett we have yet one more scientist in that illustrious line beginning with Newton, and threaded with such names as Faraday, Kelvin, Thomson and Rutherford.

Our Cover Subject

THE name Rolls-Royce is synonymous with excellence of design, manufacture and performance, and, indeed, has come to be accepted generally as implying perfection. The famous works at Derby are now turning out piston aero-engines and turbo-jet power units.

The piston engines are the "Merlin," which, fitted into "Hurricanes" and "Spitfires," may be said to have won the most famous battle in history, and the "Griffon," a younger brother 23 per cent. bigger, used in large numbers by the Fleet Air Arm in the Fairey "Firefly."

Incidentally, the ubiquitous "Merlin," in addition to being fitted into every type of aircraft except one trainer, powered motor-torpedo-boats and tanks.

The turbo-jets are the "Derwent V" and the "Nene," two of the River Class. The "Derwent V" powered the Gloster "Meteor," which obtained the world's record speed of 616 m.p.h. The "Nene" was fitted into the Lockheed X-P80 "Shooting Star," which achieved a speed of 580 m.p.h. and had an excellent rate of climb to 42,000ft., but new aircraft are needed to take full advantage of the thrust now available from the "Nene."

The illustration shows a turbine blade and disc assembly mounted in a lathe during machining operations.

The Evolution of the Safety Valve

Its Design and Operation

By G. W. McARD

ALTHOUGH one of the less conspicuous fittings on any steam boiler, the safety valve is, without doubt, the most important and the most indispensable of all, operating in a manner that none other could. Its normal functions are to ensure that the steam pressure cannot rise beyond the predetermined level, and to dispose of all steam generated which, if retained, would raise the pressure in the boiler to the dangerous level. At the same time it is designed, in most cases, in such a manner as to give warning that steam is being produced in excess of the demand. It operates in three spheres of steam power units—land (or stationary) sets, locomotive and marine, and, from the notes given below, it will be found to differ greatly to-day in its design for each service. For this reason chiefly, its evolution (from a common origin) will be considered in relation to its sphere of operation.

The history of the safety valve naturally runs contemporarily with that of the boiler, and the 19th century covers both in the main. Not entirely, however, for history records the first lever safety valve as invented by Dr. Denys Papin as long ago as 1680, while many of the valuable detail refinements possessed by the modern fitting have been made in this, the 20th, century. As usual, improvements in design location were made as the result of experience in service, though occasionally this first involved fatal accidents. One such case is illustrated in Fig. 1, where a pipe from the boiler supplied steam to the engine and, on a separate branch pipe, to the safety valve. To stop the engine the screw-down cock was shut but, unfortunately, the safety valve lead to the boiler was also isolated by the same operation, with the inevitable result.

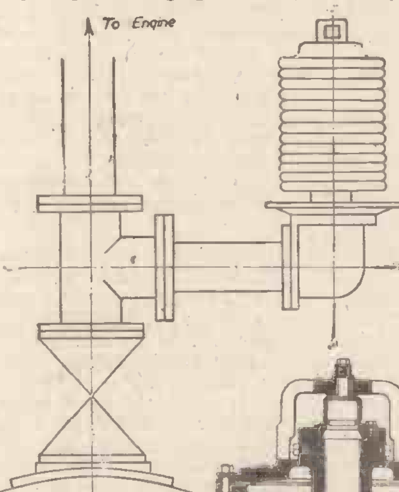


Fig. 1 (Above).—Incorrect location of safety valve in pipe line of early 19th century layout.

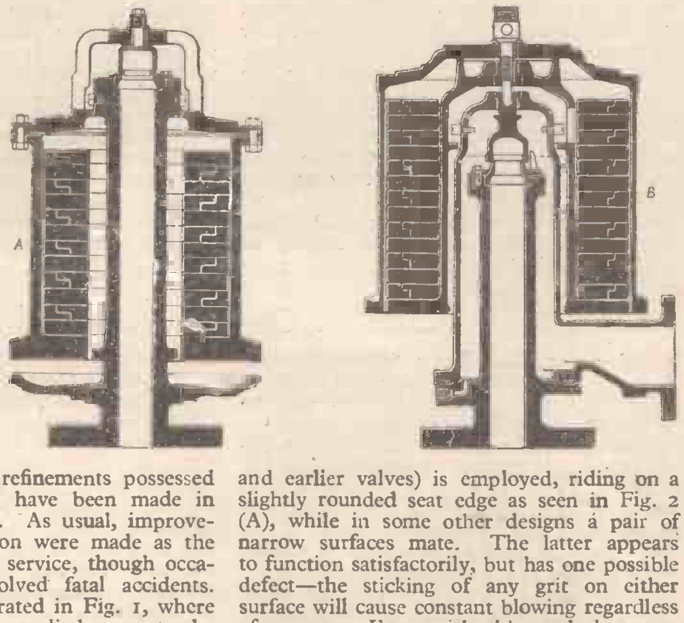


Fig. 3 (Right).—Dead weight safety valves (Hopkinsons).

Safety Valve Design

One of the principal factors that influence safety valve design is, naturally, the steam pressure. This has been extended greatly during the past thirty years, rising from around 200lb. p.s.i. to 2,000lb. p.s.i., and even higher in some experimental equipments. Increasing pressure involves higher temperature, and this is an even more important factor in valve design since the curves of strength and durability for many metals fall appreciably when a specific temperature is passed. Naturally, the proportions of the valve are affected by the steam producing capacity of the boiler, the heating surface area being one of the leading terms in the formula.

Safety valve design is in a category to itself in several respects. It must permit the escape of all steam generated above a certain level, and be tight within reasonably fine limits above and below the figure at which it is set to blow. (For locomotive valves an allowance of 3lb. p.s.i. above and below can be attained.) The material of which the valve and its seat are made must stand up to the relatively high temperature of the steam without any distortion whatever, in order that the contacting surfaces may be steam-tight with the minimum of pressure. A screwdown valve may be kept tight on its seat by force, but a safety valve is more or less balanced when the steam pressure approaches the blowing-off limit, and the load normally available for achieving a tight seal has then been removed.

Joint surfaces vary in shape; sometimes the coned type (provided in the Ramsbottom and earlier valves) is employed, riding on a slightly rounded seat edge as seen in Fig. 2 (A), while in some other designs a pair of narrow surfaces mate. The latter appears to function satisfactorily, but has one possible defect—the sticking of any grit on either surface will cause constant blowing regardless of pressure. Fortunately this rarely happens, the rush of steam when the valve lifts usually cleaning both surfaces thoroughly.

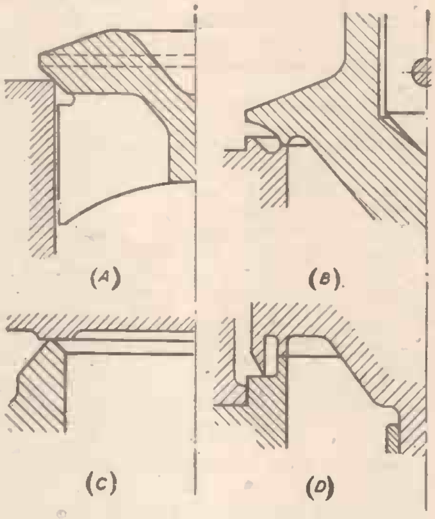


Fig. 2.—Different types of valve seating surfaces.

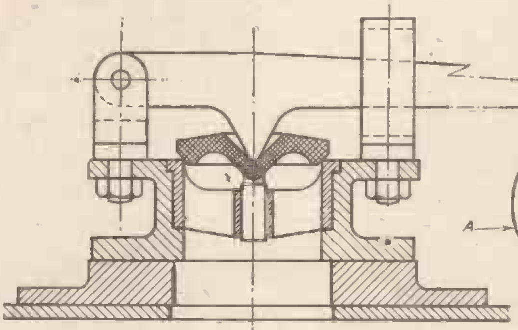
Materials for the working parts must be selected with care to reduce maintenance and replacement charges. Valves usually lift many times throughout the day's working, and the repeated closing blow on the seat tends to hammer up the surfaces and spoil the joint. If the metal is brittle the edges may crack or split, and once an opening has been made for a leak, the erosive action of escaping steam will quickly ruin the valve where high pressures are employed. Springs should be made of high grade steel by reputable makers, and be subjected to proper tests to ensure soundness of material and tempering.

Stationary Boiler Safety Valves

The two designs, which seem to have been largely employed in the early days of steam, are known as the deadweight valve and the lever type. Each has evolved from somewhat crude beginnings, and Fig. 3 illustrates two designs of the first named, that at "A" being known as the "open flow" type, with the valve at "B" having a controlled steam flow through a passage with a pipe provided to take the steam to waste. The location of the weight well below the valve seat ensures correct seating under all conditions, and has no small influence in the success of this design. In earlier types the weights could easily be tampered with by unscrupulous firemen, but in the two valves illustrated the weights are enclosed in a case which can be sealed if desired.

The lever-type safety valve shown in Fig. 4 was largely employed on early boiler schemes and gave good results, some employing the circular cast-iron weight as illustrated at "A" to give the required balance, while others were provided in later schemes with a spring balance (B), which had a screw adjustment. Unfortunately, each of these designs offered excellent scope for improper use, and the facility which enabled an increased steam pressure to be carried has been responsible for numerous boiler accidents. The lever, however, was useful, as it enabled a boilerman to test his valves and safeguard against the risk of a sticking valve. Incidentally, it opened the way to greatly improved designs in which this detail was retained.

As experience accumulated and human safety became more involved, Board of Trade regulations came into being, laying down certain rules regarding the equipment of steam boilers. Some of these concerned safety valves and required the provision of duplicate valves on every boiler. Such a unit of modern design with spring-loaded valves is shown in Fig. 5, and incorporates a high-lift feature which gives a larger discharge capacity than that of the ordinary type of valve, thus reducing the size or number of valves required. This is achieved by the addition of a piston on the spindle above the valve. When the valve begins to lift the escaping steam acts on the underside of the piston, the extra load transmitted to the spindle giving a greater lift to the valve.



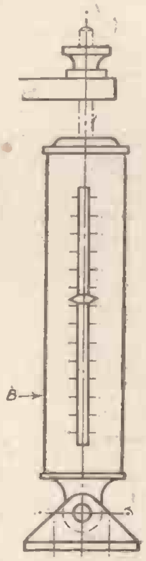


Fig. 4.—Lever type safety valve for weight or spring balance.

The real discharge area of all these valves is measured by the circumference of the valve bore times the lift of the valve, the latter varying in terms of "D" the diameter of the opening, from D/32, known as low lift, through D/9 (high lift) to as much as D/4, which is the lift necessary to give the equivalent to a full-bore outlet. To obtain such a lift, however, changes must be made to the detail design. The guides or wings which the earlier type of valve carried to ensure concentricity while lifting, become obstructions to the steam flow when the high lift (D/9) stage is reached, as the velocity of the steam rises and the nozzle efficiency of the bore is reduced.

Much experimental work has been done on the shape of the various details which together form a modern safety valve as well as the materials, and various designs have been tried out having regard to the duties expected. A type of fitting which is giving excellent results after much scientific research is that known as the "Pop" valve. In the ordinary fitting the valve begins to lift as the load approaches the balanced state under the steam pressure, and a simmering takes place for some time before the main lift occurs. A modern "Pop" valve, however, if correctly designed, will hold its seat almost until the blowing off stage is reached, discharge the excess steam and reseat with the minimum drop in gauge pressure. A fitting which has achieved much success is that shown in Fig. 6, and the reader will note the various special features in its design—the small outlet bore at the valve relative to the inlet bore (indicating relatively high velocity of outgoing steam) and the special design of the valve (noting its seat and the outer lip) with its tubular shaped guide.

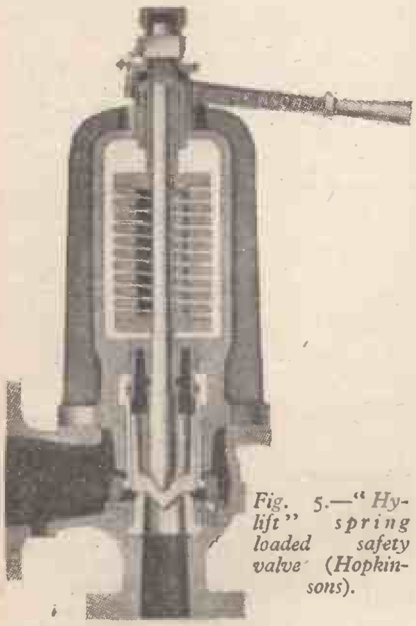


Fig. 5.—"Hy-lift" spring loaded safety valve (Hopkinsons).

An interesting design of valve is shown in Fig. 7, combining in one fitting the functions of a safety valve with those of a low level alarm. The large main valve is used to act as the safety valve, a small ball valve seated on the main valve, opening automatically when the water falls below the level regarded as the safe minimum, the escaping steam giving totally distinctive sounds as it emerges through either of the two valves. On some boilers a somewhat similar fitting is provided, but with a whistle substituted for the safety valve to give warning of a dangerously high, or low, water level, the whistle valve remaining open so long as the danger exists.

On large installations using high pressure boilers the rapid discharge of large quantities of steam creates a noise of a very penetrating character, and one that can be very disturbing to local residents. To overcome this a silencer may be fitted, and Fig. 8, shows a typical unit.

Locomotive Safety Valves

For a number of years after Stephenson produced his famous "Rocket," the design of safety valves for locomotives took different forms. On the "Rocket" a lever type, on similar lines to that shown in Fig. 4, was employed, while Hackworth's locomotive "Sans Pareil" had springs—coach springs in miniature—fitted instead of a weight. A number of early locomotives were provided with dead weight valves, but these were found to be unsafe when the engine was in motion, and their use was soon abandoned. Even the lever and weight type proved unsuitable as the weight obviously tended to jolt off the lever as the engine travelled across the irregularities of the track, the spitting of steam through the dithering valve being most objectionable.

From the latter design the change from a weight to a loaded spring balance, as in the realm of the stationary boiler, was a natural step, the valves on many locomotives being housed in a seating studded to the crown of the dome, and the spring balances, with indicating pointers, lying virtually behind the dome with the graduated surfaces towards the driver. The temptation to screw the valves down an extra turn or two and thus obtain more pressure to help a heavy load up a steep gradient was too attractive for many drivers, and Ramsbottom, the locomotive superintendent of the old L. & N.W. Railway, designed the type of safety valve which bears his name and is shown in Fig. 9. Numerous designs of this fitting are in service throughout the railway world, but all have the same principal features and object, viz., the elimination of any possibility of tampering so long as the boiler is under steam.

Safety links are provided on the Ramsbottom valve to guard against the serious results that would ensue if a spring were to break. Another interesting feature in the design lies in the small dimensional variation in the distances between the spring centre line and those for the columns; this is provided to compensate for the extra weight of the testing lever arm which falls on the rear valve. Valves of 3½in. and 4in. diameter have occasionally been fitted on large boilers, but a quadruple unit of smaller size is preferred for the higher powered units, i.e., two pairs, each with their own spring, lever and links, all mounted on a single base. With the growth in the sizes of boilers as judged from the angle of heating surface and grate area, Ramsbottom safety valves have been gradually superseded by the well-known "Pop" valve, and to-day the latter is almost universally fitted so far as heavy main-line engines are concerned.

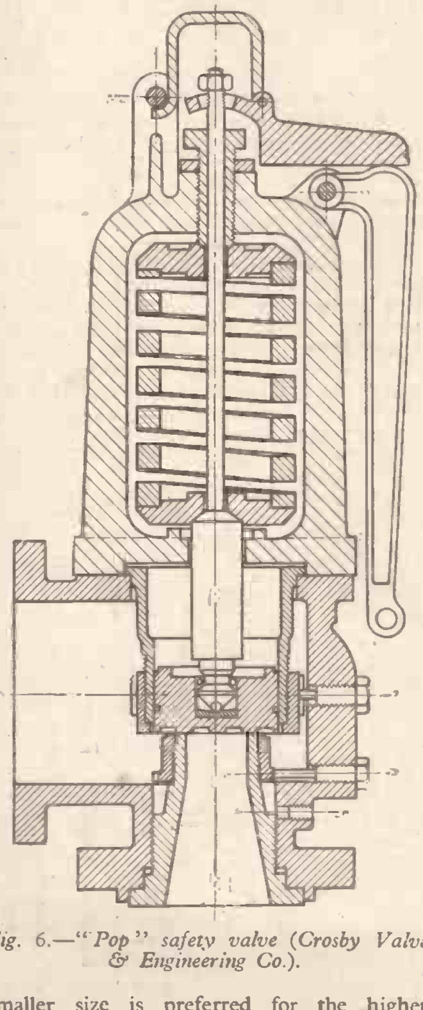


Fig. 6.—"Pop" safety valve (Crosby Valve & Engineering Co.).

