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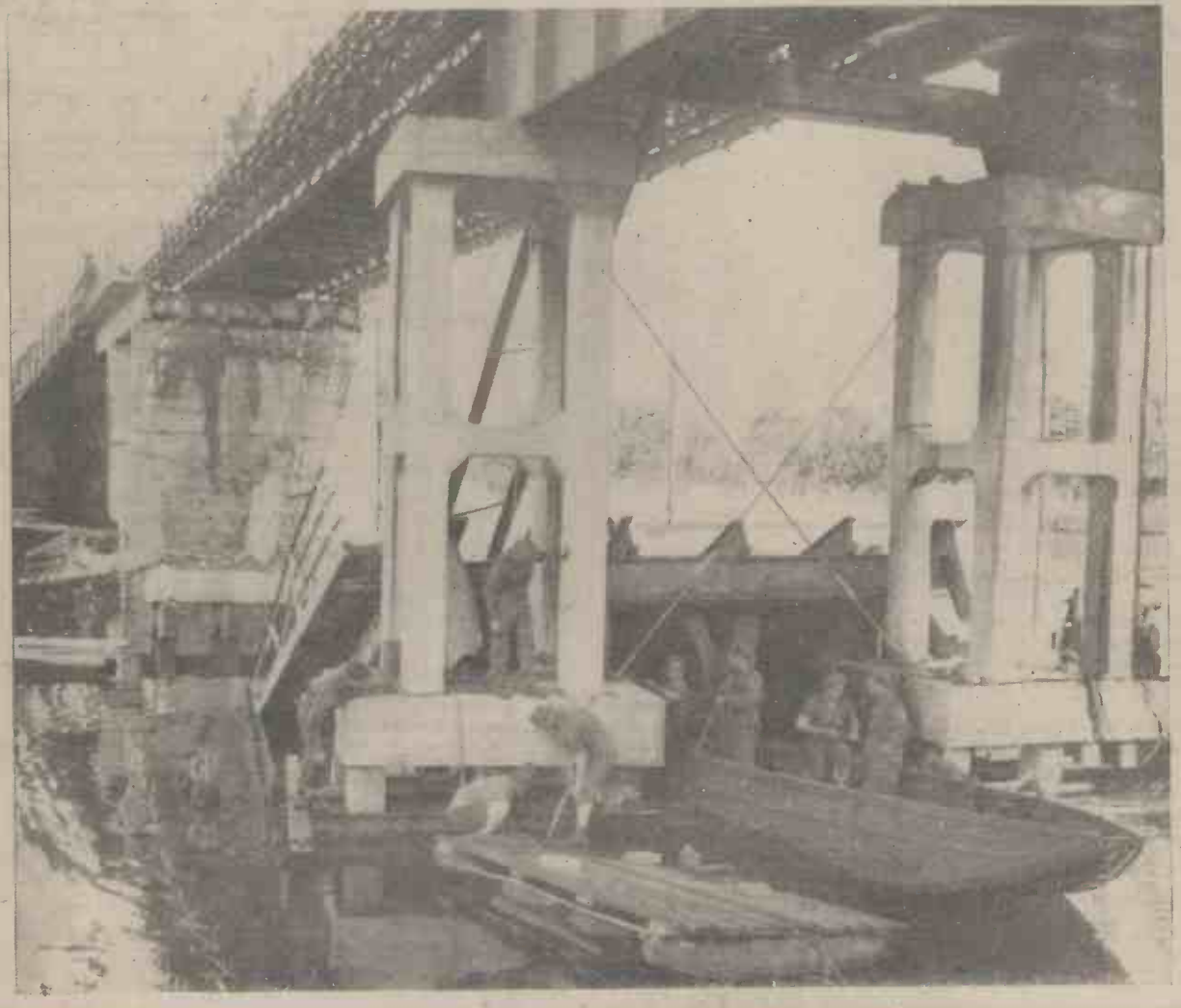

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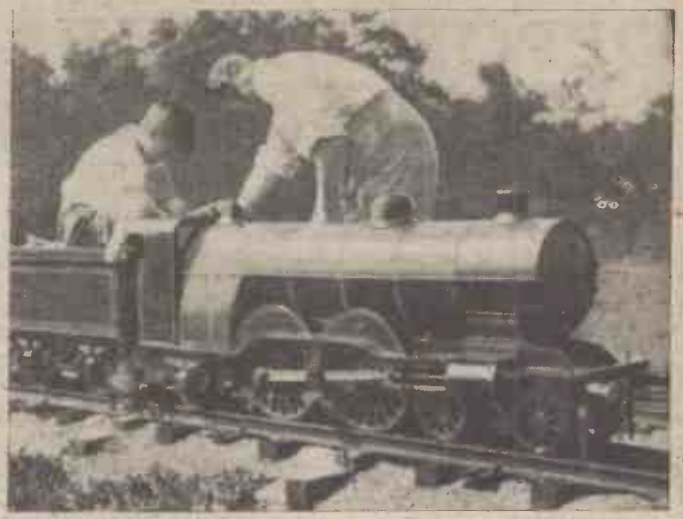

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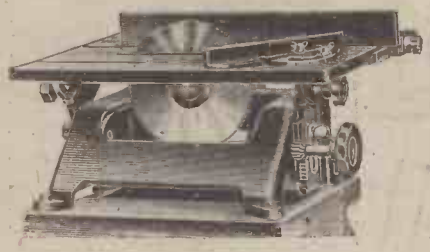

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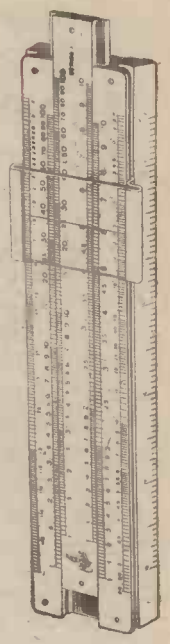

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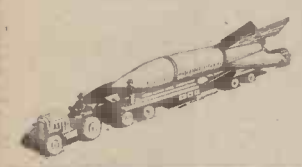

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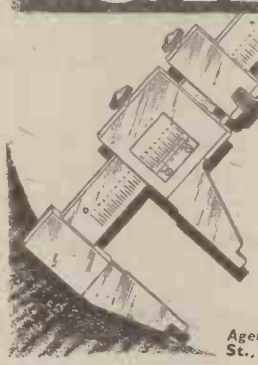

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PRACTICAL MECHANICS

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

Editor: F. J. CAMM

VOL. XII MAY, 1945 No. 140

FAIR COMMENT—BY THE EDITOR

Post-war Television

THE Report of the Television Committee appointed in 1943 to prepare plans for the reinstatement and development of the television service after the war has just been published. They were charged with the duty of preparing a plan for the provision of a service to the larger centres of population within a reasonable period after the war, to suggest schemes for research and development and to suggest what guidance should be given to manufacturers with a view especially to the development of the export trade.

In order to refresh the memory of our readers we remind them of the steps which had been taken or were under consideration at the outbreak of war to implement the recommendations made for the establishment and development of a public television service in the report of the first television committee under the chairmanship of the late Lord Selsdon in 1935.

Two Rival Systems

THE first public television service of high definition in this or any other country was inaugurated at the B.B.C. Television Station at Alexandra Palace in November, 1936. The transmissions were at first provided during alternate weeks by two rival systems, Baird and Marconi-E.M.I., but in February, 1937, the Television Advisory Committee came to the conclusion that the Marconi-E.M.I. was the better system, and thereafter that system alone was employed.

The Alexandra Palace transmissions involved separate vision and sound signals from two transmitters operating on frequencies of 45 mc./sec. and 41.5 mc./sec. respectively. The vision transmitter emitted positive images as opposed to the negative image adopted by the Americans and produced a peak radiated power of 17 kw. corresponding to the picture highlights.

The sound transmitter followed conventional design and radiated a power of 3 kw. The transmitters delivered power to two separate aerial systems mounted one above the other giving a total height of some 606ft. above sea-level. The vision aerial was mounted above the sound aerial.

The ratio between the vision and sound transmissions, namely, 17 kw. and 3 kw., proved in practice to be fairly satisfactory. The standards of picture transmission were 450 lines, 50 frames interlaced, giving 25 complete picture frames per second.

Scanning

IN the normal process of scanning, the picture to be transmitted is divided up into a great many lines, each of which is traversed by the scanning apparatus. In passing the scanner records the picture details encountered along each line, and conveys this to the receiver. In sequential scanning each contiguous line is explored progressively in turn. The process of interlaced scanning, however, consists in scanning all odd lines first, subsequently returning and scanning the even lines required to complete the picture frame. Although complicated, the interlacing system has justified itself, because the apparent flicker frequency of the reproduced picture is doubled, and hence the flicker rendered imperceptible without materially increasing the technical difficulties of transmission.

Experience shows that reliable results from the A.P. transmissions were obtainable within a range of 35 miles, and even further in some cases of interference-free situations. The limit of range was determined by the deterioration of the signal-noise ratio of the received signal.

By 1939 this service had reached a high standard of entertainment value, but the number of television receivers in use was only about 20,000. Sets in those days cost from £20 to £75. The public, no doubt, considered that the restricted range of the transmissions indicated that television was still in the experimental stage, and perhaps that accounts for the small number of receivers.

Research Work

IT was then decided to form a plan for a service on a semi-national scale to bring television within the reach of the majority of the densely populated areas of this country. The main difficulty apart from those of a technical nature was finance, and the war caused television to cease because the signals from Alexandra Palace formed a useful D.F. signal for the enemy. Although in the early stages of the war research work was planned in several directions, the war made it impossible to maintain any organised research, and as a result little progress has been made in broadcast television.

Radiolocation owes a great deal to past research work on television, but war research has produced little information and no discovery of a fundamental character bearing directly on television.

The committee has reached the conclusion that the right course in the present circumstances is to reopen the television service on the basis of the 405 line system rather than to wait for the development of a new television system as the result of research. The reasons influencing them in reaching this conclusion are:

The Alexandra Palace television service had by September, 1939, reached a high state of perfection, which with wartime research will be improved. Many of the pre-war receivers failed to do justice to the signals which were transmitted and there are good reasons for thinking that with improved transmission and better receivers the 1939 standard will soon be surpassed.

A good deal of research and development as well as new studios and other buildings will be required before a greatly improved service can be put into operation. Some years will have to elapse, for obvious reasons, before any new service will be available to the public. The re-establishment of the new television service, as soon as possible after the war, is important, for it will prevent the dispersal of the highly specialised staffs who were employed on television in pre-war days. The service, it is thought, can be in operation within 9 to 12 months of the release of the requisite staff. There should be no avoidable delay if this country is to hold its own in the television field. Extension over a wide area of the television service is essential if there is to be a full development of the television industry.

It would, however, obviously be unjustifiable to proceed with a rapid extension of the old television system to the provinces if the intention was to discard it after a few years in favour of an entirely new one. The Committee thinks that the old system will continue to appeal to many people even after a new system has been introduced. The same programme could, of course, be used for the two systems.

Definition

THEY think that television definition should eventually be of the order of 1,000 lines and that the introduction of colour and stereoscopic effects should be considered. In other words, television should endeavour to approach the cinema standard. It will be necessary to secure the release of the Alexandra Palace from its present war uses; it is far from ideal for television purposes, but a new site is at present out of the question.

Then the service should be extended to six of the most populous centres in the provinces. It is thought that a service could be established in the Birmingham area within a year of the re-establishment of the London service.

Other points in the Report are: The possibility of the use of cinemas for displaying television programmes; it is vital that the Postmaster-General should be granted the necessary powers to enforce the suppression of electrical interference; a research organisation to develop television should be formed at the earliest possible moment; a patent pool should be formed; export of television sets should be encouraged; there should be international standardisation of television.

Welded Ships

The Advantages of Liberty Type Ships Compared with Vessels of Riveted Construction

THE information given in these notes has been compiled by the Welding Development Department of the Lincoln Electric Co., Ltd., Welwyn Garden City, from American sources.

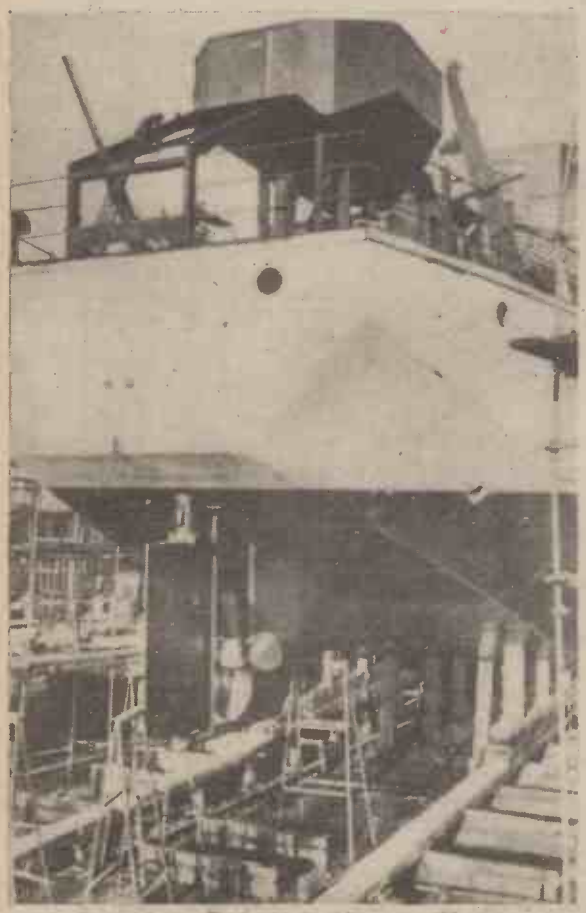
Release of this information has been approved by the U.S. Navy Department, U.S. Maritime Commission and the U.S. War Shipping Administration.

One of the most stirring stories of the war describes the ability of welded ships to withstand the terrific explosions and frequent fire damage to which they were subjected by enemy action during the crucial years of 1942 and 1943. Besides actual combat service, many of these vessels, under emergency shipping conditions, experienced long voyages through heavy seas in all kinds of adverse weather conditions.

Although a number of gallant seamen were lost during the height of Axis efforts to cut our vital supply lines, prominent naval authorities agree that the saving of an untold number of lives was undoubtedly due to the sound principles of ship construction made possible by welded design.

Surviving Combat Damage

Some of the most dramatic stories in marine history have come from the logs of the famous Liberty type ships. Although many of these sturdy vessels have been blasted by torpedoes, bombed from the air and raked with enemy shellfire, nearly all of them are still on active duty.



Stern view of an all-welded prefabricated British-built tanker just before launching.

In comparing these welded ships with the vessels of the riveted type, Admiral Emory S. Land, chairman of the U.S. Maritime Commission, says, "Every time a riveted ship goes into dock, you have a lot of repairs to do which you do not have in welded ships. You do not have openings in your hulls with dozens and dozens of leaks, nor do you have to redrive rivets. Even if we have fractured plates, it is but a handful of leaks compared with the casualties in riveted ships every time they go in for voyage repairs—something that everybody seems to have forgotten.

"In combat damage, comparing Liberty ships and others, everything is in favour of the Liberty ships. A lot of them have broken into sections, due to combat damage; in Liberty ships, the percentage is entirely in favour of the Liberty, because the riveted ships are apt to go to the bottom when they are bombed or mined or torpedoed. It is truly remarkable the salvage we have obtained from these Liberty ships in combat damage. Never mind about the fractures or cracks—they get into port."