Another type of valve, the Naylor, was introduced by Kitson's with the object of obtaining the maximum lift of the valve with the minimum extension of the spring, and Fig. 10 shows one of these in section. Two drawbacks exist in this design, (1) the inability of the driver to ease a sticking valve—at least in the design shown—and (2) the absence of a second valve. The first could have been

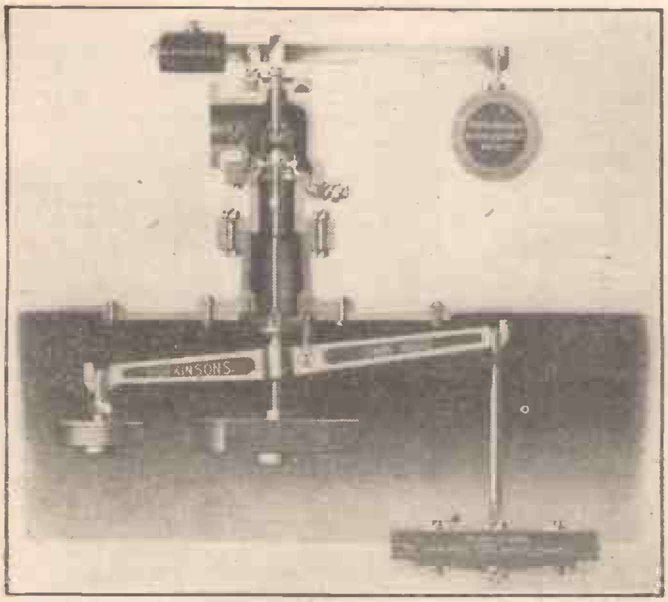


Fig. 7.—" Duad " safety valve for high steam pressure and low water level (Hopkinsons).

overcome quite easily, but a second valve would have necessitated duplicating the base and all its details.

A well-known design of " Pop " valve, of which thousands are in service to-day on locomotives, is shown in section in Fig. 11, and illustrates clearly the important features in this design. Among these may be quoted the lip which surrounds, externally, the seating faces. When a " Pop " valve reaches the set pressure, the steam which escapes is held in compression under this lip, thus increasing the load on the spring and causing

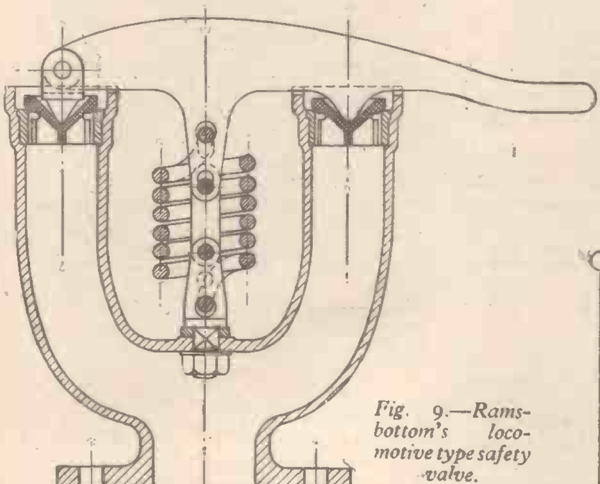


Fig. 9.—Ramsbottom's locomotive type safety valve.

the valve to lift clear of its seat. The suddenness of the lift causes the " pop " sound, and this design of valve is fitted with one or two mufflers to silence the noise. Two of these valves are mounted on most boilers, though larger capacity units may require a third fitting to cope with the steam supply. It is interesting to observe that the design of " Pop " valves for the ultra high-powered locomotives used in this country have been specially designed owing to the small space available between the top of the firebox shell and the rail loading gauge clearance line, the lower part of the valve being actually in the boiler steam space.

Marine Type Safety Valves

In the early days of steam, vessels equipped with this form of prime mover sailed mainly on sheltered inland waters, and owing to the relatively calm surfaces boilers could be fitted with the dead-weight safety valve, or that employing a lever and weight, with success. As time passed, however, and vessels were put into sea-going services, owing to the pitching and rolling of the ship the valves referred to were found unsuitable, and spring loaded valves more desirable. It was also discovered that the dead-weight valve was much too large for the steam generated, while the ordinary design of spring controlled fitting tended to err on the small side, and steps were taken with a view to devising a reliable formula to determine the size of spring-loaded valve which would afford the relief and safety demanded.

At this time numerous experiments proved the advantages of the lip shown in Fig. 2(B), the lift of the valve being found to increase immediately the steam pressure forced an opening, so obtaining the requisite increased lift times the periphery of opening to give the necessary discharge. By increasing the lift it was found possible to reduce the valve diameter, and various devices were adopted then to obtain increased lifts. In one design it was found that considerable back pressure occurred in the waste steam portion, so preventing the valves from lifting as high as otherwise they would. It was, therefore, decided to utilise the back pressure of the steam in the waste pipe to operate the piston of a relay cylinder and thus assist the valve's lifting action. Such a unit was designed and made as shown in Fig. 12, and gave every satisfaction, meeting all requirements as to steam accumulation restrictions. Further research produced the double full-bore fitting shown in Fig. 13, one of which, with two $1\frac{3}{4}$in. diameter valves, enable an evaporation of 20,000 lbs. to be controlled with the pressure rise kept within the limit allowed of 7 per cent. The valve shown in Fig. 14 is one of the modern high-lift type largely used in the mercantile marine of Britain and many foreign countries, and may be regarded as the embodiment of the best practice in marine safety valves.

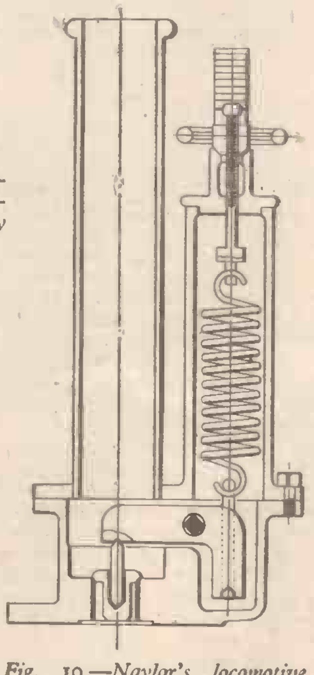


Fig. 10.—Naylor's locomotive safety valve.

To arrive at the correct size of valve, several factors (boiler pressure, total evaporative heating surface or the grate area) must be taken into consideration, and a number of

Fig. 8.—Safety valve waste silencer (Hopkinsons).

formulæ have been devised for all classes. For valves of the various types referred to the following gives good results :

Safety Valves for Land Boilers are calculated by the following formulæ :

For saturated steam—

$$A = \frac{E}{CP}$$

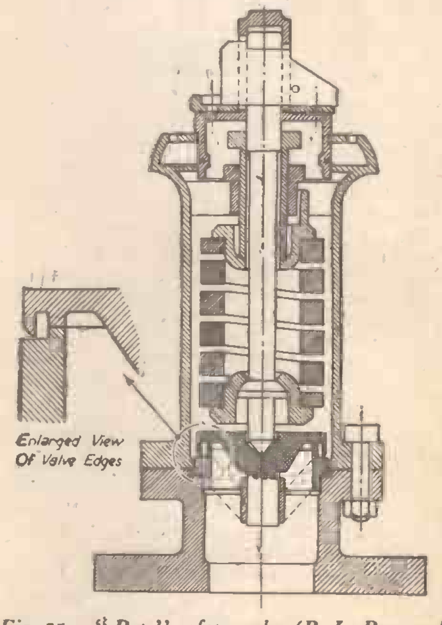


Fig. 11.—" Pop " safety valve (R. L. Ross and Co.).

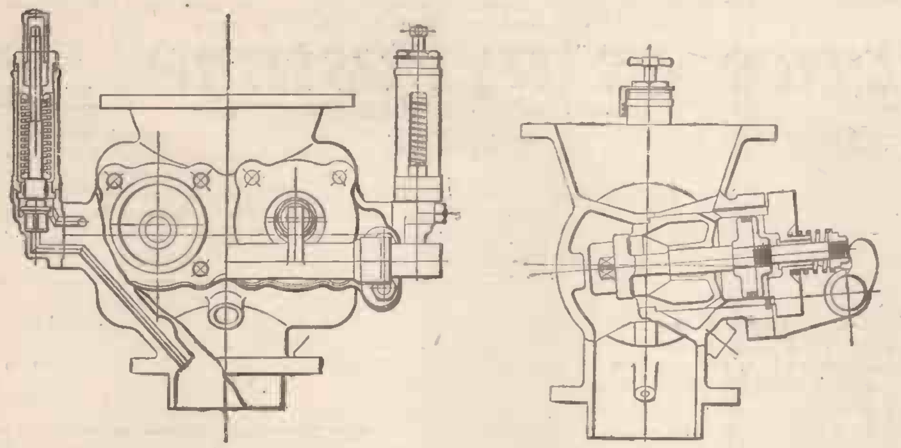


Fig. 13.—Double full-bore marine type safety valve with relay cylinders included (Cockburns, Ltd.).

For superheated steam—

$$A = \frac{E}{CP}\left(1 + \frac{t.s.}{1{,}000}\right)$$

where E = evaporation in lb. per hour.
C = discharge constant of value 20.
P = absolute pressure (p.s.i.).
A = disc area of valve (sq. in.).
t.s. = amount of superheat in degrees Fahrenheit.

Locomotive Safety Valves

Where the Ramsbottom type is to be used the following formula gives good results:

$$d = \sqrt{4H/\pi P}$$

where d = the diameter of the valve at the steam outlet.
H = the total evaporative heating surface of the boiler.
P = the absolute steam pressure in p.s.i.

Example.

H = 2,900 sq. ft.
P = 200 p.s.i.

$$d = \sqrt{(4 \times 2{,}900)/200\pi}$$
$$= \sqrt{18.31} \text{ or } 4\tfrac{1}{4}\text{in.}$$

This, however, is larger than good practice would deem suitable, and four valves would be used in place of two as previously indicated, each having a diameter of $\sqrt{18.31/2}$ or 3in.

For the "Pop" type of valve the formulæ becomes—

DN = .036H/PL, N being the number of valves and L the vertical lift of each, i.e., .0625in.

Example.

Using above values for H and P,

DN = (.036 × 2,900)/200 × .0625 = 8.35.

Three 3in. diameter valves would be ample. "Pop" valves by first-class makers will close down tight at 4 p.s.i. below the pressure at which they are set, thus maintaining an excellent head of steam, assuming correct firing. The valves may be set to blow at the same pressure, if desired, though first-class builders, in the last example given, would set the valves as follows:

No. 1—set to blow at 200 p.s.i.
No. 2—set to blow at 202 p.s.i.
No. 3—set to blow at 205 p.s.i.

Marine Safety Valves

The following are Lloyds rules (1946/7) for determining the correct size to be used and the condition affecting the setting pressures:

"For the minimum aggregate area of ordinary type valves for *saturated steam*, whether obtained by coal or oil firing, with natural, forced or induced draught, use formula (1) below:

(1) (T.H.S. × E)/4.8(P + 15)

where T.H.S. = the total external heating surface in sq. ft. of tubes and other parts of the boiler exposed to heat so as to cause evaporation.
P = the working pressure (p.s.i.).
E = the estimated evaporation in lb. per sq. ft. of total heating surface per hour, with a minimum value of 6.

(2) For superheated steam, the formula used is

$$A\left(1 + \frac{T}{1{,}000}\right)$$

where A = the aggregate area of the valves as already found above for saturated steam, and
T = the degree of superheat in degrees Fah.

"For high lift and improved high lift safety valves of approved types, the aggregate area as calculated by previous formulæ (1) and (2) may be reduced by not more than one-third and one-half respectively.

"The waste steam pipe and passages leading to it are to have a cross-sectional area not less than 1.1 times the combined areas of the safety valves as given above.

"All safety valves to be set under steam to a pressure not greater than 3 per cent. above the approved working pressure of the boiler. During a test of 15 minutes with the stop valves closed and under full firing conditions the accumulated pressure is not to exceed 10 per cent. of the loaded pressure. During this test no more feed water is to be supplied than is necessary to maintain a safe working water level."

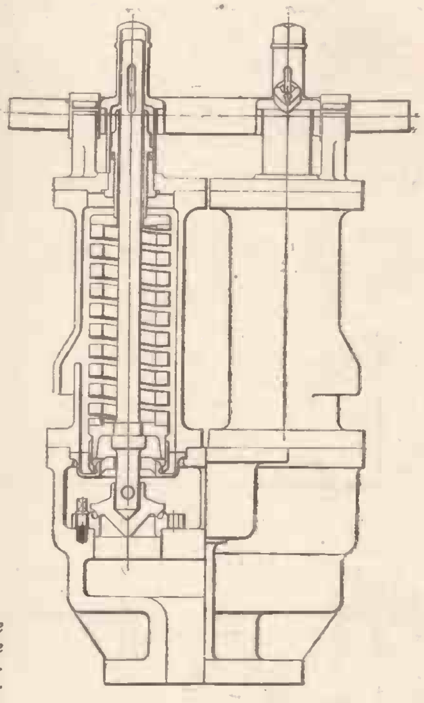


Fig. 14—High lift marine type safety valve for saturated steam (Cockburns, Ltd.).

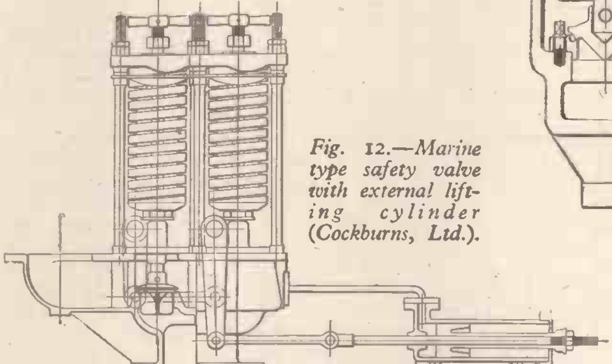


Fig. 12.—Marine type safety valve with external lifting cylinder (Cockburns, Ltd.).

High Intensity Contact Lighting

THE Ministry of Civil Aviation has recently issued the following statement on high intensity contact lighting at London Airport.

The lights are being sunk into the concrete along both sides of the whole 9,000ft. of No. 1 Runway (100 deg. to 280 deg.). Their longitudinal spacing is 80 feet, lateral spacing 150 feet, i.e., 75 feet on either side of the centre line of the runway, which is 300 feet wide.

The lights, which have been designed and manufactured by the General Electric Company, Ltd., are of the so-called flush type; they project only two inches above ground level and thus present no obstacle to aircraft.

The light is emitted in the form of two beams of a peak intensity of about 5,000 candle-power along the runway in both directions. The fittings each hold a single lamp having an optical system which will give an all-round (360 deg.) light emission with a concentration along the direction of the runway.

Previous flush-type lights have been of only 100 candle-power and the light of this new installation is therefore very much more powerful than any other flush-type light used in this country.

Elevated lights must of necessity be placed along the edges of the runways which vary in width in different parts of the world, whereas flush-type lights are laid in the concrete of the runway itself at a standard distance on either side of the centre line irrespective of the overall width of the concrete.

The high intensity runway lights at London Airport are intended to be used in conjunction with approach lights and an instrument landing aid to assist aircraft to land in bad visibility, and thus maintain greater regularity in the operation of scheduled services.

Mathematics as a Pastime

Make Your Own Table : The Torn Sheet of Paper : The Time Factor.

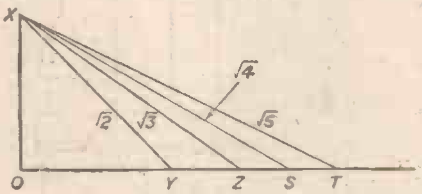
By W. J. WESTON

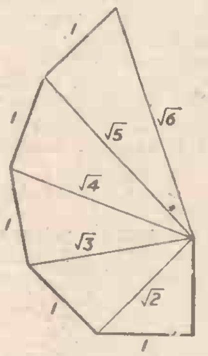
DO you want a table of the square roots of numbers up to 10—even beyond 10 assuming that you have patience? Here are two ways of making the table: either way gives you capital practice in drawing and in reading measurements.

Get your ruler, your set-square, and your compass. Draw a horizontal line across your paper. At one end set up a vertical: an inch will do, but 2in. will give you a better chance to read with reasonable accuracy. The vertical line, marked OX in Fig. 1, is your unit.

With your compass cut off OY on the horizontal equal to the unit. Then XY, being the hypotenuse of a right-angled triangle with sides containing the right-angle 1 and 1, is $\sqrt{2}$. Read this on your ruler marked in inches and hundredths: it is 1.41.

Now cut off along the horizontal from O a line equal to XY, equal that is to $\sqrt{2}$: call that OZ. Then OZ is $\sqrt{3}$, which you make 1.73. Now cut off from O along the horizontal a line equal to XZ, equal that is to $\sqrt{3}$: call that OS. Then OS is $\sqrt{4}$; and, if you have worked with precision, you make this exactly 2. Test yourself until you reach, at





Two methods of making a table of square roots.

any rate, the square root of 9, which is exactly 3.

Perhaps the second way will interest you more: it is another application of the same reasoning. Make a right-angled triangle (Fig. 2), the right angle being contained by equal lines. Then the hypotenuse is $\sqrt{2}$. Erect at one end of the hypotenuse a perpendicular equal to the unit. You now have $\sqrt{3}$. Erect again a perpendicular equal to the unit at the end of the $\sqrt{3}$ line. You have now $\sqrt{4}$, and are well on the way towards an interesting spiral. If, when you reach $\sqrt{9}$ you find it to be exactly 3, you can congratulate yourself and say: "What an accurate draughtsman I am!"

The Torn Sheet of Paper

ARCHIMEDES in his enthusiasm cried, "Give me where I may stand firmly, and I will move the world," as he meditated on the fact that the farther he was from the fulcrum the greater became the force exerted by his lever. Indeed, if only you are allowed to assume things outside the scope of possibility, you can with perfect consistence in your mathematics reach most astonishing results; and Archimedes' position would be among the stars. Certainly that comment of his upon the lever was of less immediate use than his finding how to determine the weights of metals in a mixture, the discovery that prompted the triumphant *Eureka*, "I have found it."

This problem of the torn sheet of paper presents us with another hypothesis that can never be fulfilled. Though you have in all likelihood long ago examined it, the problem comes to you with ever fresh interest, making you say, "My first incredulity was justified; can that really be the result?" And you again resort to your calculation in order to convince yourself. The other day the problem was propounded to a group of clubmen, and not one came anywhere near the correct answer—not within a mile, nor within a million of miles.

You remember the problem; you have a large sheet of thin paper, say 1,000 sheets to an inch; you tear the sheet in two, placing the two halves on one another; you tear again, getting four sheets, and so on for fifty times. How high is the resulting pile? That "over 17 million miles" is the answer appears at first to be incredible. But so it is, and you proceed to convince the doubters in this way.

Two sheets come from the first tear, 2^2 from the second, 2^3 from the third, 2^{50} from the fiftieth; and you invoke your logarithms to get 2^{50}. You can, it is true, proceed, 2, 4, 8, 16 and so on. But, long before you reach the goal of 50 your patience is exhausted, your paper too perhaps.

However, you have logarithms and for this rough calculation you content yourself with four-figure logarithms. Now, the logarithm of 2 is .3010. The logarithm of 2^{50} is, therefore, $.3010 \times 50$ or 15.0500. The antilogarithm of .0500 is 1.122; and the antilogarithm of 15.0500 is, therefore, over 1,122,000,000,000,000.

The number of inches high you obtain by docking off one of the four groups of three noughts; the number of miles you obtain by dividing this still formidable number by 12 and 3 and 1,760; and 17,000,000 miles is exceeded.

But what a sheet of paper! Why, it would serve as a wrapper in which our world would be a hazel-nut in a sack; and one life would be too short for a single tearing.

You will not have failed to note the essence of the problem. It is this: 2 is a small number, its power is also small for a small index, 2 or 3 or 4; but, as you augment its index, the 2 becomes overwhelmingly great. Suppose one suggested to you that, on the first day of May, you save two halfpennies, on the second day four halfpennies, and so on to the month's end. Lightly you agree. You speedily find, however, that you have rashly undertaken a task far beyond your powers. For on the last day of the month you would need to save over £4,000,000. You will doubtless enjoy yourself in showing that this is so.

The Time Factor

Where time is a factor in our calculations we need to tread warily. The time-factor often upsets an offhand conclusion. Every dealer knows that, if he can be assured of a speedy turnover, he can sell at a lower profit—a much lower profit—than when there is a tardy turnover. S.P.Q.R. is his motto (small profits, quick returns), and having the latter he rejoices though he also has the former.

The Director gives an option: "You start at £200 a year. Would you rather a rise of £10 each half-year, or a rise of £40 a year?" You haven't to think long before deciding that the £10 rise is better than the £40 rise. Put down three years' earnings under the alternatives:

	1st half-year	2nd half-year	3rd half-year	4th half-year	5th half-year	6th half-year
£10 each half-year rise ..	£100	£110	£120	£130	£140	£150
£40 a year rise	£100	£100	£120	£120	£140	£140

The first alternative gives you every year £10 more.

The hasty answer to the following problem also is usually wrong. The tropical water-lily reproduces by duplicating itself every day: on the first day we have 1, on the second 2, on the third 4, and so on. Starting with 1 lily it takes 30 days to cover a pond. How long would it take to cover that same pond if we start with 2 lilies? A little careful thought tells you that not 15 but 29 days is the answer. For, when we began with 1, we had on the second day 2; the 2-beginning, therefore, has only 1 day's start of the 1-beginning.

You will enjoy getting the solution to this. You walk down a moving stairway in 30 seconds when you take 26 steps; you walk down in 18 seconds when you take 34 steps. How many steps high is the stairway? Reason that out in this way. The stairway eases your progress down during 30 seconds in the first descent; it eases your progress down during 18 seconds in the second descent. The difference is 12 seconds, and that represents $(34-26)$ or 8 steps. The stairway must, therefore, go down 2/3rds of a step every second: in the first descent it saved you $30 \times 2/3$rds or 20 steps; in the second it saved you $18 \times 2/3$rds or 12 steps. The stairway was, accordingly, $26+20$ or $34+12$ or 46 steps.

You could, perhaps more readily, reach this conclusion by placing x as a temporary symbol for *a-number-that-at-the-moment-I-do-not-know-but-that-I-am-on-my-way-to-find*. Suppose this x to be the number of steps the stairway goes down each second. Then you can make these statements:

At the first descent I went down $26+30x$ steps;

At the second descent I went down $34+18x$ steps;

So, $26+30x = 34+18x$.

And taking $(26+18x)$ from each of these equals:

$12x = 8$

Or $x = 2/3$rds.

The height, therefore, is $26+20$ or 46.

THE WORLD OF MODELS

The Model Engineer Exhibition

By "MOTILUS"

Fig. 1.—Selection of transport models made by the Tramway and Light Railway Society and displayed in an upper room, which was used as a rest room and small bar during the Model Engineer Exhibition.

IF a census were taken of the opinion of boys, young and old, as to what is the most popular exhibition in London during the year, I am sure the majority would be in favour of the Model Engineer Exhibition, which has been held regularly in London for over 20 years, except for a break during the war. The one recently held at the Royal Horticultural Hall, Westminster, was opened by Mr. Percival Marshall, veteran figure in the modelmaking world, who extended his usual cordial

Another view of the Exhibition showing the ship models and miniature traction engines entered in the competition section.

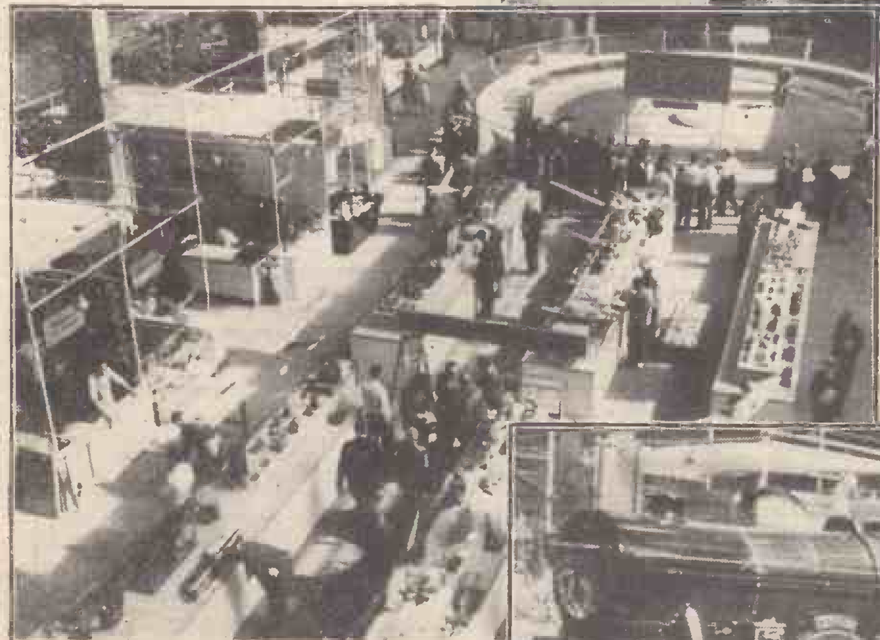


Fig. 2.—Bird's-eye view of part of the Model Engineer Exhibition, seen from the balcony adjoining the rest room. In the foreground are the competition models and in the top right-hand corner can be seen the circular Working Models Arena for aircraft, racing cars and power boats.

welcome to all visitors and said he felt that, this Exhibition being the twenty-second, it was old enough to speak for itself. In fact, he commented, it was beginning to show signs of "middle-age spread," as they were having to use extra accommodation in addition to the Main Hall. Mr. Marshall spoke of the Exhibition as a "family affair," where all those interested in model engineering came to greet old friends and to meet new ones, and he offered warm thanks to both competitors and trade stallholders, all of whom had contributed to the show's success. Mr. Marshall's address was received with enthusiasm by those present, coming as it did from one who always has a kindly and encouraging word for all modelmakers and their friends.

A new feature of the Exhibition was an upstairs rest room, where visitors could find respite from the crowds around the stalls below, and where those whom discussion had

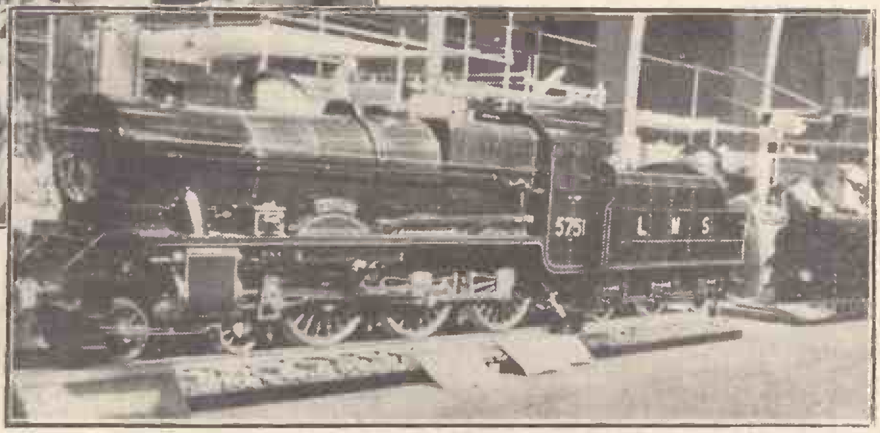


Fig. 3.—The 1in. scale, 5in. gauge L.M.S. coal-fired locomotive and tender, type 5XP, "Centaur." Made by Mr. J. Austen-Walton, who was awarded the Championship Cup in the Locomotive and Railways Section for this magnificent piece of workmanship.

left "dry" could refresh themselves at the bar. This room had its own particular attraction in a display of excellent models by the Tramway and Light Railway Society (Fig. 1), and was used to exhibit the "loan" models, a very varied collection, all having their individual merits. From here, visitors could step out on to the small balcony overlooking the Main Hall, from where they had an intriguing aerial view of the greater part of the Exhibition (Fig. 2).

Circular Runway

A notable departure from the tradition of previous Model Engineer shows was the absence of the model railway running track

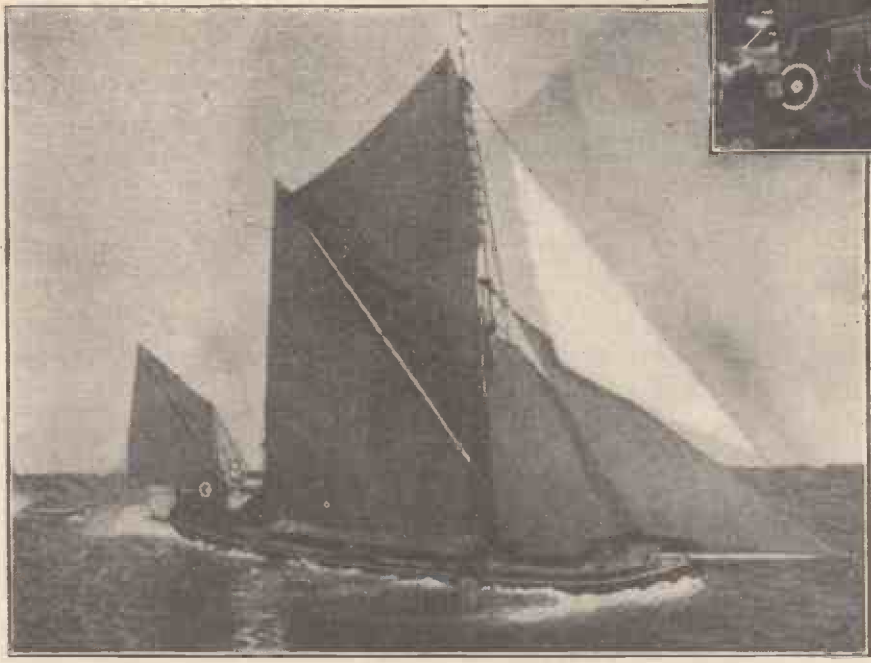


Fig. 5.—A waterline model of the well-known Thames sailing barge, in a realistic setting. The work of Mrs. Iris McNarry, wife of the winner of the Marine Section Championship Cup.

for carrying passengers, which has always proved an attraction in the past for both the youngsters and the older enthusiasts. In its place was a circular Working Models Arena, which was used to demonstrate the thrills of fast model racing cars, speed boats and aircraft. Naturally, there was much difference of opinion as to whether the omission of the passenger-carrying model railway was an improvement or not. It certainly made the Hall more comfortable for visitors to see the exhibits and kept the atmosphere a little fresher. Against that, however, the working steam railway never failed to draw a crowd of passengers and onlookers, the gangway alongside the track usually becoming impassable most of the time. There must have been many children for whom even the breathtaking performances of the model cars, boats and 'planes, impressive though they were, could not compensate for the lack of a ride behind a miniature steam locomotive.

The general distribution and uniformity of the stalls for the trade exhibitors, in steel scaffolding, seemed to me an improvement. I know that some people objected to this method of construction, on aesthetic grounds, but at the same time it gave the Exhibition a more spacious appearance and an opportunity for better display. The arrangement of the Competition Section in parallel lines down the centre of the room was a great improvement and the classification of different types of models made it much easier for visitors to find the sections they particularly wanted to examine.

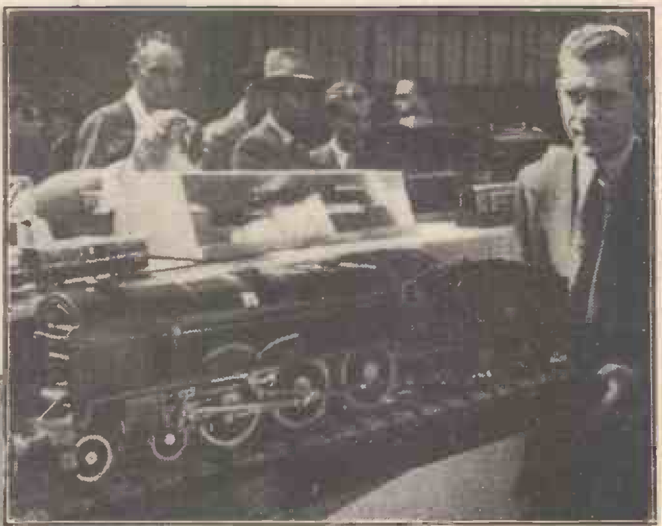


Fig. 4.—A much-admired L.M.S. model locomotive, made by Mr. G. Archer, apprentices' instructor at Percival Aircraft, Ltd., of Luton. The locomotive is a 3½in. gauge, ¾in. scale model of the L.M.S. "Royal Scot." The detail in this model was very carefully carried out, and was much appreciated by model railway builders.

Competition Models

Now about some of the exhibits themselves. The competition models were certainly of a much higher standard than last year and included some that were out of the usual orbit of modelmaking. Let us begin in the Locomotive Section, which always seems to hold first place of interest for model engineers. The winner of the championship cup in this section was Mr. J. Austen-Walton of Worthing, for his 1in. scale, 5in. gauge, L.M.S. coal-fired locomotive and tender, type 5XP, "Centaur" (Fig. 3). This model was built for passenger-carrying duties, so is not exactly to scale: the boiler, for instance, is over-scale, to supply the extra steam required for the three cylinders, which are fitted with piston valves. Mr. Austen-Walton is congratulated on his work and on obtaining the well-deserved award.

Fig. 6.—A waterline model of the Union-Castle liner, "Stirling Castle," to a scale of 50ft. to the inch, with which Mr. D. McNarry, of Barton-on-Sea, won the Championship Cup in the Marine Section.

Much attention was drawn to the 3½in. gauge "Royal Scot" locomotive built by Mr. George Archer. Mr. Archer is a most enthusiastic and well-known modelmaker, and as an apprentice instructor in precision engineering one expects, and finds, good modelmaking, with special attention given to finer details. Our illustration (Fig. 4) shows Mr. Archer with his ¾in. scale model of the L.M.S. "Royal Scot."

As a contrast to these first-class models, constructed from the best materials obtainable nowadays, I must mention a locomotive that was entered in the "Ingenious Utility" Section, consisting of exhibits made from scrap or by purchase of materials costing not more than 5s. The one I specially noted was a 2½in. gauge tank locomotive (Fig. 7), steam-driven, made by Mrs. Austen-Walton, of Worthing, who was awarded a diploma in this section. I am sure that the ingredients will amuse readers; they were as follows: 4 wheel castings (3s.), lid of an Ovaltine tin, lid from a typewriter ribbon tin, some aeroplane wreckage washed up on the beach, part of a stirrup pump, a biscuit tin, spice tin lids, parts of a bird cage and one or two more sundries amounting to a further 2s., the whole costing only 5s. for materials. Certainly a novel example of housewifely ingenuity!

Marine Section

Much as I would like to dwell longer on the entries in the Locomotive Section, I feel I must move on or the reader will be left with a rather limited impression of these very varied competition entries. In the Marine Section, there were some excellent waterline models, without which ship model exhibitions would be incomplete since this fascinating form of craftsmanship was made popular by its introduction at the United Services Exhibition at Earls Court in 1913. At that display all the navies of the world were shown in waterline models, 100ft. to the inch, made by a well-known modelmaking firm in Northampton. At the Model Engineer Exhibition, an outstanding example of this kind was that of the "Stirling Castle" (Fig. 6), a very attractive ship to represent in miniature. This was the work of Mr. D. McNarry, of Barton-on-Sea, who was awarded the championship cup in the Scenic and Miniature Ship Models Section. Mr. McNarry's wife also contributed a scenic model of a Thames sailing barge (Fig. 5), which still retains its Dutch character, and this very realistic presentation showed great skill on the part of this woman modelmaker in tackling fine detail work.