Two Remarkable Liberty Ships

The *Patrick Henry*, first Liberty ship to go into active service, is one of the scores of vessels of this type which have substantiated Admiral Land's remarks

Launched in September, 1941, the *Patrick Henry* was subjected to numerous bombings and torpedo attacks on such dangerous routes as those to Murmansk and Archangel, and to Capetown and Suez. After two years of severe service, during which the vessel travelled some 80,000 miles and moved more than 76,000 tons of supplies to Allied war fronts, an inspection of the *Patrick Henry* showed her to be in first-class condition and prompted the War Shipping Administration to hail her performance as "even better than anticipated."

One of several Liberty ships that were torpedoed, but refused to sink, was the *Anne Hutchinson*. Describing the incident in a production communiqué to the builders, Oregon Shipbuilding Corporation, Admiral Land said: "To you who built the S.S. *Anne Hutchinson* goes credit for having built a sturdy Liberty ship. She took two torpedoes in her stride and refused to sink. It was on her return trip when the first torpedo struck in number four cargo hold. The explosion almost lifted the ship out of the water; it severed the line shaft and practically tore out the ship's bottom. The vessel broke in half and it was only after being buffeted by storms that the after part sank. The engine room bulkhead held and the forward part of the vessel remained afloat. Later the second torpedo struck in the starboard engine room in the way of the boiler. Three seamen were killed. This explosion completely destroyed the starboard boiler and shifted the main engine from its foundation 10 feet to port. Still your vessel would not go down, she remained in an upright position and was towed into port. The survivors said the buoyancy of the vessel after being sliced in two parts was amazing. All of you who worked on this ship can feel justly proud of her."

All-welded Oil Tanker

Included in the long list of the all-welded oil tank ships with notable performances, was the motor ship *Pennsylvania Sun*, which has piled up a total of 506,000 miles. This vessel was torpedoed in 1942 and suffered extensive damage to the hull, the superstructure being entirely gutted by fire.

The Sun Oil Company, operators of the ship, told of this action in a recent letter which stated, "The vessel was torpedoed at the midship house on the port side; the explosion tore away the side shell plating and one wing bulkhead, and pierced the other wing bulkhead, opening approximately seven of the cargo tanks to the sea. However, when the fire on the vessel was put out by the ship's officers and a salvage crew, the crew reboarded and effected temporary repairs which permitted the ship to proceed under its own power to dry dock at Chester, Pennsylvania, for the execution of damage repairs. It was noteworthy that in most cases plates would tear in half or would tear away from a welded joint, the welds apparently showing up stronger than the steel itself."

The reliability of welded hulls is emphasised in another report from the War Shipping Administration on the *Robert E. Peary*, which sustained major damage on two occasions.

The report states, "In May, 1943, *en route* to the United Kingdom, water was found in No. 3 compartment, due to fractured shell plates; damage was believed to be caused by depth charges, but this information was not confirmed. The vessel was dry-docked and repaired in the United Kingdom. In the December of 1943 the vessel was involved in a collision outside Halifax, N.S., and returned to Halifax for dry-docking and repairs. Exclusive of her present voyage, this vessel has travelled approximately 42,246 miles."

Over 2,000 Hulls in 40 Months

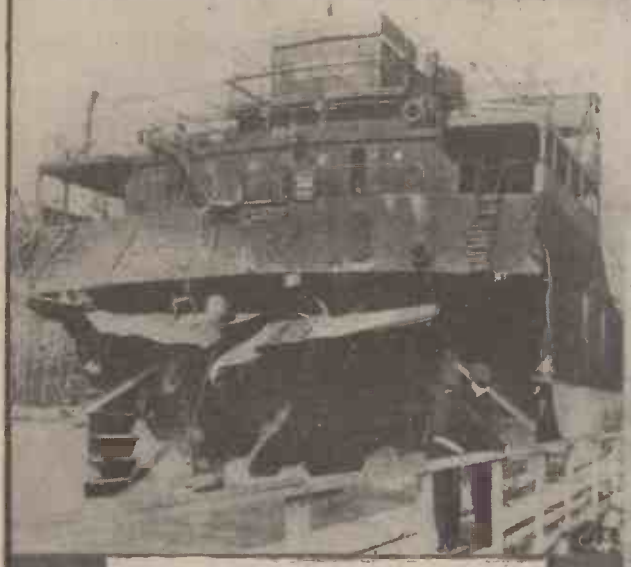
Ships such as these were produced at the rate of more than 2,158 hulls in the relatively short period of about 40 months.

It was this record which led the U.S. "Special Committee Investigating the National Defence Programme," to report that, "The most material departure from the method of construction of the original ship was in the use of electrical welding instead of riveting. The adoption of assembly line methods and extensive prefabricating of parts also made possible the construction of a greater number of ships than had ever before been contemplated."

Further comment is found in a statement released by the U.S. War Production Board which reads as follows: "Ugly Duckling (Liberty) type merchant ships were found to be 10 per cent. to 15 per cent. stronger in construction and smoother in line than the ships of 1919, which had 900,000 rivet bumps." This, despite the fact that welding used less steel, resulting in ships of considerably lighter weight. "Welding saves 845,000 rivets and 1,790,000 rivet holes," continued the WPB statement.

DAMAGED WELDED SHIPS STILL AFLOAT

Although these all-welded ships have been severely damaged by torpedoes or fire, they were able to be towed to port to be repaired for future service. The illustrations are from official U.S. Navy photographs, and show how all-welded construction saves war scarred ships from becoming total losses.



When the stern of the "E. H. Blum" was damaged, it was cut away and forward section shown here was towed to U.S. East Coast port for repairs. Salvage made possible by rigid welded construction.

(Above) The gaping hole shown in this view of an 18,000 ton tanker failed to send her to the bottom. Sturdy welded construction prevented critical damage. (Official U.S. Navy photo, courtesy of The Lincoln Electric Company, Ltd., Welwyn Garden City.)

(Below) Torpedoed merchant tanker still afloat. (Official U.S. Navy photo, courtesy The Lincoln Electric Company, Ltd., Welwyn Garden City.)

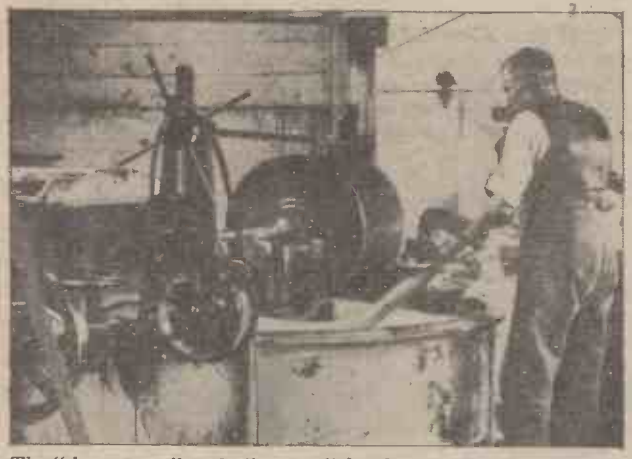
(Above) Crew of this disabled ship prevent fire from spreading by pouring water on oil tank covers. Note warped deck with weld seams still intact. (U.S. Maritime Commission photo, courtesy The Lincoln Electric Company, Ltd., Welwyn Garden City.)

(Below) Dense column of black smoke shows where torpedo struck. Ship was salvaged for future deliveries of vital cargoes. (Official U.S. Navy photo, courtesy The Lincoln Electric Company, Ltd., Welwyn Garden City.)

Close-up of a torpedoed Liberty ship after stern section had been damaged by enemy action at sea. Photo shows forward part of ship after it was towed to port. (Official U.S. Navy photo, courtesy The Lincoln Electric Company, Ltd., Welwyn Garden City.)

Hand-made Paper

The Modern Methods of an Age-old Industry



The "beaterman" at the "engine" for cleansing the rags which are subsequently to be pulped to produce the "stuff" for hand-made paper production. (*By courtesy of J. Barcham Green, Ltd., of Maidstone.*)

THERE are some things in this present-day world of ours which have not in any way been improved by the manifold advancements in science and technology. The violin is one of these articles. Paper is another. Not, of course, in respect of the latter commodity, that the speed and convenience of paper-making has not been enormously enhanced, compared with the methods in use a century or more ago. Not, also, that the multifarious grades and varieties of paper which are normally available nowadays do not represent an almost fantastical advance on the limited paper types of an earlier age.

In spite of all this, however, there remains the fact that the very highest, the most enduring and the best grades of paper which are made nowadays are still produced by the laborious hand method which was current in this country three and four centuries ago. It is, indeed, something of a paradox that the best possible grade of paper, to say nothing of the most enduring variety of that commodity, is precisely the material which has been produced by the most primitive of methods.

Such is our present-day "hand-made" paper which is still being turned out regularly in a few paper mills and which for quality, endurance and appearance excels all other paper varieties.

Naturally enough, hand-made paper cannot be applied for modern commercial press and magazine work. In the first place, it would be far too expensive for such employments and, secondly, its "natural" unfilled surface, however fine it may be, would scarcely give the detail of pictorial reproduction which is rightly demanded by the modern reading public. Nevertheless, for all artistic works, for the production of pencil or watercolour drawings, for etchings and for the printing of costly and valuable book editions, hand-made paper is unexcelled.

For important document work, also, hand-made paper is unsurpassed. So, also, is it for the making of registers and ledgers and similar volumes which have to stand up to a good deal of handling and inspection.

The finest, the strongest and the most enduring (even under adverse conditions) of laboratory filtering papers are all hand-made. In fact, a large proportion of the output of "hand-made" mills goes to such scientific usages.

Money Paper

Then again, there is the question of the now universal "money paper." Bank-notes of all countries are printed on hand-made paper, not only in consequence of its strength and essential durability, but also because watermark designs of the most intricate character can be incorporated into such papers with a view to preventing the circulation of fraudulent notes. Currency or money paper is, therefore, an important product of the English hand-made paper mill, and it is a significant fact that in pre-war years Governments the world over obtained their supplies of money paper from just a few English mills.

Hand-made paper production is a difficult job, calling for the highest of manipulative skill. It is a relatively slow job as well, for it takes about a couple of months for a sheet of hand-made paper to complete its various processes in the paper mill, during which operational cycle the paper is subjected to about a hundred separate handlings.

Lifting a hand-made sheet of paper from the "post" or pile of alternate paper and felt sheets which have been built up by the "coucher." (*By courtesy of J. Barcham Green, Ltd.*)

There exists an assembly of hand-made paper workers which is named the "Original Society of Paper Workers." This society came into being about the beginning of the last century, being formed to protect the old "hand-made" craftsmen from the speedier methods of the machine-made paper operatives who were just then coming into active being.

The "Original Society"

The modern skilled hand-made paper producer is invariably a member of the "Original Society." His apprenticeship has lasted for seven years. He is a craftsman in the real sense of that nowadays ill-used word and, in his chosen trade, he is permitted a degree of individual freedom which is quite unknown in modern industry. Members of the "Original Society" very frequently belong to different generations of the same family, father, son and grandson succeeding each other in the trade.

It is, in many ways, a labour of love, or, at least, a labour of art, this hand-made paper production. There are no strikes, contentions or disputes in this diminutive yet none the less important industry, for each worker involved in the paper production is not only a key-man, but also, in some respects, a technological artist, and he is treated accordingly.

It is not worth the labour and skill involved in the production of hand-made paper to manufacture such material from shoddy or inferior substances such as straw, wood fibre and wastepaper. For this reason alone, hand-made paper is invariably produced from the very best of raw materials, these being the highest grade of cotton and linen rags. Sometimes, for very special purposes, "hand-made" may be produced from new linen cuttings and pieces, but, usually, the aforesaid good-grade waste linen and cotton rags are employed for the making of the paper.

The rags are first carefully sorted by women and girls. Pins, buttons, black threads and all other undesirable articles are one by one picked out from the rags, which latter are then cut up into shreds.

"Breaking-in"

After this preliminary treatment, the rags are "broken-in" in revolving "breaking machines," which are fitted with drum washers serving to drain away the dirty water from the shredded rags. Sometimes a little bleach liquor is added to the washing water in order to heighten the whiteness of the rags, but in all such cases the bleach is most carefully washed out of the material subsequently in order to prevent its slow deterioration afterwards.

The washed and bleached rags are then transferred to a beating engine which

Laboratory extraction apparatus utilising an extraction "thimble" of hand-made paper.

breaks down the shredded rags to pulp, in which condition it is known in the trade as "stuff."

From the beating engine the paper pulp ("stuff") flows into a reservoir—the "stuff chest"—which serves as a container for the available stock of pulp. From the stuff chest the pulp flows over electro-magnets, which serve to remove particles of iron from it, and also through special devices known as "sand traps," whose purpose it is to extract any flinty or siliceous grains from the material. Finally the pulp, or "stuff," is passed through a sieve or strainer just before it passes to the paper-making vat or tub, in which container it is prevented from settling by means of a revolving agitator blade or "hog."

Now comes the most difficult process in the paper-making art, that is, the formation of the sheet of paper in a mould. Machine-made paper can be turned out nowadays by the mile, but the size limit of a sheet of hand-made paper is governed by the size of the mould which the vatman can conveniently and efficiently handle.

Forming the Sheet

The paper-making mould is simple enough in construction. It consists of a framework of hard wood having a number of side-to-side wooden bars, each bar being perforated with small holes which serve for the purpose of sewing down to the frame a sheet of fine wire mesh. If a watermark is required in the paper, the design of the mark is sewn in wire to the wire mesh secured to the framework of the mould.

Used in conjunction with the mould is the paper-making "deckle." This comprises merely a wooden frame—something like a thin picture frame. This rests flat on the wire surface of the mould, its purpose being to form the edges of the sheet of paper and to keep the pulp from flowing over the sides of the mould.

When forming a sheet of paper, the vatman simply claps the deckle on to the mould, dips the two into the vat of pulp, lifts the mould up and gives it a peculiar wave-like shake which serves to give regular alignment to the particles of "stuff" or paper pulp lying on the wire mesh of the mould and so forms a thin layer or web of inter-matted fibres, much of the surplus water draining rapidly away through the underlying mesh of the mould.

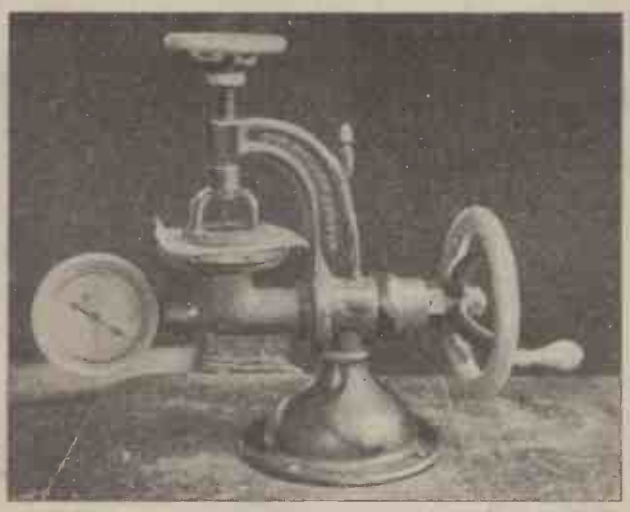
The Vatman's "Shake"

This is the first stage of the paper-making art. It is, naturally, the most important stage, and, incidentally, it is an almost indescribably difficult stage.

It takes years of practice to acquire the all-important "shake" of the vatman, and it is upon this fundamental manual operation that the strength and texture of the resulting paper depend.

No two vatmen have the same "shake."

A vatman forming a sheet of paper in the mould. (*By courtesy of J. Barcham Green, Ltd.*)



A laboratory paper-testing machine for determining the strength of paper. A fragment of paper is placed within the screw-down clamp and the right-hand wheel is turned, causing an upward stretching of the paper, which ultimately bursts. The bursting strain is recorded by a needle moving over the dial on the left-hand side of the machine.

The work of the coucher. The newly-made sheet of paper being pressed downwards from the mould on to a sheet of felt.

Consequently, if one vatman replaces another, even when dealing with the same paper pulp, a noticeable difference may appear in the resulting papers produced by the two vatmen, despite the fact that the two workers are equally skilled.

If a vatman allows himself to fall into a nervous condition—if, indeed, his mind is worried by any affair—he frequently "loses his shake." Before he can remedy matters and again display his customary skill, his worry must be relieved, otherwise the paper-forming process will suffer accordingly.

Hence it will be realised that a skilled and experienced vatman is indispensable to a hand-made paper mill and, for that reason, he is given the greatest of consideration.

The "Coucher"

Across the upper end of the paper-making vat there is a sort of wooden bridge. On to this the vatman places his mould after he has formed his paper sheet and removed the deckle from the mould. He then slides the mould across the bridge to his co-worker, who is termed a "coucher" (French: *coucher*, to lie down). This man takes the mould with its formed sheet of paper, he tilts it somewhat to allow more surplus water to drain away and then he inverts it face downwards on to the surface of a pad of felt.

The coucher then carefully lifts the mould off the felt, leaving the sheet of paper adhering to the latter.

He places another sheet of felt on to the surface of the paper sheet and then passes the empty mould across the bridge to the vatman. The latter has by this time formed another sheet of paper in another mould and this he then passes over to the coucher, who again lays the paper sheet on to the waiting felt, covers the latter over with another felt sheet and again passes the empty mould across to the vatman. Thus the process goes on for hours without serious interruption.

Gradually the coucher accumulates a pile of alternate sheets of new-formed paper and felt pads. This is called a "post."

When the post attains a standard height, it is squeezed in a heavy press. This removes all remaining water and, after removal from the press, the sheets are stripped away from the felts by an operative known as a "layer."

The layer then piles the sheets into "packs," which packs are again pressed (this time for about 12 hours), after which the individual sheets are separated and hung up in a loft so as to dry out naturally.

Waterleaf

The dried paper sheets—technically known as "waterleaf"—are fragile and are, of course, quite unsuitable for writing or drawing on, although they have their uses for certain types of printing processes.

To be of service, the waterleaf has to be sized, and this is effected by subjecting the material to the action of a pure gelatine size. At one time, the sizing used to be carried out individually, sheet by sheet, but nowadays the sheets of waterleaf are placed between two endless bands of fine felt which travel slowly through a vat of size (gelantine and water) and then through rollers which serve the double purpose of squeezing the required amount of size into the fibres of the paper and of squeezing away all surplus size from the surface of the material.

Great care has to be taken of the composition of the size, and also of the purity of its ingredients, otherwise paper staining results. The size contains a little soap, and also some pure alum. If too much soap is added, the paper tends to become transparent, while if there is too great a proportion of alum in the size it crystallises out in little glistening specks in the surface of the paper after drying.

The sized sheets of paper are usually stacked into low piles for about a day, being covered with felt the while in order to keep them warm and, thereby, to prevent the sheets from sticking together. The individual sheets are then separated by women and girls,

Making "Soxhelet," or chemical extraction filter "thimbles," from pure hand-made paper.
(By courtesy of J. Barcham Green, Ltd.)

and they are allowed to lie about individually in order to dry off the remaining water or moisture.

Drying

Finally, when all visible traces of moisture have departed, the sheets are taken up to the drying lofts. Here the paper sheets may be hung over hair ropes, or they may be laid upon scrupulously clean fine hessian sacking.

The temperature of this loft drying is very important, for if the paper dries too quickly

The conditioning room. Hanging up the finished hand-made paper to condition and mature under the influence of controlled humidity and temperature.

(owing to the presence of undue local heat or, alternatively, of draughts) the paper will be ruined.

The paper, after being stacked for a few days in loose piles to "mature" or condition, is then carefully examined by experienced sorters, who divide the mass of material into three classes—good, "retree," and "broken."

"Broken" paper is usually repulped. "Retree" represents "seconds" quality. It is like the curate's egg, good in parts, and it has a commercial value. "Good" paper is, of course, the first-class material which is turned out and guaranteed by the firm.

Many grades of hand-made paper are subsequently resized in a weaker gelatine solution after drying to give them a greater mechanical endurance. Some of the papers, particularly the writing papers, are plate glazed, or hot pressed, to give them a smoother surface, but a good deal of the hand-made paper is marketed in the rough-surface condition.

There are quite a number of varieties of hand-made paper, apart from the different surface types of this paper. Take, for example, the exceedingly strong, tough and enduring paper which is often used for bank-note printing and other purposes. This is frequently made from old yacht sails and from aircraft linen. It is difficult to prepare a pulp from this material, but once the requisite degree of fineness has been obtained after many hours in the beating engine or pulp-making machine, the stuff becomes so fine that it feels greasy to the touch. Paper made from this base is semi-transparent, and if this feature is deemed undesirable, a small admixture of pure, white cotton rag has to be made in order to confer the requisite opacity to the finished paper.

Water Purity

Naturally enough, in all hand-made paper mills, the strictest attention has to be paid continually to the purity of the water used in the operations. Most mills, therefore, make use of their own private springs, thereby ensuring a water of a constant and known composition.

The presence of iron in the water brings about staining, due to oxidation of the soluble iron matters in the water. This oxidation may appear quickly, or, on the other hand, it may, in after years, produce on the paper that peculiarly annoying brown spot-like marking known as "foxing." A perfectly pure hand-made paper will not give rise to this trouble if it is preserved uncontaminated. It is only a paper which contains iron within it or which, in some way, becomes contaminated with iron which gradually develops under damp conditions, this unsightly manifestation of slow deterioration.

There is a prevailing impression that hand-made paper is costly material. To a large extent, the notion is erroneous. Where strength, appearance and, above all, endurance is desired, there is nothing to beat hand-made paper. Compare, for example, a bit of newsprint (news paper) which becomes yellow after a couple of weeks' exposure to air and sunlight, or again, compare a sheet of the brittle highly glazed "art paper" after a year or two's exposure—compare these with any modern product of a hand-made paper mill, or, better still, perhaps, with the tough mellowed paper of an 18th, a 17th or even a 16th century volume. Such a comparison will at once reveal the merits of the hand-made variety of paper, a material whose production, strangely enough, seems to have defied all efforts of modern scientific paper-making technology to deal with it by machine processes, and on mass-production lines.

"Soxhelet" thimbles. Cylinders of pure hand-made paper, as utilised in chemical laboratories for the chemical extraction of numerous substances.

Imperial College: Centenary Celebrations, 1945

PRESUMING that the war in Europe will by then have terminated, the Imperial College is planning to celebrate next autumn the centenary of the Royal College of Chemistry, from which, through two of its three constituent colleges, it can trace descent. The third week in October is contemplated, and it is hoped that H.M. the King, as Visitor of the College, may find it possible to be present. In connection with this centenary the college has recently launched an appeal for funds which, by providing an endowment, will enable it to develop a corporate life more comparable with that of colleges in the older universities.

Royal Charter

The Imperial College of Science and Technology, constituted by a Royal Charter dated July 8th, 1907, is a federation of three constituent colleges—the Royal College of Science, the Royal School of Mines, and the City and Guilds College (formerly the Central Technical College of the City and Guilds of London Institute); and these in turn were related with earlier institutions from which, accordingly, the Imperial College can trace descent. The earliest of all, the Royal College of Chemistry, is that of which the centenary falls in this year. Its first president was H.R.H. Prince Albert (later the Prince Consort), who had also opened (1851) the Museum of Practical Geology in Jermyn Street, with which de la Beche associated his "Government School of Mines and of Science Applied to the Arts." From this source, later, both the Royal School of Mines and the Royal College of Science derived, and the name of the Prince Consort is thus associated with two of the constituent colleges of to-day.

The Imperial College is a School of the University of London. Subjects at present available for study or as fields of research include Biochemistry, Biology (Botany, Entomology and Zoology), Chemistry (Agricultural, Inorganic, Organic, Physical), Geology, Mathematics, Physics (including Astrophysics and Technical Optics), Metallurgy, Mining (including Mining Geology and Oil Technology), Engineering (Chemical, Civil, Electrical, Mechanical), Aeronautics. In them all the instruction has by tradition a strong bias towards the practical and industrial applications of science.

The Bailey Bridge

Extracts from a Recent Broadcast Talk by Donald C. Bailey

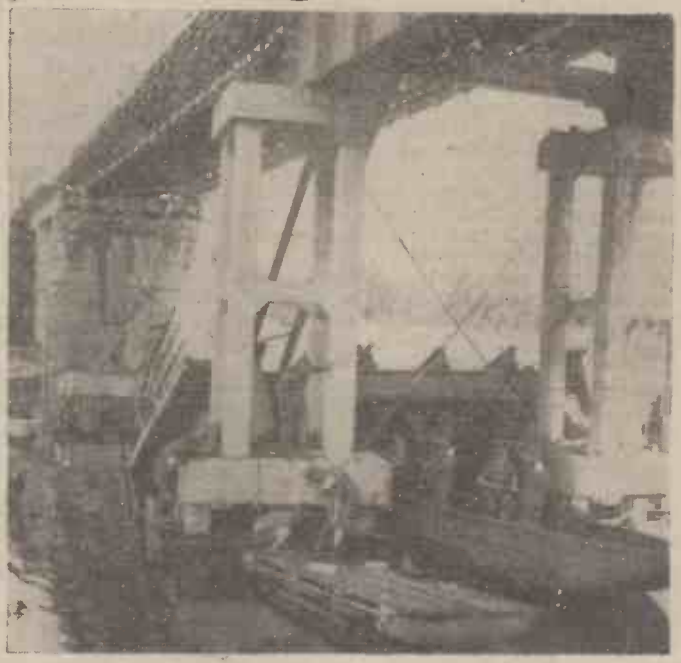
AT the end of 1940, with France out of the war, with many interruptions from the Luftwaffe, and when we in Britain were expecting invasion, at that time my job was the designing of bridges. It still is my job. But then—in 1940—bridge designing might have seemed too optimistic. They were not bridges to be used for the defence of Britain. They were bridges I hoped would carry our soldiers, tanks, guns and lorries on the offensive—on the offensive over any rivers and such-like obstacles which they might chance to meet and wish to cross. The military bridges then in existence were not strong enough for the increased loads likely to be brought into service. Until then we had been able to stretch the capacity of our equipment just enough to deal with such tanks as the Matilda, which was just going into use, but no more straws could be added to the camel's back without disaster.

The bitter lessons learnt from the German Panzer Divisions during their advance through France had made it quite certain that bigger and better tanks were urgently necessary. Moreover, where there is a tank, there must also be a "tank transporter" to carry it on long journeys.

But at this particular time—the end of 1940—the designing of stronger bridges might have seemed unduly optimistic. It didn't appear likely that there would be any opportunity in the immediate future for us to make use of bigger tanks and larger vehicles, or of bridges to carry them, unless indeed they were required in this country. Nevertheless, the order for a high capacity bridge had been made and designs had been put forward, and these plans were being considered. It seemed most essential that any scheme which was to be adopted should not be limited to the loads and spans required at that time. They should be sufficiently adaptable to carry the biggest vehicles which might come into service, and also remaining economical for carrying the smaller ones—capable of taking bigger loads and not too cumbersome or costly for smaller loads. It must also be easy to manufacture in large quantities, and be capable of erection without too much technical knowledge and training and, if possible, difficult to assemble incorrectly. They were the requirements for this all-purpose army bridge.

Prefabricated Girder Sections

I'd had in mind, for some time, the idea of using complete prefabricated sections of girder, which could be erected side by side or one on top of another to form complete girders of greatly varying strength. This seemed to have some advantages over other proposals, and so I spent a good deal of my leisure for some weeks in developing the design to a sufficiently advanced stage before I put it forward. By early in January, 1941, the main features of the project had been worked out to put before the Ministry of Supply Technical Authorities.



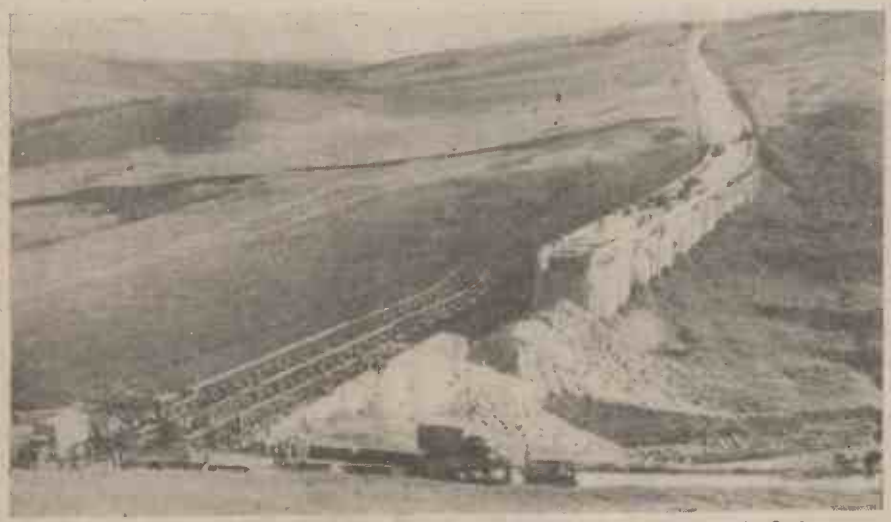
A Bailey bridge erected over the Escaut canal by Royal Engineers, who are here seen strengthening the original damaged pillars with girders, and fixing shuttering ready for concreting.

With the scheme becoming an official one, help became available from the staff of the Experimental Bridging Establishment and from commercial firms and technical bodies, whose members included famous scientists and engineers, such as the designer of the Sydney Harbour Bridge.

Eventually about 20ft. of bridge girders were made up by a local firm from a cheaper quality of steel, for we wanted to carry out destruction tests to settle one or two hotly debated points in connection with this rather unusual type of construction. But we were right. These triumphantly vindicated our theories, and at last the great day arrived when we were to stage a demonstration before the War Office—demonstrating the building and launching of a complete 70ft. long bridge. We had only just got the girders and, of course, all sorts of minor misfortunes occurred, which prevented any prior assembly. It was only after a hectic all-night session by our workshops that it was possible for the Royal Engineers, who were to erect the bridge, to get a little practice in on the very morning of the day on which the great men from the War Office were due to arrive. They were to see the bridge-building demonstration at noon, but were unavoidably delayed.

At two o'clock the officer in charge of the erection party ordered, "In double time form bridge." He blew his whistle and they were off. Eventually the bridge was completed and launched across the gap, and a lorry rumbled across a Bailey Bridge for the first time. We looked at our watches—we had not dared to do so before. It was 2.36. The 70ft. bridge had been completed in 36 minutes.