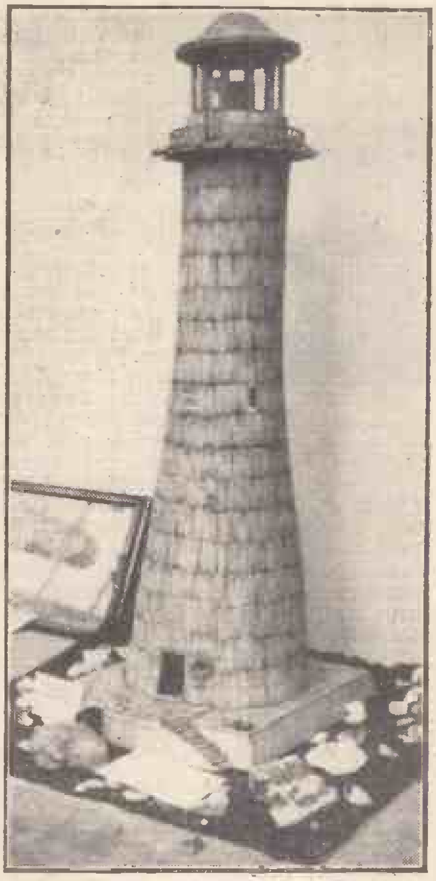


Fig. 9.—An exhibit that drew great attention in the Juvenile Section. A model lighthouse, built entirely from matchsticks, by Master C. Bravery, of Coulsdon.

Fig. 7.—A model tank locomotive, made by a lady, Mrs. Austen-Walton, who was awarded a Diploma in the Ingenious Utility Section of the Exhibition.

Fig. 8.—A ½in. scale model of a Vosper air-sea rescue launch. This is the work of Wing-Cmdr. J. F. Lewis (Retd.), who was awarded a bronze medal. This working model is fitted with a 2 c.c. Diesel engine.

Among the working ship models, one worthy of note was the well-constructed, ½in. scale model of a Vosper air-sea rescue launch (Fig. 8), made by Wing-Cmdr. J. F. Lewis (Retd). The hull was constructed of beech wood, planed down from ⅛in. to 1/32in. thickness, a very difficult operation. The model is fitted with an E.D. 2 c.c. Diesel engine, which enables the vessel to make a speed of six to eight knots. Steering is from the bridge, and in the stern is a carved dinghy, complete with stern seats and thwart seats. The whole model is well finished and painted, and the bronze medal awarded its builder is a worthy tribute.

Readers will, no doubt, remember that in the October issue of PRACTICAL MECHANICS, I mentioned the trials of a model cabin-cruiser, that had been fitted with radio control by Mr. A. Welter, of Northampton. This 4ft. 6in. model was also on show at the Exhibition, and aroused much interest among those with any knowledge of remote-controlled boats.

Model Aircraft

The main display of aircraft was in the gallery above the entrance to the Hall and enthusiasts soon discovered this elevated position and were busy discussing the pros and cons of the different types of model machines, and also the claims made by their makers.

Winner of a championship cup in this section was Mr. H. Marsden, of Gravesend, whose P51D "Mustang" (Fig. 10) was a subject for much comment and admiration. This model is so beautifully made and finished that it has the appearance of a metal machine, but in fact it is 90 per cent. wood. The engine casing is removable, so that by a simple action the engine can be exposed for examination. All the model aircraft showed a good standard of workmanship, whether rubber driven, power models, sailplanes or of the old solid type.

We cannot leave this "tour" of the Model Engineer Exhibition without reference to the Junior Class competitors, among whom must be many whose work will be seen in future exhibitions, when they have gained more experience in the art and craft of modelmaking. Master C. Bravery entered a spectacular model of a lighthouse, made entirely from matchsticks: a very ingenious piece of work (Fig. 9). All the models in this section were made by young people under seventeen years of age.

One could write pages about the numerous attractions at this comprehensive display which represents for so many model engineers the culmination of years of exacting, although much-loved, work. I would like to make brief reference to other models, not illustrated, but which showed special merit. A silver medal was awarded to Mr. K. P.

Fig. 10.—One of the many excellent exhibits in the aircraft section. A scale model of P51D "Mustang," for which Mr. H. Marsden, of Gravesend, was awarded the championship cup for the Aircraft Section.

Lewis, of Birkenhead, for his full-hull, 75ft. to the inch model of the "Empress of Australia," which shows an amazing amount of detail, and which is so built that it floats to the scale waterline. Each sidelight is 1/32in. in diameter! In awarding a championship cup to Mr. J. F. Alderson, of Pontypool, the judges showed their appreciation of his model of a rigged sailing ship, the "Norman Court," presented for viewing under a glass case.

Another championship cup winner was Mr. G. E. Hartung, of Gravesend, for his model of a compound condensing engine; a fine piece of light engineering work.

In the Road Vehicles Section, there was an outstanding 1½in. scale model of a road locomotive, made by Mr. F. G. Bettles, of Taunton. Complete with dynamo in front and crane at the back, this is a most realistic piece of work, showing all the characteristics of the showman's road locomotive, which is quite amazing when we learn that Mr. Bettles designed the model 35 years ago, from memory.

Loan Exhibits

The directors were very pleased to be able to show about a dozen loan exhibits. One of these was a unique miniature suit of armour made by Mr. D. L. Butcher, of Kettering. The figure, 11½in. high, was made of steel thoughout, and was previously exhibited at the British Industries Fair, Castle Bromwich. Also in this section was a model made during the war by the ship's company of H.M.S. *Implacable*. Every member of the crew claims to have contributed something towards the completion and display of this model which has been presented to Lloyds, who adopted the ship.

I do not know the figures of attendance at the Exhibition, but the queue outside the Hall one Saturday morning reminded me of the long lines of waiting passengers outside the main line London stations during August Bank Holiday week. Not one of the waiting crowd would miss this chance to gaze in admiration and envy at this wealth of first-class craftsmanship, to indulge in critical comment and to wander round the trade stands with a weather eye open for a special catch in the way of tools and materials. What a feast is this annual model engineering spread!

Letters from Readers

Developer For Blackline Printing Paper

SIR,—We would like to refer to the information given with reference to developer for blackline printing paper on page 393 of the September issue of PRACTICAL MECHANICS, in response to the request of Mr. J. Gallivan, of Killarney.

In the first place, the inquirer clearly means what is known as a semi-dry development paper and we would point out that Messrs. Ozalid Co., Ltd., are not specialists in the production of this type of paper, since they have specialised for years in the ammonia development paper, ammonia in this sense being applied in the form of a gas or vapour. This type of development is known as "dry development."

In ordinary practice diluted ammonia solutions are never used for semi-dry development of prints. There are two types of semi-dry developers on the market, one applying an alkaline developer and the other applying a weak acid developer; of these two the alkaline development is the old-fashioned type, and the acid development the more modern type.

The alkaline developments have the drawback that the developer discolours very rapidly once it is made up; in fact does not keep very long and would certainly be useless after a few days. The acid developer, on the other hand, has almost unlimited keeping qualities.

As regards the formulæ for these developers, it must be added that they are a closely guarded secret but, of course, the usable types of developer can be found in the respective patent literature, and if the best results are to be obtained with any given make of blackline paper it is necessary, or certainly desirable, that the developer which is marketed by the manufacturer of the paper should be used with that particular type of paper.

We thought that the foregoing would be of some guidance to interested readers.—HALL HARDING, LTD. (London, S.W.1).

Swiss Railway Centenary

SIR,—It was with pleasure and interest that I read the Marquis of Donegall's article on the Swiss Railway Centenary in the September PRACTICAL MECHANICS. In it he mentions that the first train was called "The train with little Spanish cakes." Why "Spanish"? I have just read an article in the current *Swiss Observer* on the Swiss Railway Centenary, by Monsieur E. Birbaum, chef de section à la Direction Générale, Berne. In it he gives two explanations of this nickname.

One is that this train quickly found favour with the well-to-do people of Zurich, who went to Baden, which was a well-known spa and centre of society, where they passed the time in agreeable company. At Baden they ate at tea time a kind of cake which was only made there, because a baker of the town alone possessed the recipe, which came from Spain.

The other is that the servants of the well-to-do folk of Zurich, who, before the train commenced to run, had to leave Zurich at midnight, walk to Baden, collect the Spanish cakes at 4 a.m., and then walk back to Zurich where they arrived at 8 a.m., in time for their masters to have the cakes for breakfast. The train saved them this tedious journey.

He also says that he has never met anyone who has ever seen a steam locomotive used in Switzerland for anything but shunting. One Sunday evening last year, while waiting on Cully station for a train back to Lausanne, I saw a steam-hauled passenger train stop at Grandvause station on the Berne line above us. Judging by the interest displayed by Swiss passengers on the station, it was a most unusual sight. I also saw several steam-hauled goods trains on the same line. The locomotive tenders were stacked with wood fuel. Even Switzerland has its power problems these days.

May I say how much I enjoy reading your interesting paper each month.—JAMES MACINTYRE (Oxford).

Embroidery Transfer Method

SIR,—I should like to pass on to G. Le Huquet (Newhaven), and to other interested readers, a simple embroidery transfer notion which I have used and found to be quite successful, even without the use of this tissue paper.

Using a thin paper, I have made my sketches lightly and, when I have finally decided on the best design, go over the outlines with a carbon, reversed, under the paper. Turn paper over, pull away carbon and go over the carbon lines with an ordinary steel pen dipped in an ink made of washing blue, sugar and water. The transfer is brought off in the usual way with a hot iron. —M. G. MILES (Kirkham).

Book Received

"Your World To-morrow." By Prof. A. M. Low. Published by Hutchinson and Co. 180 pages. Price 16s. net.

THIS book explains in simple language what science can do to make our lives easier and more interesting. It is not generally known that the war has advanced scientific discovery and production by twenty-five years, and this book shows that there are in every branch of industry new inventions and developments which can make life in the immediate future much more interesting and happier.

Among the numerous subjects described are radiograms containing a hundred records telescoped into a small book, telephones fitted to trains and motor-cars, electronic devices which collect every particle of dust as it is formed, and pianos that one man can lift. There are also baby cars with the performance of luxury vehicles, jet aeroplanes, knives that need no sharpening, curtains and creaseless clothes that can be wiped clean with a damp cloth, and curtains that draw themselves automatically. These are but a few examples of the progress made in works and laboratories all over the world under the stimulus of unrestricted research.

As the author remarks in his introduction, "It is no stretch of imagination to speak of the world of to-morrow as one in which there will be immense changes." The world will not be "pre-war" again, and everybody interested in the fact would do well to read this fascinating book.

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.

"One-way" Transparent Glass: "Polaroid"

I SHALL be much obliged if you will give me some information on the type of glass used for windows which are: (1) Transparent from one side and opaque from the other side; (2) glass which is transparent from one side and a mirror from the other side. (3) What is Polaroid and polarised light?—G. Nicholas (Aberdulais).

(1) THE "one-way" transparent glass is an American device. It comprises glass which has been treated on its inner side in such a manner that minute chemical crystals, almost invisible in themselves, are deposited on the glass. These crystals allow the light to pass unhindered one way, but they scatter light rays proceeding the opposite way. Hence, this type of glass, when made into a window, is transparent from the inside but only translucent (not opaque) from the outside.

(2) The other type of glass to which you refer is commonly known as a "half mirror" and is used in some microscopical and other optical instruments. It consists of a very thin film of silver which is chemically (or electrically) deposited on the glass, so that when the glass is regarded at a certain angle, the extremely thin silver film reflects almost the whole of the light, whilst if the glass is viewed from the other side it allows, more or less, light to pass and thus appears transparent.

(3) One of the modern theories of light lays down that light is a wave-like disturbance in some unknown medium which, for want of a better name, we term the Ether. Now, ordinary light (white or coloured) is composed of these waves ("light-waves") vibrating in all planes. Some vibrate up and down, others from side to side, others obliquely, and so on.

It is possible, however, by means of various devices to, as it were, comb out these light waves and to devise a sort of grid or filter which will pass only light waves vibrating or oscillating in the one plane. Such light is then called "polarised" because its rays have only two directions of oscillation or vibration.

"Polaroid" is a material in which are formed by chemical means innumerable minute transparent crystals. The material acts as a polarising medium, so that light which passes through it becomes polarised as above described, the light rays passing through it vibrating in one plane only.

Using Soap Scraps

I HAVE been saving all my scraps of soap for some time now, and have accumulated a large amount. Is there a method whereby I can remake them into solid blocks again, as I want to keep it in store?—F. Head (Southall).

THE simplest method of dealing with the soap scraps is to cut them up into shreds, moisten them with water and then to squeeze the shreds between the hands until they are reduced to the condition of a pulpy mass. This is then packed into some strong container of suitable size and shape—say, a strong wooden box—in which it can be compressed by weights or in a press of some description. On slow drying, the soap will form a solid mass which can be cut up with a knife and used in the normal manner.

Another method is to dissolve the scraps in boiling water so as to make a soap jelly. To this a strong solution of common salt is added. This will throw the soap out of solution as a white pulpy mass, which may then be dried and so used as a soap powder or else compressed on the lines indicated above.

Composition for Setting a Wood-block Floor

I WISH to set a hardwood block floor, and shall be glad if you can give me any information on the correct composition to use.—J. Rowbotham (Heywood).

A WOOD-BLOCK floor is not usually set in bitumen. It is better to glue to an existing wooden floor and to adjacent blocks. However, if you wish to use a bituminous matrix, you should employ a bituminous grout, which is nothing more than a convenient blend of medium-soft bitumens, with or without a proportion of Trinidad Lake asphalt. You should be able to obtain such material from any of your local asphalting firms, such as the Bury Asphalt Company, Ltd., Bury; The Bolton Stone and Concrete Co., Ltd., Fairclough Street, Bolton; or Messrs. Bolton and Hayes, Ltd. Viking House, Bolton. The material is quite inexpensive, but it is not suitable for use in a room which is likely to become hot in winter time, since the grout softens at elevated temperatures.

Removing Mercury Contamination Marks

I SHOULD be glad if you will inform me how to remove mercury contamination marks from the silver case of a watch, and also from an 18 carat gold ring?—F. Payne (East Sheen).

WE presume that the mercury has whitened the gold and has destroyed the lustre of the silver.

There are no safe chemical methods of removing the mercury which apparently has amalgamated with the gold and silver, but, very fortunately, the mercury can be driven out of the metals merely by heat, since mercury itself is a very volatile metal (even at ordinary temperatures). If you place the articles in a warm oven for a few days, the mercury should have been driven off after that time. If not, cautiously heat each article in a non-luminous flame (a Bunsen burner or a spirit lamp, for example). You may safely heat them to a low, red heat (provided that they are allowed to cool down slowly). This treatment will drive off the mercury and the gold ring will regain its original appearance. The silver will be slightly oxidised, but will regain its appearance after a little polishing.

Petrol-level Indicator

WOULD you please explain how a hydrostatic petrol-level indicator works, also where a supply of the liquid may be obtained and the method of replenishing the gauge?—R. W. Cooper (Kirkby Stephen).

THE hydrostatic petrol-level indicator or gauge operates on the U-tube principle. One side of the U-tube is fixed on the dashboard of the car. The tube leading from the other limb of the U-tube leads to the tank element, which consists of a tube which is fixed in the tank and which has a hole at the bottom.

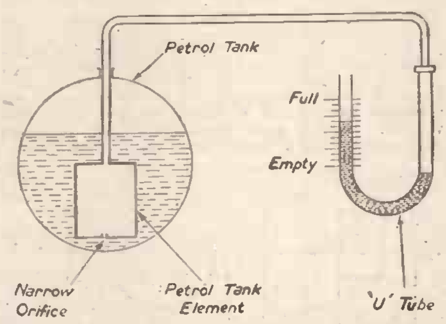


Diagram of a hydrostatic petrol-level indicator. —(R. W. Cooper.)

From the accompanying sketch you will see that petrol endeavours to enter at the hole. Hence the greater the amount of petrol the higher will be the air pressure within the tube, and the higher will be the level of the indicating liquid on the dashboard of the car.

Various indicating liquids have been used from time to time. Acetylene tetrabromide is a common one. It has a specific gravity of 2.9 to 3.0 and is coloured by means of alcohol-soluble dyes. Di-butyl phthalate and tricresyl phosphate can also be used as indicating liquids, being merely poured into the open-ended tube.

Motor dealers do not supply these liquids. They are difficult to get at the present time. You will have to inquire from a good firm of chemical dealers, as, for example, Messrs. W. and J. George and Becker, Ltd., 17-29, Hatton Wall, London, E.C.1; Messrs. A. Gallenkamp and Co., Ltd., Sun Street, Finsbury Square, London, E.C.2; or Vicsons and Co., 114, Pinner Road, Harrow, Middx.

Eliminating Condensation in Garden Hut

I HAVE erected a hut in my garden, with a corrugated iron roof, and I now find that in certain weathers it sweats on the underside. Can you tell me of a cure for this?—A. Banks (Bradford).

THE sweating of light structures such as your garden hut is a very widespread one in these days of converted air-raid shelters, and no *certain* cure is possible in any given case.