Yes, those sappers had been marvellous, as so many others have been since, and that lorry was to be the forerunner of thousands of others in all theatres of war in which British, Dominion and U.S. troops are fighting. Since then thousands of tons of Bailey Bridge parts have been manufactured by every conceivable type of contractor, from small garages up to the largest steel works in the country. Needless to say, the tremendous production did not go through without having to overcome many difficulties, some of which only became apparent when the output was stepped up to a maximum. The responsibility of solving many of these difficulties fell to the Inspection Department of the Ministry of Supply, and they, together with the Department that deals with the organisation for supply of materials, have done a fine job.



Royal Engineers erecting a Bailey bridge over a gap in a road bridge in Italy.

1,200-ft. Bridge in Burma

The finest job of all, however, has been done by the soldiers in the actual field of battle. These men have erected hundreds of these bridges, of all sizes, under sometimes the most appalling conditions—in Tunisia, in Italy, in France, in Belgium, in Holland, in Burma, and, we hope, now in Germany, and shortly in Japan. Some of their feats, like the 1,200ft. long bridge over the River Chindwin in Burma, and a somewhat similar one over the Sangro River in Italy, were real achievements.

Dairy Engineering

How Machines of Various Kinds Help in the Production and Supply of Our Everyday Milk

By C. D. WHITE

HOW many people stop to think how great a part is played by the engineer in the production and supply of good, clean milk? As a food it is of the greatest value, provided it is pure and free from harmful germs. Therefore the milk, and everything that it comes in contact with, must be scrupulously clean.

A few hours spent with a good dairyman will not be wasted, so, after he has delivered his van load we will go with him back to the dairy. This dairyman values his good name, so his van is kept clean, and all the bottles are stacked in metal crates. Take a look at these crates; they can be stacked to quite a good height without danger of falling over, because the top corners are fitted with a lug which fit snugly in the bottom corners of the other crate. It is almost an impossibility to push a stack of crates over.

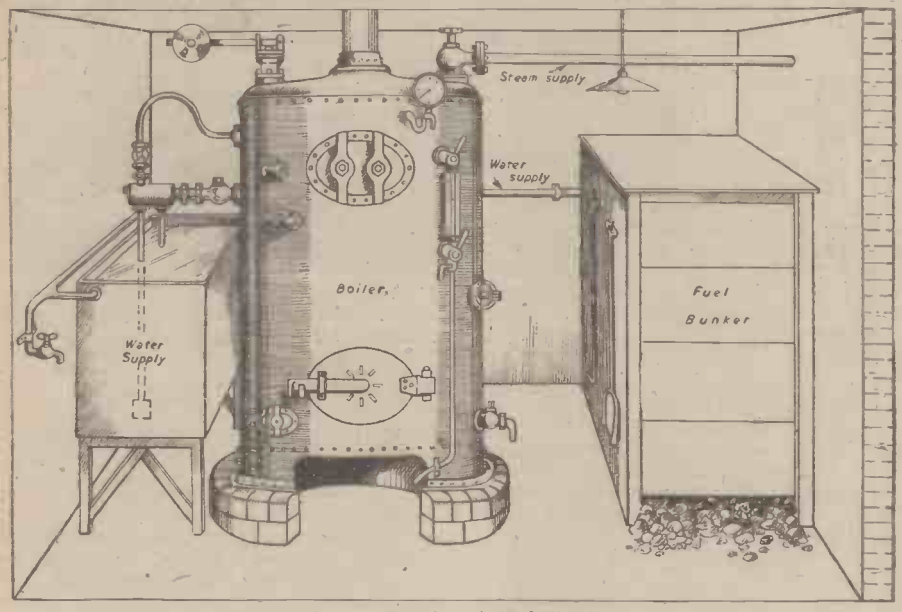


Fig. 1.—Interior of the boiler house.

Arriving at the dairy the bottles are all taken from the crates and examined at the same time; some will be thrown away, mostly because they have got snipped around the neck. A bottle which is in this condition is dangerous, and many a dairy worker has received a bad cut from a bottle with a jagged edge, also, when placed on the revolving brush of the washer the broken neck will shear most of the bristles from off the brush. That means added expense. More bottles will, perhaps, be placed at one side because they contain dirt or sour milk. These will have to be put in a bath of extra strong solvent before going to the regular washing tank.

Boiler House

On entering the dairy buildings we see at once that the dairyman is modern as well as careful. His boiler house, shown in Fig. 1, is equipped with a good boiler of the cross-tube type, is of ample size and well fitted up; this in itself is an engineering job. The owner knows that plenty of steam is of prime importance if he has to have clean utensils and bottles. To the left of the boiler is shown the water supply tank, connected to the mains and provided with a ball-tap with valve. The injector is shown side on above the tank, so that it can be seen; generally, they would be seen end on, with a back pressure valve and cock fitted.

To the right is the bunker, which is enclosed and the fuel put in from outside.

Washing Room

Going to the washing room (Fig. 2) the first thing seen is the low stool-like arrangement, which is used for the rinsing and scalding of large milk cans and other utensils which are too large to handle in the wash tank. You will notice it is connected to the water and the steam supply pipes, a valve to each being provided, but both cannot be turned at the same time. After being washed out with hot water containing solvent these large utensils are placed on the stool and given a good scalding and rinsing before being sent back to the farm.

Next to the stool is the washing tank complete with bottle-washing machine at the top right-hand side. This washer is of the multi-brush type, that is, it has one power-driven centre brush as well as a number of steady brushes spaced around this revolving brush. These machines are driven by turbine worked by steam from the boiler, or connected to an electric motor. The tank proper can be supplied from the mains with water which is heated up with steam, a certain amount of solvent being used during washing. Let us now watch the washing of the bottles which have been soaking while the water is getting hot. There is very little noise during the heating of the water, and in keeping with his other equipment the owner has had a silent heater fitted; this small fitting keeps down the noise and makes greater use of the steam. The bottle is taken from the tank, placed on the fast revolving brush, and held there for a few seconds, the inside being thus given a good scouring. The operator then releases the bottle and quickly moves a swivel brush over the bottom, and while this is being done the outside is cleaned by the steady brushes previously mentioned. The whole of this operation takes only a few seconds, and it is surprising how quickly two girls can get through a van load of bottles. After washing the bottles are placed on the rinser, which can be seen to the right of and a little lower than the wash tank. There are various kinds of rinsers; some have only one jet which comes into play when the bottle is placed in position, the flow of water stopping when the bottle is removed. The type shown in Fig. 2 will hold a standard crate, the crate being placed on the tray and the bottles placed neck down in the crate. When the crate is filled the water is turned on and series of spaced jets spray water up the inside of each bottle. The water is then turned off and the bottles quickly drain, all waste water runs into the pipe below the wash tank.

As the bottle-filled crates are removed from the rinser they are placed in the steel cabinet seen in the far corner of the washing room. When a sufficient number of crates have been placed in the cabinet, the door is closed and made tight by the locking handles. Steam is turned on and left for some time, and after

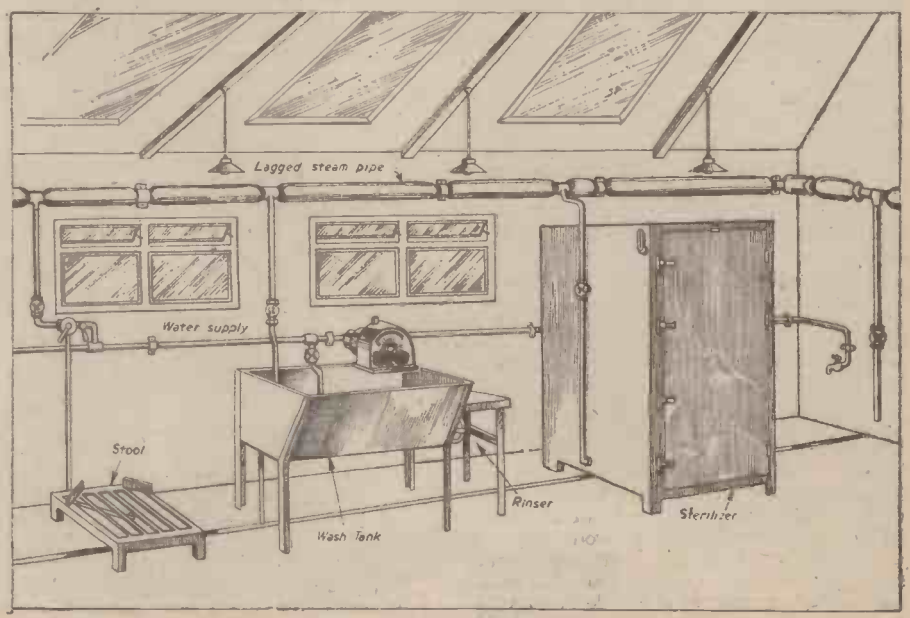


Fig. 2.—The washing room.

turning the steam off, the whole is left to cool down. It would not be safe to open the door too early after shutting off steam, owing to the danger of cracking a lot of bottles. The action of the steam in the cabinet is to sterilise the bottles, thus killing all harmful germs, and at the same time getting rid of any milk film which may have been in or on them.

You will notice on the far wall a water tap for swilling, as well as a steam pipe to which armoured hose can be fitted if required. This is very handy, as a bucket of water can be boiled any time when wanted.

The Dairy

The crates along with the bottles are now removed to the cold room, seen in Fig. 3. These are mostly of the automatic type, that is, if the temperature drops below a predetermined point the plant starts up on its own and brings the temperature back to requirements. You will see over the door an electric lamp, and this in many cases serves a dual purpose. If anyone is working inside the cold room they must have light, so the switches are placed inside, these same switches are connected to the outside light which is red, so when the lights inside are in use the outside light lets everyone know that someone is inside the room. Also, in many cases, the red light comes into operation when the temperature falls and the plant through some cause does not start up.

The fresh milk has arrived from the nearby farm which is also fitted up with steam to sterilise all the drinking and other utensils used by the cattle, as well as the milking machine parts. The milk is poured from large cans into the milk tank shown on the right near the back of the dairy (Fig. 3). From this tank it is pumped up over the top of the cooler, at the same time passing through a very fine sieve, although it has already been sieved at the farm. The milk flows down over the outside of the cooler, which is corrugated, the inside being in the form of tubes after the pattern of a gridiron. Cold water from the mains, brine, or in some cases cold air from the refrigerating plant, is passed through these tubes, and the corrugated form presents a larger area than a flat surface, and also helps the milk to spread over all the surface. Great care must be taken of these coolers; if damaged they may leak and whatever was passing through the inside would leak out and mix with the milk.

Filling Plant

Flowing from the bottom of the cooler, the now very cold milk enters the tank of the hand-filling arrangement seen in front of and below the level of the cooler. This particular filler has four outlets, as shown, these outlets consisting of tubes which go well down into the bottles. On each tube is a metal disc with a deep centrepiece which is a good fit, but will slide up or down the tubes. If one of these discs is lifted far enough you will see that the tube is drilled through, these holes being the outlets for the milk. When in use the action of putting the empty bottle in position lifts the disc and allows the milk to fill into the bottle; as one bottle is filling others are being put on or taken off. A good worker can fill bottles with remarkable speed and the waste of milk is very small.

As a general rule, while one operator is filling, another is sealing or capping. Metal caps are used in some of the large concerns, but the average dairyman uses cardboard discs, which are inserted tightly in the neck of the bottle. Various methods are in use for this; some dairies use hard wood or metal plugs with which to press the caps home, others use a hand capper. This is a small machine worked on the principle of an automatic pistol; it has a magazine which holds a large number of cardboard discs. The nose of the machine is put in the neck of the bottle, care being taken to keep it straight with the bottle, the left hand steadying while the right hand presses the grip smartly down. A cap is thus ejected and will be found tightly pressed into the bottle neck. These machines are quick and efficient in action.

The filled bottles, having all been crated, are now moved back into the cold store until required. As much labour as possible is cut out, even to moving crates inside the dairy. Trolleys, as seen in Fig. 3, are used, these small trucks being made to fit the crates, and the wheels are arranged so that they can be moved in confined places.

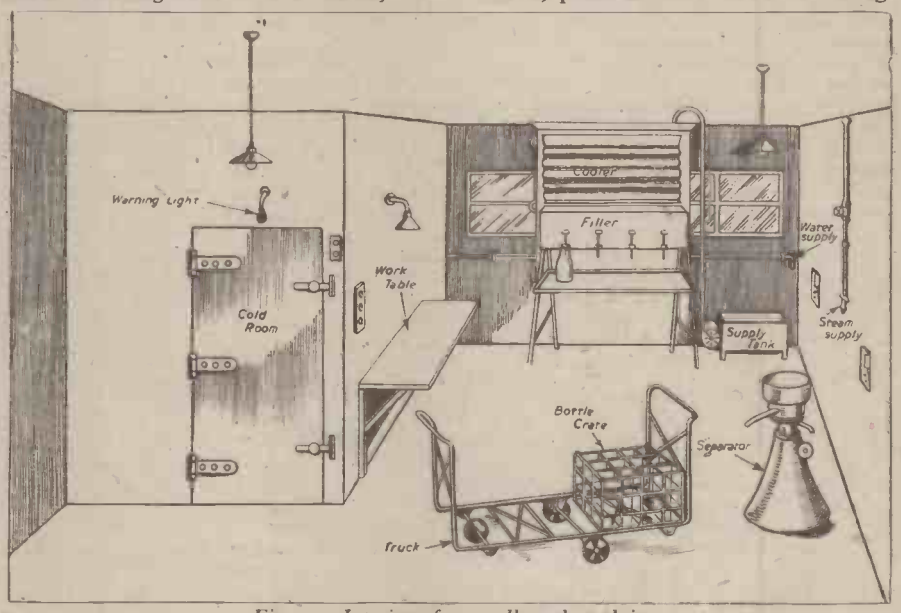


Fig. 3.—Interior of a small modern dairy.

Near the front right-hand corner of Fig. 3 is seen a small machine called a separator. This machine, electrically driven, by incorporating the laws of centrifugal action causes the separated cream to flow from one outlet, and the skimmed milk from the other.

On the wall can be seen the switches which control the pump and the separator, also a steam pipe with which water can be boiled for cleaning down, and also pumping through the pipes. The end of the steam pipe is made to fit an armoured hose, by means of which live steam can be used to scald all the equipment.

The foregoing description applies to any ordinary, medium dairy, from which good, clean milk can be obtained. The milk is not Grade A, pasteurised nor sterilised. Large concerns work much more automatic, being almost continuous in their action.

Most modern dairies are fitted out in stainless steel, although the use of heavily tinned equipment is quite permissible.

Notes and News

Coal Mining Machine

AT the present juncture in the history of our country and of the world the rapid and plentiful production of coal is absolutely essential. Therefore any invention which attains this result, if it can speedily be put into operation, will be materially useful.

An inventor has set himself the task of contriving an improved method of coal mining. He asserts that generally two methods of mining are known. In the first case, the coal face is cut by a machine over a given length in such a manner as to weaken it and render it suitable for breaking down by the use of explosives or equivalent disruptive means.

According to the second method, there is employed a machine which cuts the coal in such a way that it breaks down as fast as it is cut. Machines for carrying out this second method are designed to make multiple cuts in the coal simultaneously in different planes. For this purpose, cutters are used which operate with a sawing or abrasive action. One of these cuts, commonly called the shearing cut, is made in a plane practically parallel with the coal face.

The new device has for its object an improved means of cutting coal, so that it is broken down as fast as it is cut and has the effect of reducing the number of cuts.

The machine comprises a wedge-like splitting head and only one endless cutter which moves bodily with, but in advance of, the head. This makes a vertical incision (or shearing cut) in the coal, into which incision the head enters and splits the coal from the seam. And the leading part of the head is located within the circuit of the cutter chain, so as to enter the incision behind the latter.

Shield for Welders

AN improved shield for the protection of the eyes of the operator in electric arc welding is the subject of an application to the British Patent Office. At present, the inventor remarks, these shields are usually provided with an aperture in which is fitted a tinted glass or other suitable medium. This permits the worker to see the weld in operation. In practice, however, he adds, it is often difficult to see properly the position of the joint until the arc has been struck.

The object of the new shield is to overcome this disadvantage, so that the operator can have an unrestricted view of the work until the arc is struck. Then a semi-transparent aperture in the shield simultaneously and automatically closes to protect the eyes of the operator.

The characteristic feature of the new shield is the semi-transparent screen mounted in the shield adapted, as mentioned above, simultaneously and automatically to close upon the striking of the arc by the operator. When the arc is broken, the screen automatically opens.

Rocket Propulsion

The American Rocket Society : Rocket Motors on Test

By K. W. GATLAND

(*Continued from page 224, April issue*)

AFTER the trials of the A.R.S. Experimental Rocket No. 4, no further liquid-fuelled types were constructed for free flight, that is, not until 1939.

The Experimental Rocket No. 3 was never actually fired because of charging difficulties. Similarly, Experimental Rocket No. 5 was not prepared for test, due in this particular case to the results of earlier proving trials which had brought out severe failings in the design.

Since the building of these types, only ground trials of liquid-fuelled rocket propulsion units have been made, although complete powder rockets have been developed for stability trials and tests of alighting mechanism, for the purpose of which, free-flight firings are obviously essential.

The more current experimentation of the American Rocket Society comprises what is undoubtedly the most exhaustive technical development yet conducted outside the secrecy of the Government laboratories.

In view of the technical significance of this work, it is perhaps desirable to go into the various designs and test procedures a little more fully than in the previous discussions.

The Truax Rocket Motor

Among the most successful types developed by the Society to date is the water/fuel-cooled constant-volume motor (Fig. 22), designed by R. C. Truax.

The motor, designed to employ liquid oxygen, with petrol as fuel, was built almost entirely of nickel steel. Its chief attribute is in the unique cooling system, which combines a fuel circulation in a double walled nozzle "throat," with direct water injection into the efflux stream. This latter process is effected through an annular slot formed into the inside of the nozzle "throat." The fuel is introduced at high pressure, and has its inlet through the nozzle coolant jacket. From this, a fuel feeder line connects the nozzle jacket to a small pre-mixing chamber at the motor "head"; the fuel entering at the side. Just prior to injection, the fuel is "atomised" by its forced passage through a small centrifugal whirl fitted within the feed line. The oxygen, which enters the same pre-mixing chamber directly from the motor "head," is thus homogeneously mixed with the fuel prior to entering the combustion chamber. Both the fuel and water are forced to the motor under air pressure; and at the commencement of operation each is supplied under fully 700 lb. per sq. in. This pressure is subsequently regulated, at full operation, to 200 lb. per sq. in., and 160 lb. per sq. in., for the fuel and water respectively.

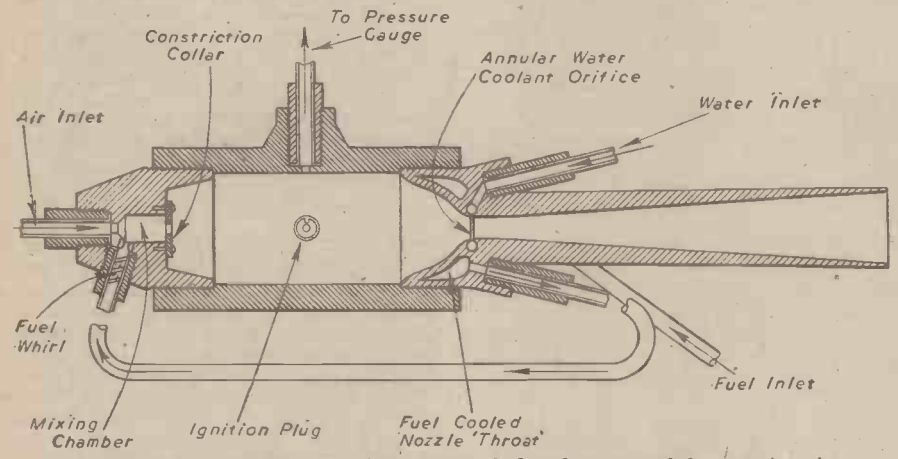


Fig. 22.—Sectional diagram of the Truax fuel and water-cooled motor (1937).

The Truax Motor on Test

The complete unit, which was first tested at Annapolis, Md., in December, 1937, had, for recording, simply a beam balance. Because of the necessity of having the operator within some 15ft. of the combustion unit—for reason of safety—the complete set-up was given a hydrostatic test up to 1,000 lb. per sq. in. The motor and testing scale on the one side, and the fuel tank, water tank, air compressor with containing tank (oxygen was not employed during the initial trials), ignition gear, etc., and operator on the other, were divided by a steel sheet.

The testing sequence was as follows: Air is first supplied to the feeding lines, the ignition circuit cut in, and with the fuel and water tanks fully pressurised at 700 lb., the inlet valves operated. Air for combustion was then introduced at a slowly developing pressure; but unfortunately, in the initial test, the motor refused entirely to respond.

A second attempt was immediately made, using the same functioning sequence, the sole difference being that the motor and fuel supply lines were first raised in temperature to red heat by oxy-acetylene flames. The fuel system was again pressurised and air supplied in slowly increasing quantity until the attainment of the required combustion proportion. On this occasion, the motor did fire, but in no way so effectively as had been hoped; its sound emanated a motor-cycle engine—a loud continuous popping. However, with slight adjustment of the supply valves, the motor was at length made to function with a steady roar, but only for a few seconds before reverting to its previous irregularity.

In view of these failings, the motor was stripped down in a search for possible fault. Consideration showed that it might be the case that the fuel supply had been affected by the momentary pressure built up during the intermittent explosion periods, and the constriction collar in the mixing chamber was replaced by a smaller one, the intention being to cause a greater pressure prior to ignition. When put to further test, however, the motor did not even function.

In the next test, the restriction collar was removed entirely. The motor was again set up, and, after pre-heating the chamber, the fuel and air supply were once more cut in. Within a few seconds of adjustment, the motor finally burst into life, but first only with the same popping noise as had resulted earlier. Slowly the supply pressure was modulated, and then, suddenly, at a certain minute adjustment, there came at last a loud, smooth roar; the sound indicative of continuous combustion. Almost immediately it became necessary to operate the nozzle coolant system because of the rapid rise of temperature which accompanied proper combustion. The water coolant device proved highly effective, cooling the motor instantly, and in subsequent trials the inlet was left slightly open.

Test Results

At the commencement of proper function, the combustion pressure rose to 50 lb., and by effecting a gradual increase of the input pressure—at the same time due care being taken to maintain the correct propellant ratio—a pressure of 150 lb. per sq. in. was finally achieved.

Had oxygen been employed instead of air as the "supporting" medium, it was considered that the motor would quite easily have reached the designed chamber pressure of 300 lb. per sq. in. As it was, the inlet ports were too small to allow the air to build up sufficiently.

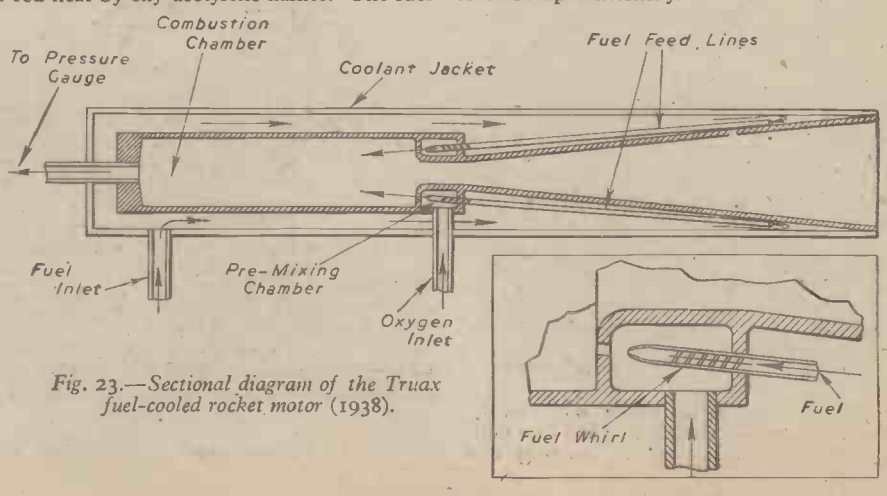


Fig. 23.—Sectional diagram of the Truax fuel-cooled rocket motor (1938).

Several further firing runs were made later in which, by an interchange of valves, even greater steadiness of control and burning was achieved. It is indeed unfortunate that the testing apparatus employed in these particular experiments was not more elaborate. There were, for instance, no facilities for determining such necessary characteristics as the constant thrust factor or the amount of fuel consumed, and, therefore, the thermal efficiency. However, R. C. Truax—who conducted the tests—reporting in *Astronautics*, April, 1938, pp. 9-11, made the following general observations, which, for our purposes, are in many ways as conclusive as the recorded figure: "The matter of determining the proper fuel mixture caused no concern; the motor would not run on an improper mixture. While the rocket motor was in full operation without water, there was neither smoke nor flame issuing from the nozzle mouth. This probably indicates excellent combustion and complete expansion. In fact, with the jet at full power an observer put his hand about a foot and a half from the nozzle, and so little heat remained unconverted that he was able to hold it there (though with considerable effort) without injury."

There is no doubt in the success of the cooling system. The amount of water consumed during the testing was about half that of the fuel, but a reduced quantity would undoubtedly serve to cool the nozzle with little effect on the operating effciency.

As already mentioned, the fuel consumption was not directly recorded, but it has been estimated that a total of about 10 gallons was used to run the motor, intermittently and at varying powers, for six or seven hours of testing.

The Truax Fuel-cooled Rocket Motor

A further Truax motor (Fig. 23), developed early in 1938, featured a fuel-cooled combustion chamber and nozzle, with reverse fuel injection.

As can be seen from the diagram, the component layout is extremely simple and no elaborate "contouring" of the chamber and nozzle firing faces is involved. Distinctions in the design are complete fuel cooling, and the provision of a propellant premixing system at the nozzle "throat."

The design is such that the fuel enters from the side, near the motor "head," circulating through the coolant jacket down to the nozzle "mouth" prior to entering the pre-mixing chamber at the nozzle "throat" through feed lines. Small centrifugal whirls fitted in the lines "atomise" the fuel prior to its injection. The oxygen enters the pre-mixer from the side, where both propellant components are well mixed, prior to their injection into the combustion chamber—towards the motor "head"—through small bore holes. A small ignition plug, fitted in the chamber wall, serves to initiate combustion.

The fuel-cooled Truax motor was shown in England when the designer visited London and delivered a lecture to an assembly of the British Interplanetary Society in July, 1938.

The Wyld Rocket Motor

As with the motors previously described, the point of significance in the Wyld regenerative motor (Fig. 24) is its unique cooling system. Again, petrol is used, with oxygen, as propellant.

With reference to the diagram: the fuel enters the motor at the double-walled nozzle, flowing round the combustion chamber, through the jacket "manifold," and is introduced, for combustion, at the motor "head." The oxygen is fed from a radial injector and enters from just above the fuel inlets, which inject from radial holes at the sides. By this arrangement, the fuel acts to cool both the nozzle and chamber, and, conversely, to vaporise the fuel by pre-heating, with a resultant improvement in combustive efficiency. The complete motor weighs only 2lb.

The Wyld Motor Under Test

The motor was tested on December 10th 1938, the recording apparatus being the American Rocket Society Proving Stand No. 2.

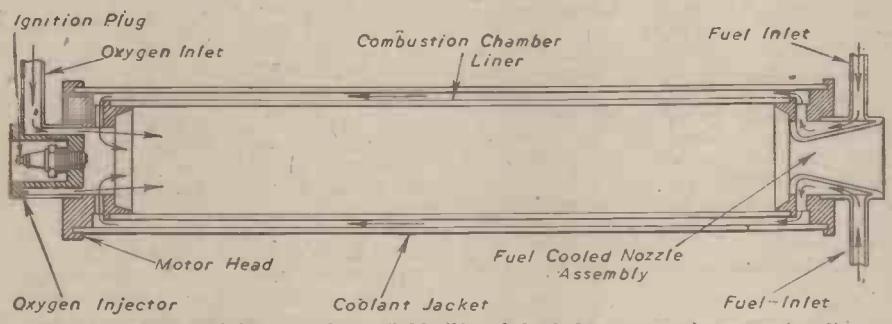


Fig. 24.—Sectional diagram of the Wyld self-cooled tubular regenerative motor (1938).

Fuses, along with gunpowder loosely packed into the nozzle, were used for ignition. When fired, the gunpowder caused the exhaust to appear first as a large yellow flame, which immediately shortened into a "spear" of blue as the liquid propellant caught. At the same time, the reactive thrust rose to 90 lb., which figure remained steady on the recording dial for 13.5 seconds, until the liquid oxygen became exhausted in the supply tank.

Upon examination the motor showed no sign of defect, apart from slight melting and erosion at the chamber "head" and liner, which had occurred about an inch from the injector ports.

Empirical Performance Data

The performance figures of the Wyld regenerative motor, derived from proving stand test, as from the period of efficient combustion, are as follow: Maximum reaction, 91lb.; alcohol feed, 0.084lb./sec.; oxygen feed, 0.34lb./sec.; tank pressure, 250lb./sq. in.; chamber pressure, 230lb./sq. in.; maximum exhaust velocity, 6,870ft./sec.; maximum thermal efficiency, approximately 40 per cent.; and jet energy, 310,000ft./lb. sec.; or 565 h.p.

Further trials of the same motor were made in August, 1941, when the American Rocket Society experimental committee conducted three exacting firings at their Midvale, N.J., proving grounds.

In the first firing, the motor functioned for 21½ seconds, consuming during that time about 12lb. of propellant. The jet appeared as a violet flame approximately 3ft. in length; the motor operating with a deep roar interspersed by sharp detonations which occurred at intervals of about five seconds. These regular explosions caused considerable vibrations, which, as well as shaking the proving stand, were actually felt by those taking part in the test. The phenomena which were in attendance throughout the three testing runs, caused no hurt to the motor.

The second test was concluded with similar results as the first, though the firing duration was bettered at 23 seconds.

The final firing was by far the most satisfactory, lasting for a period of 45 seconds, and, despite the use of a leaner propellant mixture, the motor recorded a maximum thrust of 135lb.

The average thrust for the three firings was approximately 125lb., while the tank and combustion chamber pressures were 250lbs.

One further point of interest arising from the trials was that, due to a misfire in the initiation of one of the firings, unignited propellant ejecting from the nozzle developed a thrust of almost 50lb. on its own account.