The whole trouble is due to the conductivity of the roof and/or walls of the structure, the internal heat passing rapidly through these areas which are, in consequence, colder than the inner parts of the shelter and thus act as surfaces on which the moisture of the internal air condenses in various degrees of severity.

Anything which you can do to lessen the passage of heat from the inside to the outside of the structure will lessen the trouble. The trouble can be overcome by having double walls, with an airspace between them. You can have a roof lining of some non-conducting material such as asbestos sheet, bituminised felt, etc.

Another way is to add ground mica, silver sand or asbestos powder to any good quality paint and to apply this "anti-condensation paint" to the walls or roof of the structure.

A "cork cement" which is stated to have been used by the Admiralty may be of interest to you in this connection. The procedure is as follows:

The roof (or walls) of the structure is given a coat of a red-lead priming paint. It is then coated with a layer of an adhesive preparation made up of 38lb. white lead oil paste, 38lb. ochre, 14lb. paste driers, 11 pints hard-drying varnish and 11 pints boiled linseed oil. When the composition has become tacky, granulated cork is thrown over it by hand and the excess is removed by brush. When the resulting finish is dry, a top coat of a titanium or a zinc oxide flatting paint is applied. The efficiency of this cork cement is said to be very good. It is mostly used on interior work.

Bleaching Black-out Cloth

I HAVE a large quantity of black-out material which I would like to put to other use. Can you please advise me as to the possibility of bleaching the same? I have tried using a solution of Parazone (on a small piece), but this rotted it away. On using a weaker solution I got no results. —G. Kendall (Watford).

THE possibility of effectively bleaching a black-out cloth depends entirely on the type of dye with which the material has originally been dyed. Generally speaking, the possibility of bleaching satisfactorily is but small, because very fast black dyes were normally used in the production of black-out materials.

In any case, it would be difficult for you to handle a large quantity of black-out cloth unless you had special bleaching apparatus.

The only method open to you would be by the use of chloride of lime. You could try out the following process experimentally.

Make fresh chloride of lime into a thin cream with water. Then dilute it with from 40 to 50 times its bulk of water. Immerse the black-out cloth in this. See that it is thoroughly wetted with the bleach liquor. Then remove it, wring it out lightly and immerse it in a bath containing hydrochloric (or sulphuric) acid 1 part, water 4 parts. In this acid bath the black-out material may turn brown. If it does not, it is unbleachable. If, however, it does become browned, it should then be returned to the chloride of lime bath and the operation repeated until the desired amount of bleaching has taken place.

After this it is of the utmost importance to wash every trace of bleach liquor and/or acid out of the cloth. If this is not done, the material will invariably rot and crumble.

Washing is best effected in running water. This should be carried out for a minimum of two hours, care being taken to see that every portion of the cloth is exposed freely to the action of the water.

Embossing Lampshade Parchment: Purification of Gelatine

CAN you please tell me of a method of preparing ordinary lampshade parchment so that it will emboss without cracking? I have tried embossing without preparation of any kind and find that the results are not satisfactory.

Perhaps you can help me in a further query. I am desirous of purifying ordinary cooking

gelatine to remove the "gluey" smell. Is there something that can be carried out without much difficulty?—D. Corbertt (Maidstone).

IF your lampshade material is parchmentised paper it will always tend to crack when folded sharply. If it is genuine parchment, it should be softened with a little neatsfoot oil applied to the area of the embossing (on both sides), the oil being allowed to soak in the material for a day. Parchment which is thoroughly damp will also emboss without cracking. The material can be damped by sandwiching it for a few moments between sheets of wet blotting paper. Do not, however, actually wet the parchment, otherwise it will curl and shrink.

The purification of gelatine is a most difficult job, either on a small or a large scale. On the industrial scale it is done by dissolving the gelatine in water, and by its vacuum filtration through animal charcoal, the filtered solution subsequently being evaporated in vacuum pans. This vacuum treatment is really essential for the recovery of a colourless gelatine from solution. In your case, however, all you can do is to dissolve the gelatine in distilled water and filter it several times through a 4in. layer of animal charcoal or decolorising charcoal, subsequently very gently heating the filtered solution over a slow water bath in order to drive off the water. But you will never get a perfectly colourless gelatine without vacuum treatment. In any case, however, a good class cooking gelatine should definitely *not* have any gluey odour.

Making Fabrics Gas-tight

IS there any way I can treat cotton fabric so that it may be made gas-tight? I should like this to be, if possible, a solution in which to soak the material which will proof it on drying.—R. W. Wayman (Bromley).

A GOOD way of making fabrics gas-tight is to immerse the material in a rubber latex solution and then allow them to dry, subsequently repeating the process, if necessary. This gives a flexible fabric, but, unfortunately, latex is very difficult to obtain at the present time.

Another method is to brush on to the fabric a solution of para rubber You can prepare this by "letting down" ordinary rubber cement with petrol, paraffin or naptha.

Still another solution for the purpose is a solution of perspex (plain or coloured) in trichlorethylene. This however, stiffens the fabric. The various cellulose lacquers will give gas-tight fabrics but, of course, they all dry out stiff.

Even a solution of ordinary gelatine in water will produce a gas-tight fabric, but, here, the fabric is much influenced by dampness.

If you can get hold of any stabilised rubber latex from one or other of the London chemical supply houses you would then best be able to solve your problem.

Water Softener

I WISH to make a water softener capable of treating a maximum quantity of 80 gallons of very hard well water weekly. Would you kindly supply me with particulars regarding the construction and approximate dimensions of a suitable apparatus?—A. W. Auish (Leamington).

OBTAIN a clean 10-gallon drum. Fit a tap to the bottom, and on the bottom of the drum place a 1in. or 2in. layer of clean, broken flower-pots, which should have been sterilised by boiling. On top of this place a 2in. layer of clean, washed coke, or a mixture of this and small stones. Over this place a 6-8in. layer of coarse zeolite material, and surmount this by a 1in. or 2in. layer of small stones and grit. This will constitute your filter. Do not get it too compacted, otherwise filtration will be slow. All the stones, grit, etc., should be perfectly clean, and thorough sterilisation by boiling is advisable.

You will probably be able to get zeolite material from the Permutit Co., Ltd., Gunnersbury Avenue, London, W.4. Other makers of softening material are Sofnol, Ltd., Greenwich, London, S.E., who issue literature on this subject.

It might be advisable for you first of all to make a small model of a softening outfit, say, in a 1-gallon drum. This would serve to familiarise you with the action of the softener and with its capabilities, and it would put you to very little expense.

Cementing Plastic Fabric

I HAVE tried, without success, to stick together pieces of plastic material.

I would be very grateful if you could supply me with the name of a suitable adhesive, or a formula for making same.

I wish to make some bathing helmets, so the adhesive would have to be impervious to water.—G. A. Pooley (London, E.17).

IT is extremely difficult to cement plastic "fabric" material. Ordinary glue, gelatine and other aqueous cements are useless because they will not "wet" the surface of the material. Neither are cellulose cements of much use. The best adhesive we know of is a solution of an actual plastic itself. On these lines, clear scrap perspex may be dissolved in trichlorethylene (obtainable from Messrs. A. Boake, Roberts and Co., Ltd., Carpenters Road, Stratford, E.15). The thick solution which results is spread over both contacting surfaces of the plastic material. The surfaces are quickly brought together (otherwise they will curl badly) and placed in a press for a short time. The joint which results is not particularly strong, but it *is* a joint and it is waterproof. If you use trichlorethylene, please note that its vapour should not be breathed, since it is poisonous and, also, anæsthetic.

Plastic Paint

I AM interested in the use of the so-called plastic paint for interior decoration, and understand it is a modern version of gesso.

I should be obliged if you can give me any formulæ, apart from the common admixture of water paint and plaster of paris, and/or whitening. The rough cast treatment should be suitable for after decoration by paint, as required.—R. Cooper (Liverpool).

MODERN plastic paints are, in principle, merely ordinary paints which are overloaded with filling materials so that they dry out with a firmly-bound rough surface. They are a modernised version of the old Italian gesso.

A mixture of plaster of paris (100 parts), and paper pulp (10 parts), with sufficient pigment to give the desired colour when mixed with water and stippled over the surface forms a simple variety of this paint.

Two other formulæ are:

Ground gypsum	40-60 parts.
Ground mica	15-35 "
Asbestos powder	10-15 "
Casein powder	8-10 "
Slaked lime	5-7 "

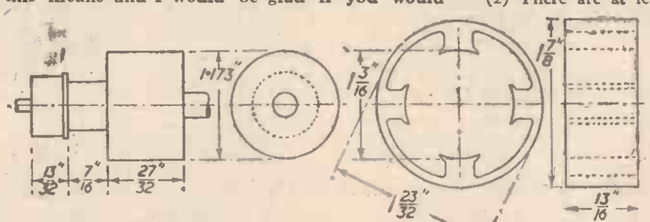
the whole being mixed with water to a thin liquid.

Zinc oxide or lithopone	18 parts.
Water	7.5 "
Glue	0.6 "
Pale boiled linseed oil	3.6 "
Resin	3.8 "
Benzol	3.8 "
Zinc sulphate	0.1 "

Dissolve the glue and the zinc sulphate in the water. Dissolve (by heat) the resin in the linseed oil. Mix the two solutions and add the dry materials. Make up to a paste with extra water if necessary, then thin out with water for use.

Self-starting Small Motor

I HAVE in my possession a motor procured from an old windscreen wiper. I wish to rewind it to work on 6 volts, so that it will provide sufficient power to drive the propeller of a model boat. I want the motor to be self-starting and have been given to understand that this depends on whether the motor is shunt wound or series wound. I am not quite clear as to what this means and I would be glad if you would enlighten me. The accompanying sketch gives the measurements of the armature and field magnet.



Armature and field magnet for a small self-starting motor.—(E. Rawnsley.)

The cross-sectional area of the armature poles is 0.730 sq. in. The cross-sectional area of the space between each pole is 0.0390 sq. in. There are nine poles on the armature and nine segments on the commutator. The area of the field magnet is 0.5443 sq. in.

Would you kindly supply me with the information required to do the job?—E. Rawnsley (Leeds).

ACTUALLY the motor would be self-starting with either a series or a shunt field winding. A series motor has the field coils wound with a few turns of comparatively thick wire, which are connected in series with the armature, so the same current flows through each. Shunt motors have the field coils wound with many turns of comparatively thin wire, the coils being connected across the armature, so the field current depends entirely on the resistance of the field coils.

A series winding is the easiest and would no doubt be best for your purpose, as such motors have a comparatively high starting torque, and the speed of the motor automatically varies with the load. It would assist us to prepare a winding scheme if you would advise us of the air gap clearance between the armature and field poles.

Gut Reviver

COULD you please supply me with the formula for tennis racket gut reviver, as was sold before the war? I find it impossible to buy a proprietary brand nowadays, and would like to make up some for my own use.—A. J. Spurried (Edgbaston).

BOIL ½oz. starch in 8oz. of water. Dissolve about 3½oz. of gum arabic in 8oz. of water. Mix the two solutions and add to the mixed solution an equal volume of a 2 per cent. solution of potassium dichromate (made by dissolving 2 parts of potassium dichromate in 98 parts of water).

Once mixed, the dichromated solution must not be exposed to daylight, since under the seconditions the gum would gradually become insoluble. It is not influenced, however, by artificial light.

For use, the mixed dichromated solution is brushed on to the gut, which is then exposed to bright daylight (or sunlight) for a few hours. By this means, the gummy coating becomes hard and insoluble. Hence the gut is toughened and made water-resistant.

Another gut reviver has the following composition:

Gelatine	1½lb.
Water	½gallon.
Glycerine	2½oz.
Turkey red oil	½oz.
Neatsfoot oil	½oz.

The above ingredients are mixed in the order given, the temperature of the solution being maintained at about 95 deg. C. (just under boiling-point) during the mixing. The liquid is then allowed to cool, and subsequently it is bottled. It sets to a jelly when quite cold, and must therefore be used warm, the gut being brushed over sparingly with the warmed liquid and afterwards allowed to dry without heat.

The former method of gut reviving is the better, but the latter one is quicker in action.

Wax Polish: Sulphur Chloride

WOULD you kindly supply me with the following information:

(1) A recipe for a good motor-car polish of the emulsified type.

(2) Particulars to enable me to make sulphur chloride.

(3) Particulars of the charge for small sky-rockets. Are the ingredients powdered separately, then mixed dry and packed into the rockets, or is some wet mixing method employed, please?—W. Teeboon (Nelson, New Zealand).

(1) AN emulsified wax polish can be made according to the following formula:

Carnauba wax	11.9 grams.
Paraffin wax	1.3 grams.
Oleic acid	3.0 ccs.
Triethanolamine	1.9 ccs.
Water (boiling)	100.0 ccs.

Melt the waxes and add the oleic acid and the triethanolamine. Keep the temperature of the melt to a minimum of 95 deg. C. (i.e. just under boiling point) and add the boiling water very slowly. The mixture must be stirred all the time. When the water is added it will thicken up and form a dark paste, but after this stage it will gradually become thinner with the continued addition of the boiling water until eventually it will become of normal liquid consistency. The liquid polish is then cooled down and filtered.

(2) There are at least three sulphur chlorides, but we presume that you wish to prepare sulpho monochloride, S_2Cl_2 (sometimes called "disulphur dichloride"), this pale yellow, pungent-smelling liquid being used as a solvent for sulphur in various rubber manufacturing processes.

Dry chlorine gas (prepared by the action of hydrochloric acid on manganese dioxide) is passed over molten sulphur contained in a flask. A glass tube leads from this flask into another flask which is cooled in water. The sulphur chloride which is formed in the sulphur-containing flask distils over and is collected in the cooled flask. It is purified by redistillation. It boils between 138 and 140 deg. C.

Another sulphur chloride, sulphur dichloride, SCl_2, can be prepared by passing chlorine gas through sulphur monochloride until the pale yellow liquid turns into a garnet-red liquid. The flask containing the sulphur monochloride must be cooled in ice during this reaction.

(3) A suitable rocket powder may be made according to the following formula:

Potassium nitrate (saltpetre)	72 parts (by weight)
Sulphur	6.5 " "
Charcoal	21 " "
Mineral oil	0.5 " "

More oil may be incorporated to slow up the rate of combustion if required.

An alternative and somewhat more rapid-burning powder is:

Potassium nitrate	74.67 per cent.
Potassium sulphate	0.09 " "
Sulphur	10.07 " "
Charcoal	14.22 " "
Water	0.95 " "
	100.00

A Correction

IN the reply to P. H. Belsey (Dover) in the September issue a printer's error occurs in the formula, which should read as follows:

$$V = 4.44 \times f \times S \times \phi \times 10^{-8}.$$

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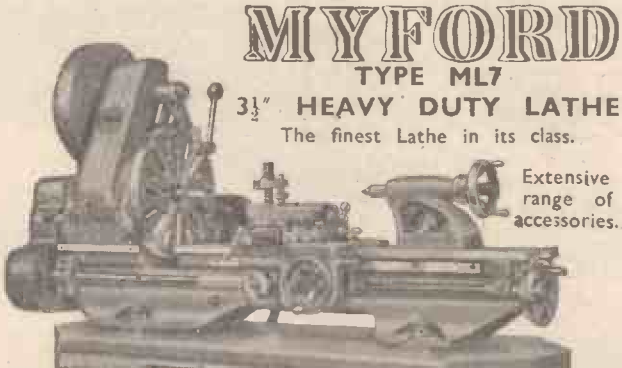

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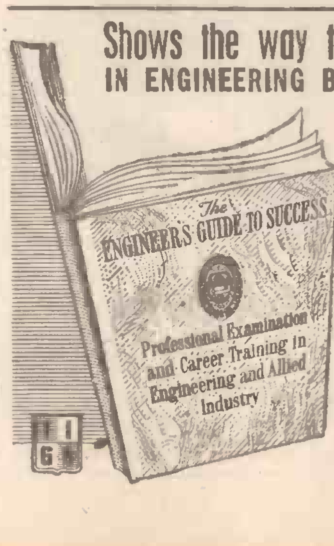

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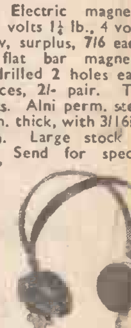

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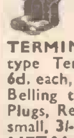

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THE Cyclist

Editor: F. J. CAMM

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

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Comments of the Month

By F. J. C.

Final Report of the Committee on Road Safety

THE Committee on Road Safety has issued its final report, and it contains a number of suggestions affecting all road users. We do not know how the recommendation affecting cyclists will be received by those whose minds have not been shaped by the mould of the N.C.U. or the C.T.C. It is certain, however, that both these bodies will oppose them.

The clauses affecting cyclists deal with subjects which are by no means new, and all the arguments for and against have been placed before the committee. Their final conclusion is that pedal cyclists should be required to report to the police accidents in which personal injury is caused, and that they should be liable to prosecution for reckless and careless riding. The committee also considers that the police should have powers to stop pedal cyclists on the road similar to the powers they now have to stop drivers of motor vehicles.

It is felt that if cyclists are compelled to report accidents, registration of cyclists will follow as a matter of course. This, of course, would mean taxation as a necessary corollary. The committee also feel that the time has come for regulating the behaviour of pedestrians. They think it should be an offence if a pedestrian fails to conform with the signal of a police officer regulating traffic, or impedes the free flow of traffic which has been signalled to proceed by a police officer or by traffic light signals, or if he disregards guard rails created on the edge of the pavement in certain localities to restrain persons from crossing at such places.