These figures are among the most favourable ever recorded by the American Rocket Society. Coupled with the fact that the motor functioned almost without damage, this data shows clearly the increased reliability obtainable in the development of liquid-cooled rocket propulsion units. A similar, though admittedly less ambitious motor, it will be remembered, was produced a number of years earlier by the German engineer, Dr. Eugen Sänger.

A Mosquito of Coastal Command being loaded up with rockets while final adjustments are made to the machine preparatory to taking off.

Inventions of Interest

By "Dynamo"

Anti-roll Ship Wings

AN invention to prevent the inconvenience occasioned by the rolling of a ship is not a new idea. Some years ago a lady of title devised a berth which, whatever the angle of the vessel, always remained level. An anti-rolling arrangement is the aim of an invention which has recently been submitted to the Patent Office of this country.

This consists of wings formed of steel plates 10 feet in length, 1 foot broad, and 1 inch thick. One of the 10 feet edges is riveted to the inside of the 10 feet length of steel angles.

The steel angles are riveted to the top sides of the ship, the after ends being 6 inches above the water line, above which the fore ends are 18 inches.

Such an arrangement should mitigate rolling and make for the convenience of the passengers and crew.

Storm-proof Lighter

IN these days when matches are in short supply, the lighter acts as an effective locum tenens—sometimes. To improve this method of getting a light is the object of a current invention. The originator has realised that a flame's breath of life is oxygen. He provides a lighter in which special means is adopted to feed oxygen to the flame, and to guard against easy extinguishing, so that he claims that his lighter is practically wind and stormproof.

This lighter has the usual casing and a hollow cylindrical wick, both open at the top. The characteristic feature is that there are openings in opposite sides of the casing and of the wick. These permit a current of air to pass through them into the wick.

The same inventor has contrived also a lighter in which means are provided against loss of combustion mixture or liquid vapours, or to retard such loss. There are a cap and a removable bottom section furnished with absorbent lining, preferably composed of a number of layers of thin textile material pressed one upon the other. This is designed to absorb the fuel vapours accumulating in the casing and cap, and bottom section, while the device is closed.

Surgical Appliance

THE normal method of treating a burst blood vessel is the application of a tourniquet, which is a bandage or pad tightly twisted on the artery. A newly designed first-aid appliance for arresting bleeding from a wound in the arm or leg consists of two steel arms hinged together so that they can be adjusted with respect to each other. The arms co-operate around the arm or leg to exert pressure by virtue of their springiness upon the artery above the wound.

Resilience Without Rubber

THE present shortage of rubber makes a wheel which needs no rubber, and is yet resilient, undoubtedly a desideratum. A new invention consists of a wheel without the customary pneumatic tyre.

This wheel comprises an outer rim, and a number of quarter-elliptical leaf springs, each rigidly secured by one end tangentially to the inside of the outer rim. And there are links pivotally connected by one end to the free ends of the leaf springs. The other ends of the links are pivotally connected to the inner portion of the wheel.

Trailer Brake-control

WHEN a motor vehicle has a trailer, if the brakes of the tractor and trailer are not applied fairly equally, there is a danger of vigorous snatching of the towing coupling, resulting in the loss of directional control. For example, this may occur during sudden application of the brakes while a curve is being rounded.

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

With a view to obviate this risk, an inventor has contrived special brake control mechanism. His device includes a brake-actuating member for the tractor, and another for the trailer. There are also a driver's brake-controlled member, and a differential mechanism interconnecting the three members. And a spring limits the displacement of the trailer-brake actuating member until that member has been displaced by the predetermined resistance which has been built up.

Lubricating Track Rails

CURVING rails require constant lubrication. Otherwise they are easily subject to wear and tear, and may produce unearthly shrieks.

There has been devised a new apparatus for applying lubricant to the sides of track rails. According to this invention, the lubricant container is vertical, and is attached to the rail. It has a superimposed weighted piston, so placed that the instantaneous rapid flexing of the rail augments the effect of gravity upon the piston to expel the contents of the container.

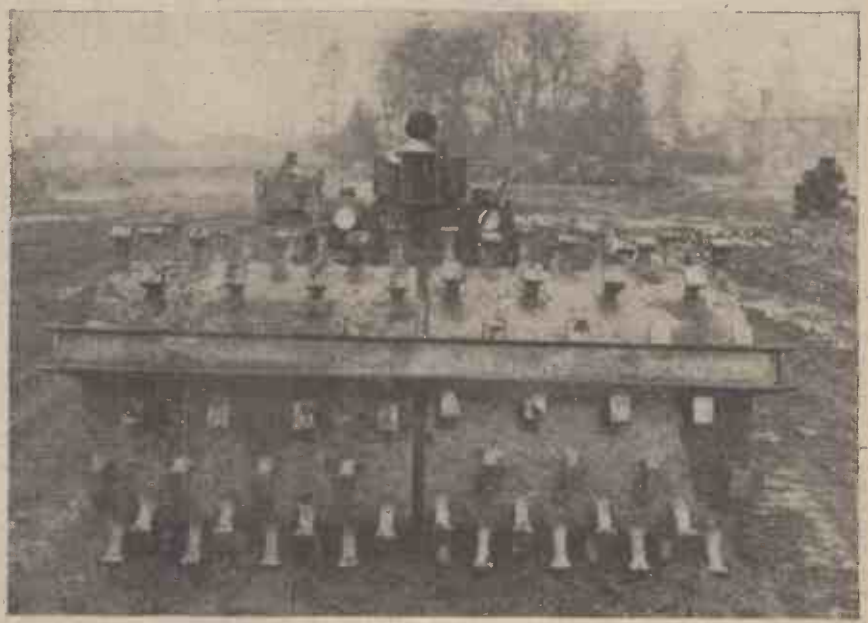
Light Bricks

YET another process relating to building has made its advent. The inventor asserts that during the last few decades, after the erection of the steel or ferro-concrete framework of a building, the outer and party walls have been filled in with ordinary clay bricks, limestone, hollow bricks of terra cotta or silica, etc. It is realised that there is no longer any need for the filling material to possess any great resistance to compression. Outer and party walls have only their own weight to support. Their sole function is to serve as protecting screens against the elements and atmospheric changes. It is particularly desirable that the material used should be light in order to reduce to a minimum the load on the framework. The outer wall surfaces at least must be unaffected by atmospheric conditions.

The object of the new process is to produce a light material suitable for outer and party walls for steel-framed or ferro-concrete buildings to be made from cheap and plentiful materials, which need not themselves be light.

MOULDED UNDER PRESSURE

The bricks consist only of limestone and Portland cement. The limestone is crushed into grains. These are graded by sifting them through three sieves of successively finer meshes. Grains of more than about four millimetres across and grains of less than about three millimetres across are selected. The granules of intermediate sizes are eliminated, so as to form small cavities within the mass. The larger selected granules are mixed with about twice the amount of the smaller selected ones. This combination is then mixed with Portland cement and water. The resulting mixture is moulded under pressure equalling that of the atmospheric.



A "sheepfoot" roller for pummelling the ground, being pulled by a bulldozer. These specially formed rollers will be largely used after the war for housing clearance and road construction.

NEW SERIES

The Annals of Electricity—4

Tapping the Lightning's Energy. The Electrical Experiments of Benjamin Franklin

BENJAMIN FRANKLIN led a full life. By basic occupation a printer and a stationer, he became an editor, a newspaper owner, and a celebrated author, besides raising himself to the status of a sort of alderman or town councillor.

Climbing still higher, he found fame as a diplomatist, and, in this high capacity, he found an exalted position in the councils of the then embryo American nation, putting the seal of national eminence and distinction on his career by becoming one of the signatories of the famous American Declaration of Independence of July 4th, 1776, the formal instrument by means of which, as a result of the inherent and constitutional stupidity of George III and his ministers, England lost for ever her formerly hard-won and lucrative colonies on the American mainland.

But besides all this work on the part of Franklin, he also found time not only to interest himself in the then very immature science of electrics, but, also, by dint of his own individual experiments therein, to become a world authority on electricity.

Franklin, too, dabbled in mechanics (to say nothing of theology, metaphysics and kindred other subjects). He also invented a smokeless stove, went in for constructing printing gadgets, and experimented a little in scientific chemistry.

Franklin's father was an Englishman. He hailed from the little village of Ecton in Northamptonshire, and had been a dyer by trade. But when, about 1685, he emigrated to the New World, he blossomed out as a soap-boiler.

Fondness for Books

Benjamin Franklin was the fifteenth child of the English Franklin. He was born at Boston on January 17th, 1706. Being a bright lad, he was sent to a local grammar school at the age of eight, with the intention of his ultimately entering the ministry. However, the parent Franklin, in view of his large family, found himself unable to educate Benjamin to such a calling. Instead, seeing the lad's fondness for books, he put him to the printer's trade in the office of his elder brother James, who was at that time a flourishing printer.

Side by side with his learning the printing business, Benjamin devoted much time to other studies, including science, languages, and mathematics. Ultimately, at the age of 17, he left his brother and went to New York in search of a fresh job. Soon afterwards he removed to Philadelphia and eventually established himself in that town as the editor, author, printer and proprietor of the *Pennsylvania Gazette*. Previous to this success, he had made a voyage to England, working in London as a printer for about eighteen months.

His settlement as a master printer and newspaper proprietor at Philadelphia brought success, and a certain amount of independence to Franklin. He now began to fill various public offices, a phase of his career which, as we have already noticed, led him to positions of very high statesmanship in his country.

With such facets of Franklin's career we cannot, of course, deal in this article. Instead, we must now betake ourselves to Leyden, in Holland, in which town, the year being 1746, an electrical investigator named Peter van Musschenbroek had noticed that electrified bodies always lose their electricity when exposed to the atmosphere. Musschenbroek wanted to electrify a quantity of water, and, in order to prevent its "de-electrification," he placed the water in a glass jar having an ordinary iron nail standing within it, the function of the nail being to conduct the electricity to the water from the frictional machine.

An associated experimenter named Cuneus held the glass jar with its nail in contact with

Benjamin Franklin in his later years.

the conductor of the electrical machine, and when, still holding the jar in one hand, he touched the nail with the other, he received a violent shock.

Peter Musschenbroek then repeated the experiment. He got an even worse shock,

Franklin's kite experiment, by means of which he collected static charges from the clouds during a thunderstorm.

so much so that he wrote to the effect that not for the imperial crown of France would he expose himself a second time to a similar shock.

The Leyden Jar

Thus came into being the famous "Leyden Jar," a device, which as all experimenters know, consists of a glass jar having an inner and an outer coating of tin foil reaching to within about a couple of inches from the top. The jar is corked, and through the cork passes a brass rod surmounted with a brass ball and making contact at its lower end with the inner tin foil lining of the jar by means of a small length of flexible chain.

The Leyden jar is a simple storage device for frictional electric charges. It represents the world's first electric accumulator.

For a considerable time, the action of the Leyden jar remained a complete mystery. The best minds in Europe could think of no suitable explanation for this.

In far-away Philadelphia, Benjamin Franklin had become postmaster of the town. He had established a public library and had also founded an "American Philosophical Society" for the discussion of scientific, literary, and other learned affairs.

Up to this time Franklin knew nothing about electricity. He had become mechanically inclined, and had invented his smokeless stove, which had attained success in America, and had even reached the distinction of being pirated in England.

At one of the meetings of the Philosophical Society, Franklin came into contact with a certain Dr. Spence, a Scotsman, who, it seems, had some practical acquaintance with the *modus operandi* of the electrical experiments of the day. He performed some experiments for Franklin, with, of course, the anticipated result of firing Franklin's imagination. From this stage onwards Franklin became a confirmed electrical "fan," devoting much of his spare time to experiments and conjectures concerning the new science of "electrics."

Peter Collinson, a London F.R.S., appears to have sent Franklin full particulars of the Continental experiments with the Leyden jar. Franklin at once repeated the jar experiments. He found that an insulated ball, after contact with the inner coating of the jar, was repelled by the outer coating, and vice versa. He made an experiment in which he suspended a light cork ball within the jar between two wires which were, respectively, connected with the inner and outer tinfoil coatings of the jar. Between these two wires the cork ball (having first received a charge from the outer tinfoil coating of the jar) oscillated until the apparatus had completely lost all its electricity.

Electrical Law

Basing his theory on these experiments, Franklin offered the first explanation of the jar's action, and, simultaneously, he announced a more general electrical law to the effect that when two oppositely charged conductors which are separated by an insulator are brought near to each other they will attract each other.

Franklin, therefore, was the first man to show that positive attracts negative.

On one of Franklin's famous statues in America is inscribed the statement:

"He snatched the lightning from Heaven, and the sceptre from tyrants."

The "business end" of a modern lightning rod.

The latter portion of the legend obviously refers to the famous Declaration of Independence, in which Franklin had some close concern; the former portion of the phrase commemorating Franklin's epoch-making lightning experiments, and his demonstration of the similarity of the lightning flash to the electric spark.

For years various experimenters had essayed opinions to the effect that electric sparks and lightning are both manifestations of one and the same thing. Nobody, however, had ever attempted to prove such a theory, and, indeed, many actively disbelieved in it. In fact, when Franklin first communicated to the stately Royal Society, in London, an account of his lightning experiments, and his theory concerning the identical nature of lightning and the electric spark the members of that august body saw fit to laugh with much gusto when the paper was read. It must be remarked, however, that, in after years, the Royal Society, repenting of its error, made Franklin an honorary member, and also awarded him its most cherished honour—the celebrated "Copley" medal—which is only given for scientific eminence of the very highest order.

Experiments on Lightning

Franklin began his lightning experiments in the year 1752. At first, he had proposed to have a wire conductor attached to a church steeple which was to be built, but there happened to be some delay in the erection of the steeple so that Franklin conceived the idea of flying a kite in a thunderstorm, which experiment was duly carried out. The kite consisted of a silk handerkerchief stretched on a cedarwood frame. The frame carried a vertical copper wire, which made contact with the long length of kite string to the lower end of which was attached a large iron key.

To the key, also, was attached a length of stout silk ribbon, this ribbon being held by the person in charge of the kite.

When the thundercloud approached, the pointed wire of the kite attracted an electrical charge which then ran down the kite string after the latter had been thoroughly wetted by the rain. It reached the iron key, but was unable to pass along the silk ribbon because the latter was held under the shelter of a shed by the operator, and so retained in a fairly dry condition.

By means of this simple apparatus Franklin was able to draw off large amounts of electricity from the iron key at the lower end of the kite string. He produced large electric sparks and performed all the recognised electrical experiments of the time.

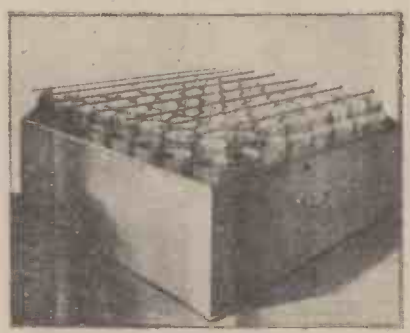
In reality, however, this experiment of Franklin's was a highly dangerous one. The only factor which saved him and his assistants from instant electrocution was the inadequate conductivity of the wetted string.

Having thus, with certainty, established the identity of the electric spark with the lightning flash, Franklin reasoned that the destructive energy of the lightning might be neutralised (at least, in part) by securing conductors to the highest places of buildings and by running a metallic wire or ribbon from those conductors to a plate buried in the earth. Just as a portion of the lightning's energy ran down the kite string, so, argued Franklin, it ought to proceed to earth safely and non-destructively via the metallic conductor attached to the building in question.

The First Lightning Conductor

Thus came into practical being the world's first lightning conductors. The first permanent lightning conductor was erected on the house of a German clergyman, and shortly afterwards many were erected in America.

A Russian professor named Richmann, living in St. Petersburg (now Leningrad), had an insulated lightning conductor running down into his laboratory for the purpose of studying atmospheric electricity. Unfortunately, the device ended in a tragedy. During a severe storm occurring in August, 1753, Richmann entered his laboratory and approached the lower end of the lightning rod which had been carefully insulated. As he did so, a large ball of fire was observed by an assistant to jump outwards from the rod



The first battery, consisting of a box of Leyden jars connected together for the generation of a large spark.

and to enter Richmann's body, flinging him instantly to the floor and killing him on the spot.

St. Elmo's Fire

Benjamin Franklin, quite apart from his zeal for national and political causes, found himself almost world famous in consequence of his lightning rods and his electrical experiments. He was able to throw fresh light on old mysteries. For instance, he showed that the former highly mysterious "St. Elmo's fire," an electrical luminescence which was often noticed playing around the tall, pointed masts of sea-going vessels, was merely an electrical phenomenon, the mast acting in the capacity of a lightning rod.

Franklin's success with his lightning conductors led to his retirement from active business. It was, however, only a nominal retirement, for his subsequent social, diplomatic and Government work fully occupied the remainder of his days, even, indeed, to the eventual exclusion of all further scientific experimentation.

It should be noted that Franklin recommended that all lightning rods should be *pointed* at their upper ends, since he found by experiment that pointed conductors were better collectors of electricity than were blunted ones.

In opposition to Franklin, a number of authorities in England and on the Continent announced that pointed conductors were actually dangerous since they "solicited the lightning," whereas a blunted conductor, such as one with a metal ball fixed on its end, does not attract lightning but, at the same time, draws off the electric energy from the clouds in a perfectly safe and harmless manner.

For a time, the matter was allowed to become an affair of very great dispute in scientific circles, and when, in 1772, the English Government requested the Royal Society to decide which was the best type of lightning conductor to erect over gunpowder factories and magazines, the dispute took upon itself a decidedly acrimonious character, some members of the Royal Society insisting on their recommendation of pointed conductors, the others warmly praising the superiority of blunted or "knobbed" conductors. Needless to say, Franklin himself was not to be consulted on the subject, he being then what we would now term an "enemy subject," or, possibly, in the eyes of the Georgian Government, a "war criminal"!

"Points versus Knobs"

The Royal Society could not decide on the matter of "points versus knobs." At last, the reigning monarch, George III, had knobbed lightning conductors put up over his palace, by way of setting an example which he hoped would be imitated. The occasion gave rise to the following epigram:

While you, great George, for knowledge hunt,
And sharp conductors change for blunt,
The Nation's out of joint;
Franklin a wiser course pursues,
And all your thunder useless views,
By keeping to the point!

It is seldom remembered that it was Benjamin Franklin who first introduced into use the terms *positive* and *negative* to express the condition of bodies containing more or less than their normal amount of electricity. In our days, of course, in the light of the electron theory of matter and electricity, the precise conception of positive and negative has been revolutionised.

One of the questions which occurred to Franklin's mind was this: Is the electricity which is manifested by the rubbing of a silk rag on a glass tube created by the friction of the experiment or is it derived from some outside source?

Franklin tackled the problem by standing on a large cake of resin, thus effectively insulating himself from the ground. He then electrically excited the glass tube by rubbing

The first electrical accumulator—a Leyden jar. The example illustrated was made during Franklin's lifetime.

it with his bare hand. Afterwards, he drew off its electricity into his own body.

Now, Franklin realised that if he had drawn off the electricity from a similar tube which had been excited by another person he would have become strongly electrified. As it was, however, he did not become electrified.

In view of this fact, he reasoned that there was no change in the sum total of electricity which he communicated to the tube by friction and that which he drew off from it. Hence his body did not show any signs of electrification.

He tested this view by separately insulating two individuals. One of these rubbed the tube; the other drew off electricity from it. In this instance, both individuals became electrified. But when the two persons, still insulated from the ground, touched each other, all signs of electrification instantly vanished, a small electric spark passing between them.

"Franklinism"

It was upon experiments such as these that Franklin based his theory of (frictional) electricity. It was called the "Franklinian theory," and was even, indeed, sometimes dubbed "Franklinism," as if it had constituted some kind of religious philosophy.

Franklin's theory had it that every natural body or thing contained within it some definite quantity of a subtle "electric fluid." When bodies or substances are equally supplied with this "fluid" or energy-principle, no signs of its existence are evident. But when, for instance, a glass tube is rubbed, the natural distribution of the "fluid" between two substances is disturbed. The glass tube receives more than its share, the excess being derived from the hand or the pad which rubs the tube.

Considering the times in which Franklin lived and worked, the theory of electricity which he evolved was remarkably accurate. Substitute the idea of "electron-deficiency" for Franklin's "disturbance of electric fluid" and you have the germ of our modern theory of electrification.

But, of course, Franklin must have been an all-round genius, and it is just these all-round geniuses who have a trick of getting to grips with Truth years (and sometimes centuries) before the latter becomes apparent to other people.

There is no doubt that Franklin was a most valuable pioneer in the realms of electricity. In later life, however, national fame overtook him. He became a founder-statesman of America, and his electrical essays took a back seat.

He died at Philadelphia on April 17th, 1790, advanced in age and honoured by all, friends and political enemies alike, the world over.

High-power Short-circuit Testing

Testing Technique, Special Equipment, and Layout of a Testing Station

By S. STATON

APART from the question of economics, which is of prime importance to all engineers, the electrical supply engineer is mainly concerned with the reliability of supply to the consumer. The British grid is a fine example of engineers' efforts in this direction.

During the past five years of war, reliability and maintenance of supply have become more vital than ever; whilst demands on the supply industry have increased a hundredfold. In spite of all these increased demands, and the difficulties of war, the electrical supply industry has maintained its high standard of efficiency and reliability, which is indeed a tribute to the British Engineer, and the equipment he has produced for the industry.

There are, of course, many different pieces of equipment which go to make up a power supply system, and the supply engineer, when he purchases this equipment requires proof that they are capable of meeting all service requirements and conditions. It is the duty of the manufacturing engineer to supply this proof, and common practice is for the manufacturing engineer to carry out an agreed series of comprehensive type tests on the particular equipment he manufactures. The tests are conducted in the presence of the customer's representative if this can be arranged; failing this, the tests are carried out by the manufacturing engineer and certificates of the test results are forwarded to the customer, in this case the supply engineer.

In this article it is proposed to set out high power, short-circuit testing technique as applied to circuit breakers.

The special equipment and layout of a testing station will be described and the characteristics of the testing circuit with methods of varying its severity discussed. Finally, the assessment of performance from oscillograph records will be explained.

Service Requirements of Circuit Breakers

It has been stated that the supply engineer requires proof that the equipment he is purchasing is capable of meeting all service requirements, and in order to obtain this proof agreed tests are carried out.

Before a clear idea can be obtained of the significance of the various agreed tests for circuit breakers, as set out by the British Standards Specifications 116/37, it will be necessary to consider what may be required of a circuit breaker in service.

Normal Duties

Fig. 1 shows a circuit breaker connected between an alternator and transmission line. Under normal conditions, the duty of the circuit breaker is to make the line "live" at the required time by switching on power from the alternator. Secondly, to make the line "dead" by opening and interrupting the power flow from the alternator. The circuit breaker must therefore be capable of "making" and "breaking" the peak load current at the rated service voltage of the line at any time so required.

Abnormal Duties

Short Circuit Develops on "Live" Line.—Consider now what happens if the circuit breaker is closed with the line "live," and a short circuit occurs at the point "X" along the line. The current supplied by the alternator immediately rises to a peak value, and then gradually decreases to a final steady value, as indicated in the curve Fig. 2. The value of this peak current is governed by the reactance of the line, and any synchronous plant between the alternator and point of short circuit. It may rise to many times the value of the full load current.

Obviously, the alternator must be cleared of the fault; and the circuit breaker is called upon to break the circuit, and interrupt this abnormal short circuit current, without any damage to its contacts, frame, or mechanism, etc.

There must be no danger of fire or explosion due to the current arc igniting the oil in the circuit breaker tank and forming gas.

Circuit Breaker Closes on to "Dead" Line which is Short Circuited.—It is, of course, quite possible that the short circuit of the line occurs whilst the line is "dead," the circuit breaker thus being open. This short circuit, or fault, will not be made manifest until the line is made "live," by the closing of the circuit breaker; thus the circuit breaker will be closed on to a short circuited line.

To clear this latter condition is generally worse than the former as will be seen by considering the sequence of events step by step.

At some point along the transmission line, which the circuit breaker controls, the short circuit occurs; this, of course, is unknown, as the line is "dead," or de-energised. It will be understood by the reader that there are many lines which are not in use for the full 24 hours per day. When the appointed time arrives for the line to be made "live," the station control engineer closes the particular circuit breaker concerned by energising its closing coil from the control panel in the control room. The closing coil operates the closing mechanism of the circuit breaker, thus bringing its contacts together. Immediately the contacts touch together the short circuit is established, and again the current supplied by the alternator attains a peak value. The circuit breaker has, therefore, to "make" this peak value of current.

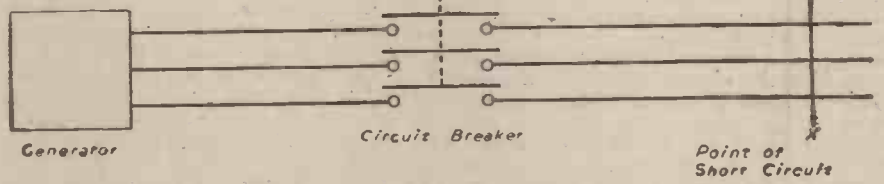


Fig. 1.—Circuit breaker connected between generator and transmission line.

Tripping Mechanism

The short circuit current sets up an electro-magnetic force amounting to several tons, which tends to hold the contacts and prevent them from closing fully. Considerable mechanical forces are set up on the contact carrying bar, and this has to be capable of withstanding such forces. The electro-magnetic force opposing the final closing of the circuit breaker very often delays the

closing to such an extent that the short circuit current has had time to operate the relays which operate the tripping mechanism of the circuit breaker, thus tripping the breaker before it is fully closed. As not being fully closed the compression springs which are arranged to compress when the breaker is closed are not fully compressed, and therefore they do not accelerate the opening of the breaker as would be the case if they were fully compressed. The opening of the breaker is therefore slowed, and this has a very marked effect on its ability to clear the current arc.

Short Time Carrying Capacity.—There are several systems of protection in present use which may require a circuit breaker to remain closed on a fault, or short circuit, until it has been cleared at some other point along the line. The circuit breaker remaining closed has therefore to be capable of carrying the short circuit current for the time required without any damage to itself.

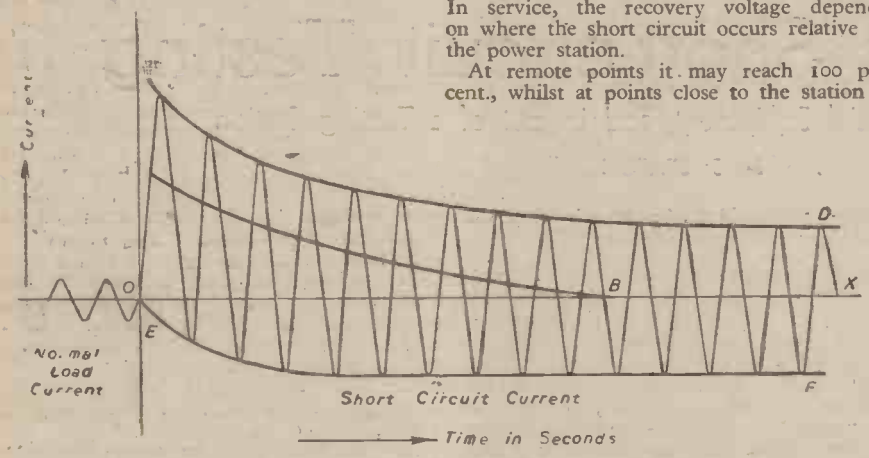


Fig. 2.—Short circuit characteristic of an alternator.

It is not proposed to describe any system on which the above conditions may occur, but the reader may, if he desires, read of such schemes in any text-book on protection. "Group Feeder" schemes furnish about the best example.

Standard Tests

To ensure that a circuit breaker will meet the above service requirements standard tests are carried out as follows:

(1) *Break Test.*—Short circuit current is passed through the closed circuit breaker under test which is tripped to interrupt the current.

(2) *Make-Break Test.*—The circuit breaker is closed on to a short circuit, and then tripped to interrupt the current.

(3) *Make Test.*—The circuit breaker is closed on to a short circuit, but is not tripped to interrupt the current, the tripping being done by the station circuit breaker.

(4) *Short Time Test.*—Short circuit current is passed through the circuit breaker under test for intervals of one second and five seconds.

It has been proved by experience that although a circuit breaker may successfully interrupt the maximum K.V.A. stated on its rating plate, it may fail to interrupt a fault of lower magnitude.

A series of tests are carried out to prove the breaker on this matter, as follows:

(1) Break—3′—break—3′—break, at 10 per cent. rated symmetrical breaking capacity.

(2) Break—3′—break—3′—break, at 30 per cent. rated symmetrical breaking capacity.

(3) Break—3′—break—3′—break, at 60 per cent. rated symmetrical breaking capacity.

(4) Break—3′—make break—3′—make break, at not less than 100 per cent. of rated symmetrical breaking capacity, and not less than 100 per cent. of rated making capacity.

(5) Break—3′—break—3′—break, at not less than 100 per cent. of rated symmetrical breaking capacity.

The 3′ in between the various tests are three-minute intervals. In tests (1), (2) and (3), which are "breaking" tests, the breaking current may be plus or minus 20 per cent. of the specified test value.

In tests (4) and (5) it is to be noted that the current must be not less than 100 per cent.

Voltage and Power Factor

In an A.C. system the current passes through zero twice in every cycle. Obviously this instant of zero current is the best time to interrupt an A.C. arc.

Interruption can only take place if the rate of rise of dielectric strength of the oil between the contacts is greater than the rate of rise of voltage across them.

This voltage is termed "Recovery Voltage." In service, the recovery voltage depends on where the short circuit occurs relative to the power station.

At remote points it may reach 100 per cent., whilst at points close to the station it may be about the 70 per cent. to 80 per cent. mark. The value of the recovery voltage also depends upon the system power factor.

Fig. 3 shows how the recovery voltage varies with power factor.

The testing plant must be capable of reproducing the severe conditions met in service, and at present the following conditions are specified:

(1) For circuit breakers up to 500 m.v.a. the recovery voltage must not be less than 95 per cent. of the rated service voltage.

(2) For circuit breakers of larger breaking capacities than 500 m.v.a. the recovery voltage must be as near to 100 per cent. of the rated service voltage as possible.

A variation is allowed in some cases depending on the particular test plant employed.

Since the system power factor has an important bearing on the severity of the test, as seen in Fig. 3, it is laid down that during testing operations the limits of power factor are 0.15 for circuit breakers up to 500 m.v.a. and 0.30 for circuit breakers of any higher rating.