Self-preservation being the first law of nature, it may seem quaint to have to make it compulsory for pedestrians to use devices specially created to protect them from their own folly. We must agree that there is a great amount of careless pedestrianism. The pedestrian crossings are not used, and guard rails are ignored.

We think that most cyclists will agree with the suggestion made by the committee for the periodic inspection of motor vehicles in publicly owned testing stations. This proposal is based on the belief that if all vehicles are roadworthy road accidents would decrease considerably. Accordingly the committee suggests that the legislation necessary to give effect to the scheme should give power to the Minister of Transport to require vehicles to be presented at a testing station at specified intervals (it is tentatively suggested that there should not be more than two inspections yearly); and to require a vehicle to be taken to a testing station or presented for inspection if there are grounds for believing that it is in a dangerous condition or that the condition may have been the cause or a contributory cause of an accident.

Permanent Testing Stations

IT is thought that permanent testing stations should be set up in towns where the number of vehicles registered within a radius of eight miles approaches 20,000, and that where the concentration of vehicles is less mobile testing stations should be used. It is recommended that a standard, or standards, of braking performance should be prescribed for the guidance of testing officers and all concerned. New vehicles should not require to be tested until they have been licensed for six months.

This committee has made an intensive study of the accident problem for over three years. Its interim report, published in 1945, dealt primarily with questions which required urgent consideration in the early post-war period.

Other recommendations include: research should be made into the determination of accident proneness; police mobile patrols should be extensively used, and considerations given to increase in the rate of grants from central funds towards their cost; direction indicators and stop lights on motor vehicles should be compulsory and that motor vehicles should normally be fitted with an external and internal mirror.

The report has not yet been considered by the Minister of Transport and no decisions have been taken on its recommendations, to which the Government is in no way committed. Whilst the work of this committee now comes to an end another committee replaces it, and it is intended that this should be a permanent feature of the Ministry of Transport.

It would be a most unpopular move if the Government thought fit to introduce compulsory registration and taxation.

The reporting of accidents, we think, is sensible and fair. There have been many cases where, as with motorists, a pedestrian is knocked down by a cyclist and the cyclist fails to stop. Cyclists have been loud in their criticism of motorists who adopt this reprehensible practice, and we do not see how they can sensibly oppose this recommendation. Many years ago cyclists agitated for the fitting of rear lights on horse-drawn vehicles, but successfully opposed the fitting of rear lights to bicycles for a number of years. This attitude does not impress Government departments.

Educating Road Users

OF course, taxation will not reduce accidents, and yet we know of police witnesses who advocate taxation as a means of reducing the number of accidents on the road. Well, it has not done so in the case of motor-cars, nor has the creation of about 2,000 technical offences. It is in the realm of educating road users that the solution to the accident problem lies. A great deal has been done in this respect, but a large amount of it has been misguided effort. The gloomy-looking road widow poster was a waste of paper and money.

However, resolutions are being passed, and the big guns of cycling opposition are being manœuvred into position. A great deal more will be heard about these recommendations before they reach the Statute Book, *if* they ever do!

"Closed" Circuits

THE president of the N.C.U. has been made aware of certain facts concerning recent N.C.U. massed-start racing. It is stated that there have been serious breaches of N.C.U. rules which have been condoned and even supported by N.C.U. officials, whilst at the same time condemning B.L.R.C. events.

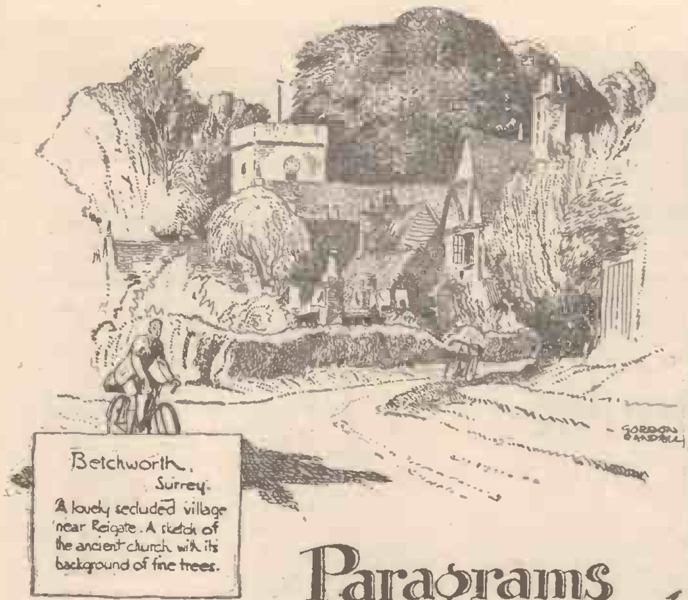
In the West Middlesex events at Wembley, it is reported, there were several buses and private cars using the roads during the events. The police have no power to close the roads to people having business on them. It cannot therefore be argued that the circuit is closed and the event to all intents and purposes is run under the same conditions as those promoted by the B.L.R.C., but with important differences. League riders must strictly adhere to the rules of the road, the field is restricted and the police co-operate in the running of their events; whereas in the N.C.U. events the field is unrestricted as to numbers and they are permitted to ride without regard to other road users.

The N.C.U., although well acquainted with these facts, have decided to take no action, because it is said that the Wembley circuit is a useful training ground for riders. The N.C.U. has no rules, of course, for massed start racing on the road other than on closed circuits.

We have already drawn attention to the fact, in a previous issue, that similar conditions to the Wembley event also apply to the Cumrae circuit, where there were cars, cattle and pedestrians, travelling to and from the Ferry, whilst racing was in progress. At Newcastle last year the event took place on open roads.

It would also seem that the roads were not closed in the recent championships, part of the circuit here being on private roads. It is reported that at least one bus was on the same circuit during the progress of the race and that a member of the N.C.U. London centre was riding round in a car whilst the race was in progress.

The N.C.U. has been invited to explain how the above facts can be reconciled with their policy and rules. Photographic evidence is available to support the above facts. It would appear from this that the N.C.U. opposition to the B.L.R.C. is dog in the manger.



Betchworth, Surrey. A lovely secluded village near Reigate. A sketch of the ancient church with its background of fine trees.

Paragrams

Plenty to Choose From

AT a Ministry of Supply sale of bicycles and motor-cycles at Kirmington, Lincs, 2,572 cycles were offered and found ready purchasers. The highest price for a single cycle was £4 2s. 6d. paid for a ladies' model, but the majority of the machines were sold in lots of 20. These lots went for between £12 and £25 each lot.

In the Bag!

A NOVEL method of carrying the youngest member of the family when mother and father go out cycling was seen the other day. Fastened to father's back by wide webbing straps, in the same way as a haversack, was a stout bag just large enough to hold the baby comfortably, with a hole at each side of the bottom so that its legs could dangle through. The baby appeared to be quite at ease, and surveyed ordinary babies, who have to ride in prams, with complete disdain.

Birthday Celebrations

ARRANGEMENTS are going forward for the 21st birthday celebrations of Doncaster Wheelers Cycling Club in October. A special birthday dinner and social gathering is planned, so that as many of the present and old members as possible can get together.

Bad Road Surfaces

CYCLISTS who slide and bump about over newly surfaced roads and curse the local authorities who laid down outsize granite chippings instead of using the correct size should turn their wrath on the quarries who supply the chippings. Like everything else these days, the customer has to take what is thrown at him in the way of granite chippings. Screening plant at the quarries is not what it should be, and local authorities have to take larger size chippings or none at all. Not that this is much consolation when one has just escaped being thrown under a bus because of a wheel skid caused by the road surface.

Footbridge Plan Deferred

THE Isle of Ely Highways Committee have decided to abandon their proposed £92,000 scheme for the construction of a bridge over the railway level crossing in Station Road, March, owing to present conditions and the curtailment of Ministry of Transport grants. A traffic census taken recently shows that the majority of traffic over this crossing consists of cyclists and pedestrians, and accordingly the L.N.E.R. are to be approached with a view to the provision of an improved footbridge for cyclists as well as pedestrians.

Bicycle Saved His Life

ONLY the promise of a bicycle when he gets better has pulled seven-years old Peter Biggs, of Peterborough, through a serious illness. For a long time he made no progress until one day his parents said he would have a brand new cycle ready for the time he was well enough to ride it. Hearing of the promise, some 40 of Peter's friends and neighbours clubbed together to help to buy the machine. Peter is now out of hospital, although not quite well yet, and his greatest joy in life is "my new bike" and the thought of the many hours of pleasure he is going to get from it.

Bicycle (Plus Hay) Pony Decoy!

WHEN Mrs. Jill Morgan moved from the Yorkshire village of Tanfield to her former home at Stratton St. Margaret, Wiltshire, she decided that she, her six-year-old son, four dogs, her friend and various odds and ends would travel by road. So the pony was harnessed to the trap and Mrs. Morgan and her friend took it in turns to ride the bicycle, to the back of which was fastened a bundle of hay, just in front of the pony's nose to give it an interest in life. The procession took about 13 days to cover the 216 miles from Yorkshire to Wiltshire, and the only unfortunate incident occurred almost at the end of the journey when some thief dismantled the cycle and stole the three-speed gear and a tyre.

Asked for King's Help

SO angry have residents of the village of Helpston, near Peterborough, become over the apparent lack of interest by any authority in the repair of a much-used bridge on the road to Peterborough that one resident has written to the King, asking if he can do anything for them. The bridge, the repair of which was believed to be the responsibility of some private individual or concern, was washed away during the spring floods and has been useless ever since. Peterborough County Council Roads and Bridges Committee have now recommended that the Council should contribute towards the cost of repairing this and other bridges in the district, but nothing definite has yet been arranged.

Sweeping Statement

TO Mr. H. J. Deane, North Leicestershire coroner, all cyclists are apparently just menaces on the road. At a Loughborough inquest on a cyclist, killed by a following lorry, the coroner said: "Those in the habit of using the roads must have observed that cyclists are not at all disposed to give proper and timely signals of what they are going to do." According to the evidence the cyclist, when about 15ft. in front of the lorry, "looked and turned at the same time and only half raised his arm." The jury exonerated the lorry driver from all blame when they returned a verdict of accidental death.

New Cambs Club

THE March (Cambs) Cycling Club, which was disbanded during the war because of the absence of members in the Forces and various wartime difficulties, has now been reformed. A good number of supporters were present at the inaugural meeting held at the George and Star, March, when plans were made for runs and social activities, and a committee was elected, consisting of: chairman, Mr. C. Waters; treasurer, Mr. G. Currey; secretary, Miss A. Currey; captain, Mr. C. Bradshaw; vice-captain, Mr. A. Walker; and an official repairer, Mr. A. Briggs.

Cyclists Were Suspicious

THREE drivers connected with a Peterborough garage co-operated with the City Police during the local Road Safety Week by driving through the streets observing every clause of the Highway Code and carrying appropriate Road Safety slogans. These cars even gave way to cyclists and pedestrians, the majority of whom were so startled at receiving courtesy from a motorist that they just failed to take advantage of it. The drivers admitted afterwards that driving correctly according to the Code was quite a strain.

Good Advertisement

MR. WILLIAM CHARLES WEBB, of 77, Parklands Drive, Loughborough, is at 70 years of age a fine advertisement for the sport. When he was about 14 he started riding on an "Ordinary," which he acquired in a barter transaction involving a silver watch and five shillings cash. It was a "racing model," but was liable to shoot its rider through the air at the slightest provocation. Eventually it shed a pedal and was sold for half a crown. In spite of a lifetime on the road, Mr. Webb claims never to have been in collision with another road-user or pedestrian. His pleasure is to ride alone so that he can get the fullest enjoyment from the scenery. He does not like club cycling, nor does he fancy riding with a companion who talks at the wrong moment, but when he reaches the end of his trip he is the most companionable man possible. He cycles all over the country visiting relatives and friends and a short time ago carried out a trip of 500 miles in a fortnight. He has never been without a cycle since his first penny-farthing and he hopes it will be very many years before he is unable to pedal along in the fresh air.

Three Fast Girls

THREE Northampton sisters, all members of local cycling clubs, came in first, second and third, respectively, in a five minutes' pursuit race at a Kettering track meeting which was arranged by the Northampton Invicta Road Club in conjunction with the Kettering Club. They were Mrs. D. Moore, of the Invicta R.C. and the Misses P. Eldred and M. Eldred, of the Eleanor R.C.

The "Round of Bergen" Race

SPORTSMAN from Boston, Lincs, who paid a visit to Bergen-op-Zoom, in Holland, from where a party visited Boston last year, had the opportunity of seeing the famous "Round of Bergen" cycle race through the streets of the town. Some 30,000 people watched the 60 odd riders cover the course of 60 laps of about two kilometres each. The winner was a local rider, Braspenning, who cover the 125 kilometres in 3 hrs. 23 mins., winning the first prize of 1,000 guilders or approximately £100. Cyclists and other sportsmen from Bergen are planning to revisit Boston next year and take part in competitive events.

Long Ride

PERSHING BALDWIN, a former paratrooper with the 52nd U.S. Airborne Division, who was stationed at Hinckley, Leics, for a time during the war, called to see old friends there when he passed through with a small party who are cycling round Europe. The party is connected with an organisation which is planning the establishment of hostels in various continental towns and villages to provide low-price accommodation for young cyclists and hikers of all nations who visit Europe.

On the Road at Ninety

CYCLING certainly seems to have something to do with longevity. Ninety-year-old Miss Jessie Colman of Lincoln Road, Peterborough, who celebrated her ninetieth birthday at the end of August, is a good example of the sprightliness which comes of years of cycling. She has been riding since 1896 and is a familiar figure in Peterborough and district on her tricycle which she has had for some 30 years, and on which she has covered thousands of miles. Traffic does not bother her unduly but like the rest of us she wishes there were a little less of it at times.

Vanishing Death Trap

ONE of the most dangerous spots in the whole of Huntingdonshire, which has brought the heart of many a cyclist into his mouth as he met some car or huge lorry almost head-on, the ancient hump-back bridge over the River Nene, at Ramsey St. Marys, will soon be just a bad memory. The old bridge was of brick, with blind approaches and a hump which rose seven feet above the normal level of the road and was only 11ft. 6ins. between the parapets. It is being replaced by a modern reinforced concrete bridge with a between-parapets width of 40ft. Plans for a new bridge were considered before the war but had to be shelved for the time being, but work is now proceeding satisfactorily and the bridge will, it is hoped, be ready for use before the end of this year. Spring flooding brought the old bridge almost to a state of collapse.

Cycle Polo in Midlands

SHORTLY before the war bicycle polo, which is once again becoming popular in the London area, was revived in the Midlands by the Wellingborough Cycling Club. When the war came the special cycles and equipment were stored and there are now tentative suggestions in the air that the sport shall be restarted again. Last winter attempts were made to start two cycle polo teams in Northampton—Invicta and Eleanor—but when it appeared that the teams would have to be more or less continually playing against each other, owing to the absence of other local teams, the idea was temporarily dropped.

Misspent Holidays

ACCORDING to the Superintendent of Kettering Police, several local boys who became bored during the school holidays hit upon the idea of taking unattended bicycles, riding them for a while and then leaving them in various parts of the town. The Police, who have plenty to do these days without any unnecessary work, took a very poor view of this scheme and soon some young offenders made their appearance in the Kettering Juvenile Court. One nine-year-old, charged with stealing a cycle and also a cycle pump, was said to be a neurosis case in need of treatment.

Watch Those Repairs

THE necessity for cyclists to check their machines from time to time was emphasised at the inquest, at Chesterfield, on a 71-year-old cyclist who was found by the roadside outside the town suffering from severe head injuries, having apparently been thrown from his machine. A check of the cycle showed that the rear mudguard had been fastened to the frame with wire, but the wire had broken, allowing the mudguard to slip round the wheel and act as a brake and twisting the mudguard stays round the rear axle. There was quite a steep gradient at the spot where the accident happened and the cyclist, said to be a keen and capable rider, was unable to save himself.

Healthy and Cheap Holiday

THAT if you use a little common sense it is still possible to have an enjoyable holiday without spending a fortune, in spite of high prices everywhere, has been proved by two young Leicestershire cyclists, Don Crutcher, of Hinckley, and Roy Stevens, of Erdington. With £2 and a blanket each and a few oddments, they cycled the 350 miles to Lyme Regis and back, getting most of their meals at transport cafés, where they say the food was good and cheap. They spread their blankets for the night in haystacks and sheds and once, near Salisbury Plain, slept in an old bus station. Their expenditure included one dance, some picture postcards and, of course, a quantity of ices.

Around the Wheelworld

By ICARUS

RYE, Sussex. The great Landgate dating from the days of Edward III. The town was twice burnt by the French, in 1377 and again in 1448

"The Mounted Foot"

IT is the general belief of lay journalists and other ignorami that cyclists go out on their bicycles looking for a car to knock them down or, alternatively, that motorists have large searchlights fixed to their cars and that they go out at night looking for cyclists to knock down. If a motorist knocks a cylist down on a pedestrian crossing that doesn't count; the motorist is entitled to have another shot.

There are journalists who think that cyclists may be found driving cars, sitting in the middle of the road laughing hysterically, or in the nearest asylum. I was therefore interested to read an article in the *Irish Independent* on the subject of "The Mounted Foot." Here is a quotation from this misleading article:

"By far the most numerous class are the Mounted Foot. These are mounted on a lethal engine called a bicycle. Most fashionable method of propulsion is by pressure of the instep on a pedal. This enables the feet to stick out on either side, but whether this results in any increased lift or speed is an undecided problem in aerodynamics.

"The members of the Mounted Foot are a race apart. In the first place they are immune from the law of gravity. In fact, it is very difficult to find any law to which they conform. This is as it should be, for these wheeled and whirling Dervishes and Dervishesses are, in reality, disembodied spirits.

"Now, if you were a cyclist, could you pass between a five-ton lorry and a taxi-cab, separated one from the other by half a handlebar? You could not. I thought so. That means that you are not a qualified member of the Mounted Foot.

"Watch this frail-looking Dervishess do it. She comes up at a fine smack of speed, looking behind her to see whether her companion has decided to go round, over, under, or through a motor car.

"Suddenly she sees the narrowing gap in front of her between the lorry and the taxi. An unholy joy fills her. In some strange, fantastic, Disney-like way, she becomes all length and no breath, and sails through the gap in two dimensions. The moment she is through she fills out again in human form. This is one reason why lorry drivers and taxi men are such believers in the supernatural.

"The two of them are just reaching under the dash for their vocabularies when her companion performs the same trick. They put their books back. What is the use of talking?

"The methods of the male of the species differ somewhat. The pet delight of the Dervish is the swerve. This is a feat breathless in the beauty of its curves.

"To do it really well, the Dervish requires at least four motor-car bonnets, preferably all in motion in different directions and at various speeds, a woman with a pram, a flock of sheep, part of the road up, and an onrush of fellow Dervishes. Then he is in heaven—or would be if he did not know how to swerve.

"It is because of these people that motor car radiators are so shiny. The high polish is due to Dervishes rubbing them at high speed broad side on.

"Of course I could tell you something about cyclists, too, but they do not count for anything in this town."

Now I am sure that the columnist concerned really enjoyed writing that article, and I am more than ever convinced that the late Lord Northcliffe's suggestions should be adopted—namely, that daily paper journalists should be lined up in Hyde Park to let the public have a good look at them!

Vehicle Lighting-up Time

MAY I remind cyclists, what they should already know, that the lighting-up time for all road vehicles, including bicycles, is from half an hour after sunset to half an hour before sunrise instead of from one hour after sunset to one hour before sunrise?

Bicycles in America

ANOTHER daily paper journalist who can know very little about bicycles wrote an article in one of our leading daily newspapers telling British bicycle manufacturers what they ought to make for selling in the American market. I do not think that any bicycle manufacturer will do other than laugh.

This correspondent seriously suggests that British manufacturers should follow American practice in bicycle design. Cycling has never been very popular in America, judging from the number of cyclists in relation to the total American population. I suggest it is because American bicycles are so heavy, so badly designed, so over-tyred, so imitation motor-cycle, so flamboyant, and so slow that one needs to be a Goliath to propel them at all.

American bicycles of the popular type have dummy petrol tanks and dozens of gadgets to disguise the fact that they are pedal propelled. That is why the English-made bicycle is in ready demand in America. If any advice is needed, it is to the American manufacturer to emulate British practice and to produce a bicycle worthy of the name instead of ornate toys which they present to film stars in exchange for a photograph of the said star dressed in night attire with one toe delicately poised upon a pedal. We have nothing to learn from America on the manufacture of bicycles. This country was the home of the bicycle.

I cannot think of one invention or development in connection with it which comes from America. Editors of daily newspapers really should obtain the services of competent cycling correspondents.

The Social Season

IN these austerity days I expect that the number of social functions will this year be considerably reduced. There is no reason however, why clubs should not meet for a merry evening minus the festive board. It is not the food which should be the main attraction, but the annual get-together spirit. The annual "do" is the one occasion when all members of the club can meet. Some clubs I understand are getting over the problem by pooling their food resources for the particular evening.

My diary of engagements, in spite of the number of events which will not be held, is full.

There will not be an Albert Hall function this year. This does not surprise me after last year's deplorable and disgusting display on the part of some Northern guttersnipes who showered paper all over the Hall, interrupted artistes, and indulged in boos and catcalls as well as insulting remarks.

Had there been such a function this year I should have declined the invitation unless I had received assurances that the R.T.T.C. had taken steps to ensure discipline.

The whole evening was spoiled by this reprehensible display, and the prestige of cycling went down in the eyes of many who made their acquaintance with a mass meeting of cyclists for the first time. I took a party and most of them left in disgust halfway through the proceedings. I do not know whether this year's cancellation is due to the attitude of the Albert Hall authorities, but I can well believe that they are not anxious to have such a crowd again.

B.L.R.C. News

A PROVISIONAL calendar has been arranged for an international programme of events. The following events have been approved.

May 1st.—Paris to Lens Road Race, 230 km. (143½ miles).

May 25th.—Paris to Tours Road Race, 220 km. (137 miles).

June 24th.—Grand Prix de la "Humanité." Three daily stages, 550 km. (344 miles).

July 25th.—Paris to Rhieme, 160 km. (100 miles).

A Grand Festival, lasting several days, will start early in June, to include track racing, road racing, and road time trials, for male and female.

French Track Dates.—June 15th and Sept. 14th.—Omnium International.

The British calendar is as follows:

Easter Monday.—Dover to London Road Race.

Whitsun Holidays.—"Circuit of the Cinq Ports," Kent. Three Days Road Race.

July, early.—"Tour of the Peaks," 140 km. (87½ miles).

July 14th.—"Grand Prix de la Bastille." Battersea Park, London.

August Bank Holiday Monday.—"Brighton to Glasgow," six daily stages, 600 miles.

Wayside Thoughts

By F. J. URRY

Bad Practice

THERE is an increasing tendency among motorists to pass me when rounding a highway island, and I think the habit is dangerous, particularly on the smaller roundabouts when one automatically keeps near the inside kerb. It is an extension of the impatience so many people seem to think a good reason for driving a car. Twice lately I have experienced close shaves when half-rounding one of these islands and making a left turn to follow my route. In ample time I have signalled my intention to the car coming up, but an urgent hoot on the horn has been the response and the obvious intention of the driver was to come through, so I waited, and my courtesy and care was rewarded by a mouthful of abuse and a glare like that of an angry Bengal tiger. This kind of treatment is not good enough and there should be a ruling against overtaking on certain types of roundabouts, for the present position of the cyclist in such places is dangerously unsatisfactory. It seems to me a little curious that no mention of road conduct on roundabouts is to be found in the Highway Code, yet obviously these traffic islands are constructed to slow the traveller and so prevent the chance of accident at road junctions. If authority allows these island junction places to be used for overtaking cyclists then their object will surely be defeated. As a matter of fact (and I round four such islands twice a day) I have never seen one car or truck attempt to overtake another at such places; but I suppose the cyclist does not count, as is too frequently the case when road conduct is being discussed. Still, he has a life to lose, the result of a smash hurts him quite as much as any other human and, curious as it may seem to some motorists, he may be as useful to the community as the next man.

The Colossal Ignorance

I WAS playing golf a few days ago with a business acquaintance, indeed the affair was of the business-courtesy type, and because I arrived at the appointed place on a bicycle, my companion seemed surprised. "But then," my friend said, "I might have known, for I've never seen you in the conventional garb of the business man. During the war I rode a bicycle, but it was too much like hard work, so I gave it up immediately the basic ration was restored." I wonder how many thousands of similar cases exist in this land? I did not argue the matter at that moment, but over a cup of tea I was paid the compliment of looking and being fairly fit for my years, a compliment that probably had its basis in the enjoyment of a good game and with the older opponent lasting the journey to scrape home the victor. So I told my companion why I was fit and the joy, as well as the health virtues, of cycling. He seemed surprised as are so many people who only know cycling in a very perfunctory manner. "Why then," he asked, "didn't I discover these things?" And, of course, the answer is easy: he bought a wartime bicycle, heavy, badly saddled, and from what I could gather, over-geared. Indeed, gearing, in the sense of measuring it to the need of the individual, seemed a mystery to him, and the question of how to sit a bicycle had never struck him as of the slightest importance. So I compared it to a stance at golf or the grip of the clubs, matters which he could understand, and such talk began to let a little light through the cloud of ignorance. And there must be millions such, and people tell me the public know all about cycling. What utter nonsense; most of them have it all to learn.

Right for the Part

THAT spell of sticky weather in July made me glad to be a cyclist. "But how dreadfully hot you must get," people said, but they lose sight of the fact that the rider creates a breeze as he passes through the atmosphere and is fully air-cooled as a result. I am not pretending the cyclist is cool, but at least he is as comfortable in such heat as any other moving individual. And, of course, he can and does dress for the part. Indeed, I have noticed many motorists who have followed his example and shed their coats. But the pleasure rider can do much better than that, for shorts and shirt are the raiment *par excellence* with which to defeat the stickiness of a heat wave. And how happy these people look moving over the sunny roads in a neat costume that has by now defeated all the inhibitions of Mrs. Grundy. I do not know a more dainty picture than a slim girl rider in well cut cycling garb winging an easy flight along a bowery lane. There are, of course, the other types, and I am sometimes startled that men and women should be content with raiment that badly needs the attention of the wash tub; but then it takes all kinds of people to make a world, and thank goodness the soiled ones are but a small minority. Whatever other game you may play in the full heat of the summer sunshine, I'm fairly sure cycling is the coolest, unless, of course, you are cluttered up with unnecessary clothing. For my part I keep the sun at bay on bare places, for sunburn can be very painful. I never ride with arms exposed, but unroll my shirt sleeves and allow them to flap in the breeze. Knees soon become inured to the heat, but I prefer thin stockings as protection to the legs, rather than run the risk of an overdose of violet rays. After all there is reason in all things.

This Variety

THERE are so many pleasant things to do on a bicycle that sometimes I find it difficult to make a choice. There was a country cricket match the other afternoon, 15 miles from home, a joyous ride of an hour and a half followed by a long smoke on the greensward watching a vigorous innings by the village blacksmith, who made up in energy anything he may have lacked in style by knocking the ball three times over the lime trees bordering the meadow, rousing his clients to a vociferous chatter of excitement. Tea in the pavilion served by the village dames and maidens, a couple more hours of carefree cricket, and then a trundle home in the gloaming. A day to remember, fulfilling the joy of riding as well as the lingering interest in a real English game. The next morning I was out at 6 a.m. 15 miles down the road to watch and help at a club "50" in which 20 of the younger generation made the tyres hum over our Midland shires. With a couple of companions I checked the lads through, and as the last one departed hurriedly, so did we, to make our seven miles cross-country dash to be on hand at the finish. How can a man grow old when time grants him such occupancy? By 10.30 that morning a goodly bunch of us were easing our appetites on cakes and tea, discussing the incidents of the trial and making appointments for future similar meetings. And on the way home with three of the company we talked of touring, where we wanted to go, where we had been, old memories of great days along the road and the culinary joys of the meals we ate ere the war of 1914 broke and the old order changed. Yet I believe the best is still to come despite all the pessimistic talk and that the adventure of living is greater than ever if people will but make up their mind to live, and not merely exist.

In Luck

ONE of my trade friends told me he could just about manage to build a bicycle of the very best type, some of the components being pre-war material—such as stainless steel rims and the set of light gauge tubes—and some from post-war fittings, like the new wide ratio four-speed hub. Would I like it? Would I not! It came to hand the other day; it looks the goods and feels right after about a hundred miles of journeying, and a trifle of adjustments to suit my make and shape. I'm not saying more about it than that at present. I like the stainless bar, the feel of it and the comfortable knowledge that it will not rust, and my short experience of the gear suggests we shall get on very well together. The normal ratio is 60in.. quite enough for me on my prowlings, but this wide ratio hub gives me something like a 75in. top if I want it, and the ease of a 40in. low with which to idle up the long slopes, with a second gear of about 51in. if I feel vigorous on the hills. The frame angle is 68 deg., with the result that the machine steers itself without any strain on arms or shoulders. Indeed, I am of the opinion that the steep angle frame has been overdone and, in any hands but those of the expert racing man, is a mistake. The only other departures from general practice are felt blocks for the pedals in place of rubber ones (light and everlasting), and a military leather saddle on which I can sit all day and still discover it to be a comfortable perch at sunset. The weight is 32½lb., and it ought to be a couple of pounds lighter if makers would only give us a light and lively stainless steel rim. The tyres are the post-war Sprites (a few thousand pair of which have now been delivered to manufacturers), 1-3/8in. by 26in., and the brakes the Cantilever with inverted lever fitment. Unfortunately the machine is a special and cannot be repeated, and I am just fortunate to get it. One can only hope the time will not be long before such bicycles can be bought at any dealers, for the demand for them is great. An agent friend told me yesterday that while he can hold a fair stock of basic bicycles, any machine he can get to a modern specification, costing from £20 to £27, is gone in the winking of an eye. Yes, we are starving for the better type, and for the sake of the sport and pastime I hope we can make our choice of the very best in the spring of 1948.

But When?

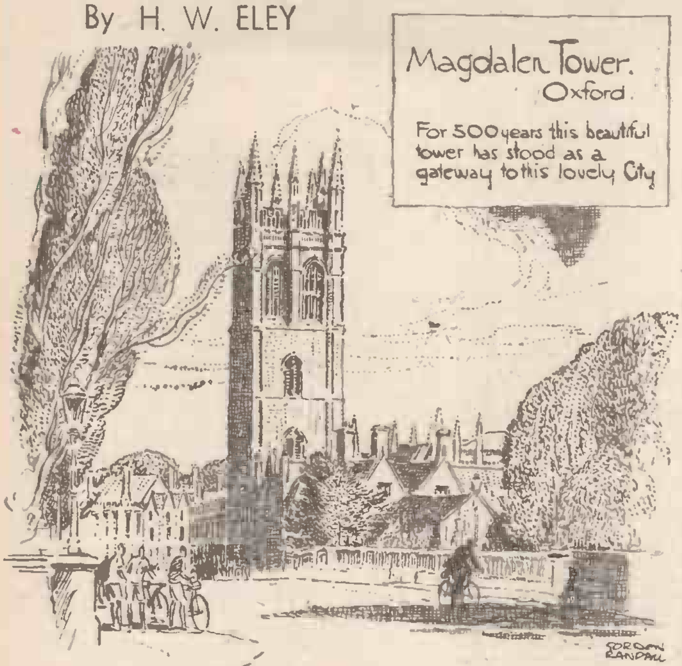
IT is good news that light tyres will shortly be available to all of us who know the value of such products either for speed purposes, or translated into the ease of the potterer. For seven long years we have been unable to keep our wheels lively with the hum of the light tyre, and that has been a real handicap to the comfort of cycling. Sometimes I do not wonder that the uninitiated have found cycling hard work; the poor type of machine, grossly overgeared and shod with war grade tyres, while as often as not the owner seemed ignorant of making the best of a poor combination by sitting on the thing like a sack of potatoes. But the return of the light tyre will please most of the cyclists who ride for joy, and something of their enthusiasm for the pastime should be transferred to the war novice rider when he sees these lads and lassies making a great holiday of their week-end. Personally I do not think it an exaggeration to say that cycling among the intimate crowd owes the light tyre a great debt, for it has made the sport and pastime faster or easier—according to desire—than any other single thing in the equipment of the bicycle. I'm sure it has for me, and I believe it would for all people who ride if they would give it the opportunity. When I was racing on sprint tyres, I used to say that if ever I became rich enough to use such peripheries for touring and pottering in my elder years I should think myself fortunate. And the light, open-sided tyre has done more than that for me, for it has given me reasonable security with speed, and a far greater resilience than even the old time sprints of 45 years ago could present.

Our Funny Habits

IT is curious how some of us acquire a fixed habit of liking certain things which are supposed to be outmoded by the younger generation. Perhaps my own peculiarity is for the old B.10 No. 2 leather saddle, now known as the military type. This was the only fitment worth while on the military machine. I also like felt pedal bars, as you are probably aware, for their lightness, non-slipping qualities and everlasting service. But there I think I end up, for all the modern equipment I use and revel in, gears, hubs and derailleur, brakes, bends and taper tubes, all except the flashy coloured finishes, which after a winter of rain and mud do not seem to me nearly so neat as my rubber enamel black bicycles. I have even known some cyclists who have found the hammock strung saddle of the old Dursley-Pedersen a comfortable perch, and regret its disappearance. To me that slung hammock was most uncomfortable; it would not allow me to shift in its seat, and if I tried to, just followed me up and, incidentally, made dismounting a new athletic action. Now a friend writes to know if I can help to obtain a B.S.A. spring frame! It must be nearly half a century ago since that model was made, and for a time was quite a fashion, numerous records being made by the great riders of those days. To-day the modern B.S.A. folk know very little about this old product of theirs, so the only chance my friend has of fulfilling his need is to find a fairly well preserved frame and have it re-equipped with modern tyres, rims and brakes. Good road surfaces and finely made tyres have killed the spring frame, as applied to bicycles, for ever.

CYCLORAMA

By H. W. ELEY



Magdalen Tower. Oxford.
For 500 years this beautiful tower has stood as a gateway to this lovely City

I Sojourn in Brecon

IT was a bright and sunny day in early September when I journeyed to Brecon in connection with an impressive ceremony of the ancient Cordwainers' Guild, and my memories are of inspiring ceremonial in the old Guildhall and of a service in the cathedral . . . so beautifully set amid stately trees. And, wandering around Brecon streets, I fell in with some cyclists who had come from Birmingham ; good cyclists who loved the road and quiet villages and ancient market towns and the grey stones of churches and cathedrals. What did I know of Brecon ? What should they look for ? Well, of course, I directed their steps to that inn where, in July, 1755, the one and only Sarah Siddons was born ; that same inn where, in July, 1943, Owen Nares died. And I spent some time with those good fellows from "Brum" and found that on their holiday tour they had been wise enough to visit Hereford, and—by devious ways—had come to Brecon. And the place delighted them . . . as it did me on that bright September morning when, sitting on a seat in the square, I watched the buses roll in from Swansea and Newport and Pontypool. What can equal the lure of Wales ?

The "Roadfarers" Again

THAT was a truly great meeting when the Roadfarers' Club was addressed by Sir Malcolm Campbell . . . who gave a thrilling and absorbing account of his water-speed-boat and drew aside the veil which hides some of the mysteries of his jet-propelled craft. A large gathering . . . with the enthusiasm which has ever characterised this club since the days when F. J. Camm founded it with other enthusiasts. And the great thing about the Roadfarers is that it represents every class of road user ; the cyclist hobnobs with the man who speeds along our roads in a Bentley or Rolls ; there is a place for the keen motor-cyclist ; a place for the pedestrian. And never have I listened to a disappointing talk . . . my good friend West, the energetic secretary, has a flair for finding just the right type of speaker.

"Named" Cycle Tyres

ONE of the bad features of the war was that is caused many manufacturers, for good and obvious reasons, to drop some of the famous branded tyres and concentrate on "utility" or war grades. It will be a good day when the old favourites return, and I gather that it may not be long before some of them do. Meanwhile, I think that the tyre makers deserve a bouquet for the way in which, in spite of many difficulties, they have given us covers of quality and good wearing capacity. Almost every week, in my official capacity, I receive unsolicited testimonials about the good mileage given by war-grade covers. But cyclists like their own particular favourites . . . so speed the day when the wide and attractive ranges will again be on sale!

Harold Goodman of Avon

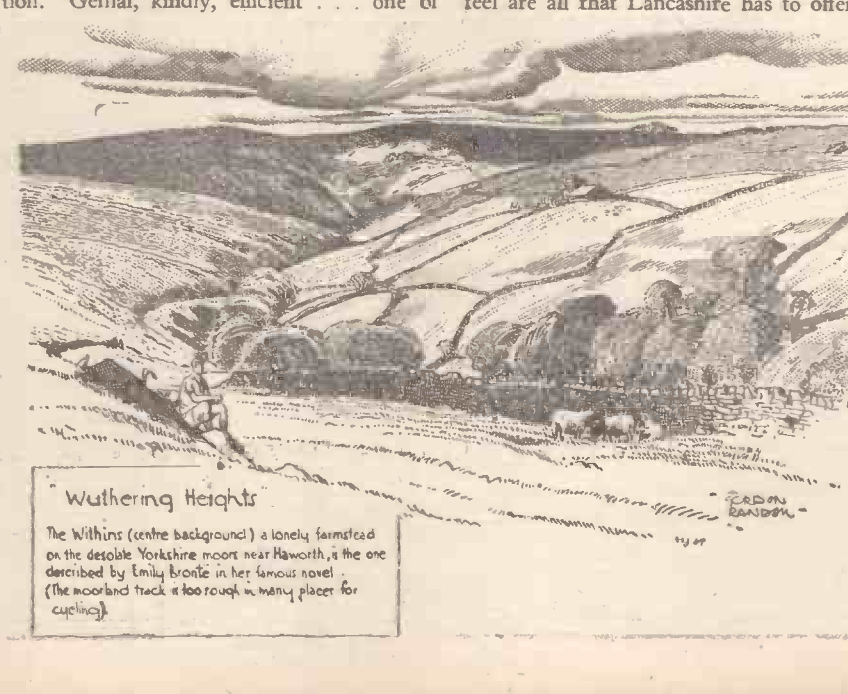
AN old and valued friend of mine is Harold, who has given many years of fine service to the Avon Rubber Company. I was talking to him the other day and he is glad to be back in his native and beloved London after a wartime sojourn in Melksham . . . the home of Avon tyre manufacturing. I know Harold as a good committee man, for he sits on the advertising committee of the Tyre Manufacturers' Conference . . . but years ago I worked with him on the Advertising Managers' Association. Genial, kindly, efficient . . . one of the many good men connected with the advertising of cycle tyres.

A Bit of Salesmanship

A DEALER'S shop . . . in a small provincial town. A customer wanting brake-blocks and a pair of trouser clips. Small enough purchases indeed! But important if you are a tradesman anxious to build a business and not merely content to hand over some goods and pocket the cash! This dealer's shop was, from the point of view of display and attractiveness, appalling. No orderliness in the setting out of the window ; no system in placing the goods where they could be easily got at ; and no sense of salesmanship at all. Now, the cycle dealer may deal in a lot of small items ; it may be hard to keep a shop tidy . . . but it is not impossible. I plead for better display and selling methods in the industry. And I feel that it might be a good thing if some trade journal ran a series of instructive articles for the edification of the dealer. There are certain cardinal rules of selling which apply to almost any retail business, whether it is a grocery, outfitting or cycle business. The cycle manufacturer has kept up a high standard—he has not let the war kill his initiative or his resolve to build for to-morrow. I suggest that the retailer should copy his good example.

A Line from Lancashire

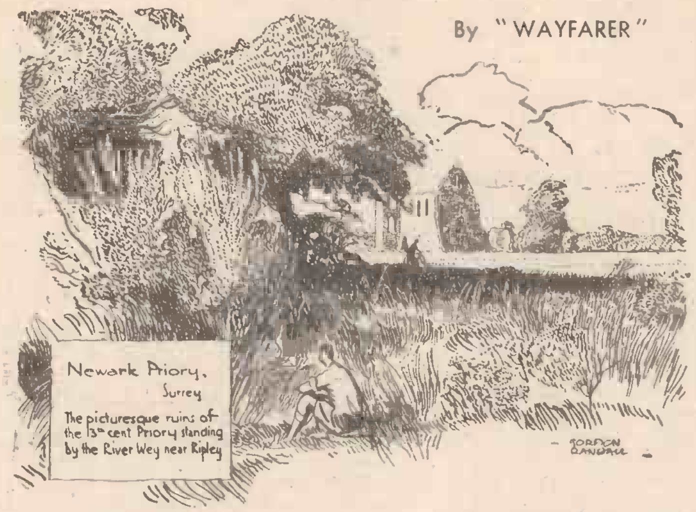
IT is always gratifying to me when I receive letters about some paragraph I have written in this feature . . . and the other day I had a cheery letter from a cyclist in Lancashire chiding me that whilst I had often referred to the beauties of many counties, and been almost lyrical over the glories of Devon and Warwickshire and Sussex, I had never, or rarely, given praise to the beauty spots of Lancashire. Did I imagine that the County Palatine was all ugliness and cobbled, dingy streets and belching chimneys ? . . . No, my good Lancastrian, I have ridden among the scenic loveliness of Lancashire and know of its hidden beauties. But what can one do in a short article ? Some day, when time permits, I will write a story of Lancashire . . . and extol those beauties which to many are unknown. And I shall deal with the Lancashire witches and the fells and villages . . . and shut my eyes to those industrial scars which so many feel are all that Lancashire has to offer.



"Wuthering Heights"
The Withins (centre background) a lonely farmstead on the desolate Yorkshire moors near Haworth, is the one described by Emily Bronte in her famous novel. (The moorland track is too rough in many places for cycling.)

My Point of View

By "WAYFARER"


Newark Priory, Surrey
The picturesque ruins of the 13th cent Priory standing by the River Wey near Ripley

Those Good Old Days

DELVING through an old address book a few evenings ago, I came across a note regarding accommodation at two places in Warwickshire. Completely out of date, these would have passed unnoticed but for the fact that the prices were recorded, thus:

Tanworth-in-Arden, 15s. a week.
Ullenhall, 2s. 6d. a day.

There have been two World Wars since then, and it is now safe to assert that prices such as the above have gone, never to return. What we glibly call "the good old days" were not all that good, in some respects, but the cost of cycle-touring was very low indeed.

Joyful Sight . . .

WHAT a delight it was, a recent week-end, to encounter so many troops of boys and girls all happily careering along on their bicycles! They are a very colourful crowd, thanks to the way they dress and to the bicycles they ride, and they add materially to the picturesqueness of the countryside and the open road. Whether, owing to a too ambitious programme, many of them had to "chew acid" before completing their day's journey, I am not able to say, but that is quite a common tendency, and such a lot of young cyclists forget that a 20- or 30-mile outward ride means, as a rule, a 20- or 30-mile homeward trip. It is one thing to achieve a score of miles: multiply that by two, and the result may not be quite so happy.

. . . And a Sad Thought

AND here a sad thought strikes one. What proportion of those boys and girls, who were obviously out for enjoyment—obviously in full possession of what the French call *joie de vivre*—will be participating in the pleasures of cycling three years hence? To ask that question is to pose a problem which takes some answering. My own view is that the life of a cyclist is about three years, and then, too frequently, the game is relinquished—perhaps because it is found to be hard work. If only the newcomers to the game would get into the right hands, and be taught how to ride—really *how* to ride—the average life of a cyclist would be much more than three years. The pastime of cycling is for all ages, and, with the application of common sense, it will serve the devotee through all the years that physical strength endures. . . and through all those years there can be a full programme of sight-seeing. Then, when the evening of life comes, what memories there are to ponder over in the chimney-corner!

Wonder-Bicycle

FROM this point it is quite fitting for me to proceed to discuss a stray thought—lacking newness—which came into my mind one day recently. I have now been riding bicycles for over 50 years, yet the magic of the bicycle is still apparent to me; the possibilities of the handy two-wheeler still fill me with excitement—still make me marvel. Consider the bicycle—its weight, its frailty, its simplicity, the extraordinary low cost of its running and maintenance, its achievements in the hands of any normal person who knows how to ride. The speed at which a bicycle can be propelled is remarkable; the distances it can travel are astonishing; the ground it can cover is amazing; its penetrative characteristic is staggering; its general freedom from trouble is "grateful and comforting." In these islands of ours—leaving out continental touring altogether—the bicycle is to be found wherever there are roads, and in many places where there are no roads. It appears in remote passes and on the shoulders of rugged mountains and on field-paths and cart-tracks. The most distant places see it, and it seems to pass by magic from point to point. Last night the owner went to bed some hundred miles away from the point where he proposes to sleep to-night, and to-morrow night he may be another century of miles farther on. You don't hear the bicycle coming or going. It is a silent traveller, and it gives to the man (or woman) in charge of it a serene outlook on life—exercise in its most joyous form; mental and physical health; a fund of knowledge which can be obtained in no easier way; a form of weather-proofness which is most acceptable. The cycle-tourist can talk intelligently of Northumberland and Cornwall; he (or she) can tell you what you want to know about the Great Glen and the Vale of Glamorgan and the Bog of Allen. He (or she) is a travelling encyclopædia—though, fortunately, a boastful attitude is lacking. It is the bicycle—the wonder-bicycle—that accounts for all these things.

Two Englands

IT is well for us all to remember that there are two Englands. There is the England of Fleet Street, London, and New Street, Birmingham, and Lord Street, Liverpool, etc., and there is the England of the heart of Shropshire and Rutland and Somerset. There is the England of the "rush-hour" in the neighbourhood of any of our great centres of population, and there is the England of the lanes in any of our counties—an England which has stood still all down the years: serene, untouched, unhurried, asleep. There is the England of the great main roads, and there is the England of the secondary roads and the byways. Two different Englands! It may be unfair to say that cycling conditions should be judged by the standard which prevails in that other quieter England—but I do not think it is. It certainly is unfair, and quite wrong, to judge cycling conditions by the standard which prevails in the England that most people know—the main-road England, the "rush-hour" England, the busy city-street England. It is because of the very limited knowledge which prevails that people hold fast to the idea that cycling has long ceased to be enjoyable owing to the press of traffic; they are convinced, too, that it is now a highly dangerous pastime. We who ride bicycles at every week-end throughout the year, and as often as possible on all other occasions, have a true mental picture of the prevailing conditions, and, at the cost of repetition, I have no hesitation in saying that, by and large, cycling remains a peaceful and highly enjoyable pastime. By and large there is little danger, no congestion. By and large the keynote of one's experience is of seclusion—loneliness—rather than of uncomfortable overcrowding. Only a fool would deny the presence of congestion at times. But, taking the rough with the smooth, and including the thousand cars which are said to pass a given point every hour of the day, and the "opposite pole" where you see two or three cars within 60 minutes, I say that we cyclists are still "on velvet"—and there we are likely to remain for many a day. Cycling is still the joyous pastime it was 50—yes, 50!—years ago.

Alibi

WHEN on tour in mid-Wales during September I rode for some miles with a young Staffordshire cyclist, who waxed enthusiastic about a certain catering establishment in Shropshire. It is evidently a very popular place (and deservedly so, judging by what I was told), and my youthful companion clinched the matter by saying that he had seen "Wayfarer" there only a fortnight before. My alibi is complete: I have not been in that part of Shropshire for at least two years, and I have never before heard of the catering paradise in question!

Pilfering

I AM extremely sorry to hear that a certain amount of pilfering is going on at some of our rest-houses. One caterer told me the other day that a hot-water jug simply ceased to exist after the visit of a cycling club, while another caterer is greatly concerned over the disappearance of her teaspoons. This is all most regrettable, and I can only hope that, where cyclists are concerned, they will bear in mind the Golden Rule of doing unto others as they would be done by.

No Compulsion

IT is not often that we cyclists have an opportunity of expressing our views to those who do us wrong, but a recent Sunday morning provided me with such a chance, of which I did not fail to avail myself. A light motor-van, in overtaking me, did the "scraping" act, and caused me to think things. As I went ahead, I observed that the back of the vehicle carried the learner's "L," which could be interpreted as explaining what had happened—though, to be sure, it is not only motorists in embryo who fail to play the game with cyclists. Luckily, the van had to stop in obedience to the red of an automatic signal, and in a trice I was alongside the driver, to whom I said, very quietly: "One of the first things you have to learn is to give cyclists a little room." The man's reply was revealing, if incomplete: "Well, yer see, I 'ad to." Just that! Because of other traffic on the road he "'ad to" continue on his way even at the cost of endangering a cyclist. My retort was simply this: "Oh, no, you hadn't. There was no compulsion, and if there isn't room for you, you must wait behind until there is!" Then, the brief lesson over, the lights changed, and we all went forward.

Manners

IT has been well said that "dog does not eat dog," and the truth of that is manifest—except as regards the way in which certain motorists treat their brothers of the wheel. No better example of "man's inhumanity to man" exists. I hope, however, that the occasional practice of "dog eating dog" will not grow in the case of cyclists. Two recent incidents (one of them mildly multiplied) are the reason for expressing that hope. I am frequently overtaken nowadays, and no possible objection can be taken to that actual event. What is to be deplored is the habit of certain young riders in coming as close as possible during the overtaking act, on a perfectly clear road, too. There is not the slightest need for this "scraping" or "skimming" business, which is clearly a case of sheer bad manners. The other point of which complaint may be made relates to the habit of a few cyclists in clinging to the crown of the road and refusing to give way so that others may overtake in a proper manner. The most recent case I encountered was that of a soldier-cyclist who seemed to be welded to the white line in the centre of the road. I rang my bell, and he refused to budge. I again rang my bell, and still he refused to move, though taking the extraordinary course of waving me on. As I went by, I said to him, with considerable acidity, that, if he would but keep to his left, he would be saved the trouble of wasting energy on such signalling.

Manufactured Difficulty

A PERSON interested in the Youth movement in the Midlands asserted the other day that the committee was now faced with the problem of what boys and girls did with themselves in the evening. In the summer, of course, many of them went out to walk, cycle, or swim, but in the winter they roamed the streets with nowhere to go except the public house. To my mind, this is a manufactured difficulty, which a spot of education will cure. Cycling is not anything like impossible on a winter evening (nor is walking), and a lot of fun can be obtained from riding in the dark, while there is much to be said for cycle travel on moonlight nights. To suggest that there is no alternative to roaming the streets and visiting the pubs, is a policy of defeatism, and it is not true.

History Repeats Itself

ACCORDING to *The Times*: "As the Rocket (Southampton and Bath coach) was descending Stoford Hill, it came in contact with a wagon laden with hurdles, there not being room for the coach to proceed, and to pull up in time being impossible." This paragraph, taken from an issue of 100 years ago (19-8-1847), suggests that there is nothing new under the sun!

Wise Man

THE cycle repairer who does some of my very few (and minor) jobs, told me, when last I saw him, that he was doing his best to discourage cyclists from having their tyres transposed from time to time, in order to equalise wear. Owing to its position, the back tyre is under greater stress than the front one, and my man thinks it is a mistake ever to put the less good tyre on the front wheel, where so much may happen in the case of a burst. I have long since given up the habit of having my tyres swopped round, and feel that there is a good deal in what this wise man says.

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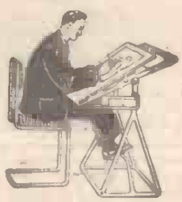

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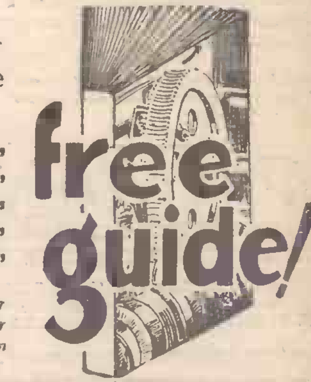

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