A.C. and D.C. Component

Fig. 2 illustrates the characteristic of a short circuited alternator.

It will be noticed that the current wave is displaced from the zero line during the first few cycles, after which it becomes symmetrical again.

This displacement depends upon the instant at which the short circuit occurs; the displacement being a maximum when the short circuit occurs at the instant of zero voltage.

This unsymmetrical current wave may be analysed into two components.

(1) A direct current component as indicated by the line A and B (Fig. 2).

(2) An alternating component indicated by the difference between the lines AB and CD. The R.M.S. of the A.C. component is taken to be the same as an alternating current wave of constant amplitude, whose maximum value is half the distance between CD and EF. The direct current component has a bearing on the recovery voltage as will be seen from a study of the curves in Fig. 3. In the first three "Break" symmetrical tests and the fourth "Break"—"Make Break"—"Make Break" test, the breaking current in any one of the phases must not include a direct current component of more than 20 per cent. of the A.C. component at the instant of contact separation.

In the fifth "Break" asymmetrical test, the direct component must not be less than 50 per cent. of the A.C. component at the instant of contact separation.

Distress of Circuit Breaker

It is important that a circuit breaker must be capable of "making," "carrying" and "breaking" its full load rated current after each or all of the above-mentioned tests.

If the circuit breaker becomes a wreck after clearing a short circuit, it has obviously failed its tests and would be no use for service requirements.

Conditions are laid down in B.S.S. 116/37 relating to the general behaviour and factor of distress of a circuit breaker under test duty.

These matters which include smoke and oil emission, condition of contacts, and any maintenance of the breaker between test duties must be included in the test reports.

In the next article the special equipment and layout of a testing station will be described.

(To be continued)

Workshop Calculations, Tables and Formulæ
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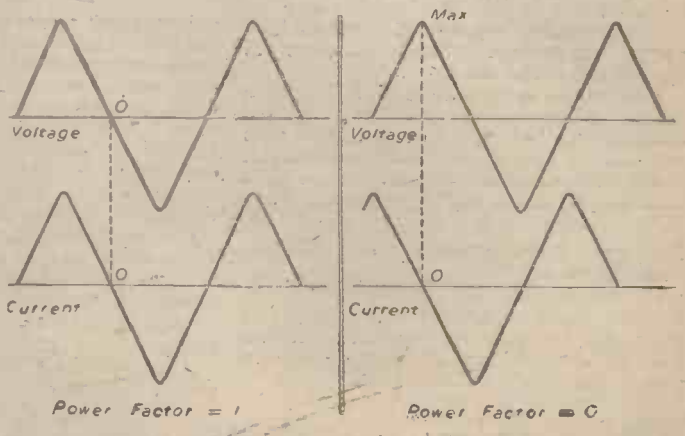


Fig. 3.—Diagrams indicating variation of recovery voltage with power factor.

Making Model Railway Track

A Method of Making "0" Gauge Tin-plate Points

By T. HADFIELD

(*Continued from page 246, April issue.*)

HAVING now had practice in making up the straight and curved rails, the next step is to make points. The majority may draw the line here, but if tackled in a methodical manner it will not present any great difficulty.

Fig. 13 shows the points for a right-hand turn, and this type can be fitted into any formation, either in the curved or straight portion, and I will later show different methods of adapting it to various track layouts.

Of course, we shall also need the opposite hand and if the diagram, size, etc., are reversed the construction will be exactly the same, so I will keep to the right-hand turn for the start.

First lay out the diagram Fig. 13 (which is to scale) to full size on a piece of wood or stiff cardboard, and mark in the rails and the sleepers as shown.

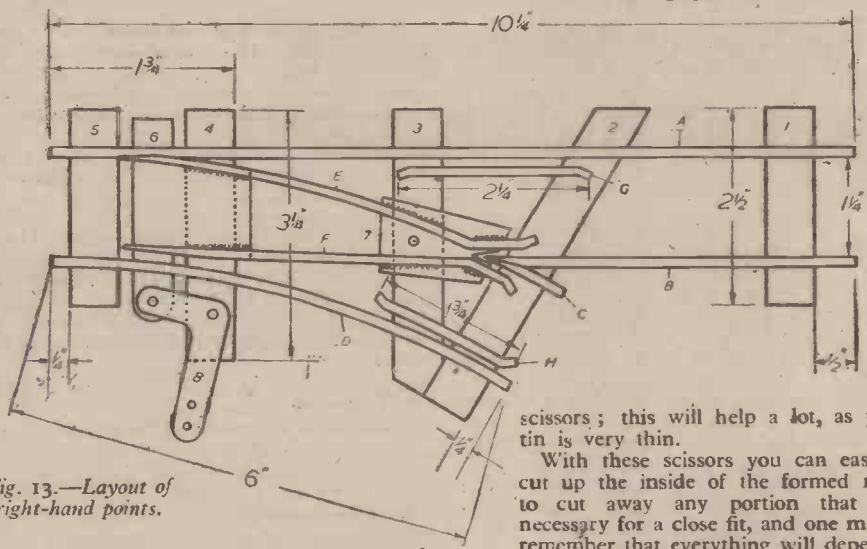


Fig. 13.—Layout of right-hand points.

All the sizes I have already described of rails and sleepers will be the same, but the sleepers 2, 3 and 4 will be longer. The sleepers can be cut to length and ends angled as shown. The curved rail portion is the same as the template, Fig. 12.

The pieces of rail B and C can be cut and ends mitred so that when fitted will make the angle shown; solder these togther, flooding the inside of the top with solder and the excess can be filed off afterwards. Then cut lengths of rail for A and curved piece D, which must be shaped to template.

Place sleepers in position on the diagram as set out on the board. The rails A, B, C and D are then placed in position on the sleepers and adjusted by means of the gauge (Fig. 11), and if some flat weights are placed on the top of the rails they will hold steady whilst being tacked with solder. After tacking, the sleepers can be properly soldered both sides of the rail and sleepers, and see that all the rails are just the gauge of 1¼in. apart inside.

The movable pieces of rail E and F can now be tackled, and E must be first bent carefully to curve template, allowing extra length for cutting off after fitting.

The filing of the ends to form the tongue portion must be carefully done and the lower flat portion must also be cut away, as in Fig 14, so that it will fit close to the straight rail when in the closed position.

If the shape of this rail is distorted in filing or fitting it can be rectified by opening the round portion with a piece of ⅛in. wire and hammering carefully back to shape. If possible get a strong pair of curved nail scissors; this will help a lot, as the tin is very thin.

With these scissors you can easily cut up the inside of the formed rail to cut away any portion that is necessary for a close fit, and one must remember that everything will depend on this fit for the efficient working of the points, so don't be afraid of spoiling a little bit of rail.

The same will hold good in the straight piece F for the other movable rail, when fitting to the curved fixed length D. The rails E and F can be placed in position and marked for bending to form the guide piece. To make this sharp bend file a nick in the back of the round portion of rail and with the snips cut a nick in the flat portion and the rail can then be bent easily, but mind you don't break it through. To form the small bend at the tip of the guide portion, put a small piece of ⅛in. wire in the rail and grip with the pliers, when this bend can easily be formed and it is only to guide the flange of the wheel into the points. The two guide rails G and H can be cut and bent the same as E and F with the pliers at the tips.

The piece of tin plate 7 (see Fig. 15) can be marked out from the diagram and cut and drilled for the pivot pin. This can be a small bolt or a rivet, but don't fasten it till the final assembly. Place plate 7 in position with the pivot pin and adjust E so that when fitting close to rail A there is about ⅛in. space at the guide end for the wheel rim. Then E can be tacked to plate 7. Adjust rail F in a similar way on to rail D, but before tacking to plate 7 do not forget to move E about 3/16in. from rail A.

The plate 6 (see Fig. 16) can be made and fitted under the tongue end of movable rails and can be tacked with solder to each.

This will now tie both rail E and F, and they can be moved and tested for fit to see that each fits snugly the rails A and D and also that the space at opposite ends are about ⅛in. clear for the rim of the wheels, and the gauge, 1¼in., is correct.

These rails may need springing with pliers to adjust but be careful that you don't put a kink in the formed rails.

Testing

When all are correctly adjusted it is as well to try a truck over them, and see if there is any binding of the wheels or any attempt to jump, which can be rectified before all joints are finally soldered up. The two guide rails G and H can be soldered into position, again leaving ⅛in. for the flange of the wheels to pass. Finally the operating crank 8 (see Fig. 17) can be made of 16 G. brass, and fitted with rivets or small screws.

Some readers may not like this method of fitting the crank to operate the points, but this can be altered to conform to the actual railway method in having a vertical lever. My reason for using this flat crank is that with the vertical lever it always gets bent and strained when dismantling and packing the rails away, but the flat one is more compact, and further, the flat crank lends itself to remote control of the point from a common signal box, to operate with pull and push stiff wire, when fitted up as a permanent railway layout, or it could be operated with electric solenoids.

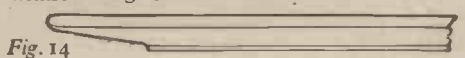


Fig. 14

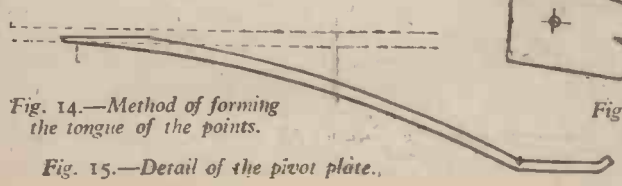
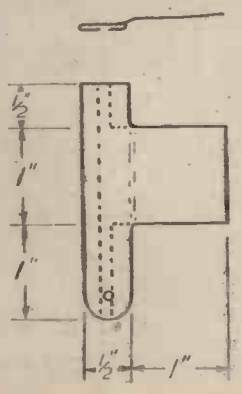


Fig. 14.—Method of forming the tongue of the points.

Fig. 15.—Detail of the pivot plate.

Fig. 15.

Fig. 16. (Right).—The tie plate for the tongue ends of the points.



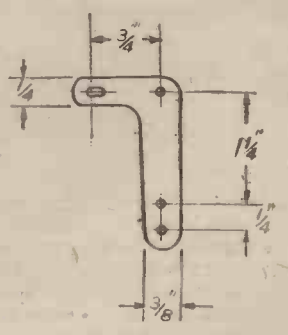


Fig. 17.—The point operating crank lever.

The Unit of Life

The Cell and Its Mysteries

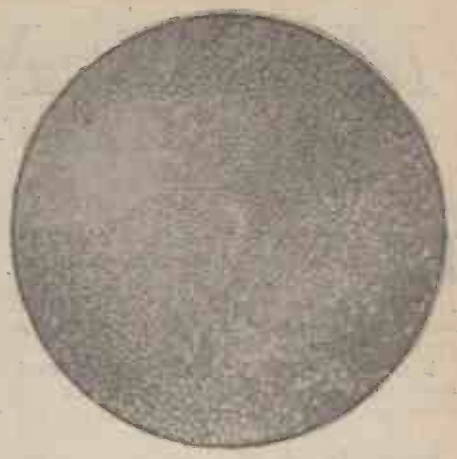
IT is only a little more than a hundred years ago since it first dawned upon scientific mankind that all living things, from the smallest crawling creature inhabiting the bed of a river or the floor of the ocean, up to the elephant or the whale, have all a cellular structure. That is to say, any living entity is made up of one or more (usually very much more) single units or cells which, for a time at any rate, are capable of pursuing an independent existence.

If life possesses any definite unit, such a unit is the cell.

We might define a "cell" as an enclosure. A prison cell, for example, comes under such a definition. So, also, does a living cell situated in an animal or in a plant. Both the latter types of cell constitute organised units which, in some as yet exceedingly mysterious way, are permeated through and through with a principle of self-organisation, the manifestation of which we conveniently term Life.

More than that, each individual cell has within itself the power of giving rise to other cells of a like nature. It is a living machine which duplicates itself and so perpetuates its species to an indefinite extent.

In addition to the mass of separate cells constituting the flesh, nerves and muscles of the animal and human body, there are many other types of cells, each having specialised functions of its own. There are, for instance, the red corpuscles of the blood (a few billion of them altogether in each adult human body) whose function it is to carry oxygen from the lungs to all parts of the body and to carry back to the lungs the waste oxidation products of the muscles and other tissues. Then there are the white cells of the blood—the "phagocytes"—which are the servicemen of the bloodstream, ever on the alert to pounce upon and destroy any invading enemies in the way of disease germs or other foreign matter.



A drop of human blood viewed under the microscope. Note the individual red cells of the blood.

some hidden way, the apparent product of the activity of a very highly specialised set of cells which, in consequence of its mass appearance, has been designated the "grey matter."

Specialised Cells

Like the plants, we—humans and animals—are, so far as our anatomical make-ups are concerned, nothing more nor less than mere organised masses of countless special cells, each cell having its one definite function and performing that function with a well-defined rhythm and regularity, to say nothing of precision, in the body.

The anatomist or the scientist who painstakingly dissects the plant or animal body in his quest for the source of life and growth gets down at last to the single cell. And there he stops. He can go no further. Apparently, he has reached the very unit of life, just as a chemist detecting a single atom would at once realise that he had reached the unit of matter.

A microscopic view of a connected chain of single cells forming the green slime which collects in ponds and ditches.

It is not proposed here to deal with any of the multitudinous ways in which masses of cells are assembled together to form even lowly animals. We must, on this occasion, concentrate our attention on the character of the single cell, which, after all, forms the most fundamental problem in the whole range of biological physics and chemistry.

While some cells are exceedingly minute, the majority of them come, in size, just within the limit of human visibility, being to the naked eye mere specks of jelly-like matter.

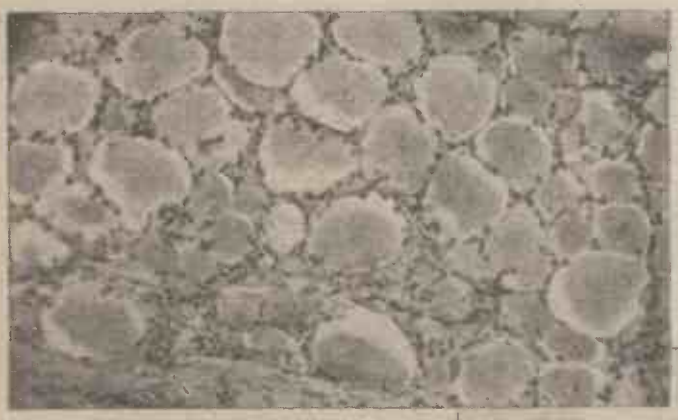
A number of lowly forms of animal life comprise single cells only, and these special cells are endowed with all the various attributes of life, such as ingestion, assimilation, sensitivity to stimuli, and so on. These special one-cell animals mainly inhabit the mud at the bottoms of ponds and slow streams. They are known as the *protozoa* in contrast to the *metazoa*, or multi-cell animals which constitute the higher forms of life.

It is therefore to the protozoa or unicellular organisms that we must go whenever we wish to study the mysterious phenomenon of animal life in its first beginnings and in its simplest forms.

The Amoeba

Crawling on the surface of the fine mud at the bottoms of shallow field ponds and pools exists life's simplest cellular organism—the *amoeba*. It is a form of life which is well known to natural history students, microscopists and the like. The organism is common enough, and anyone having a small microscope can study its many marvels at his or her leisure.

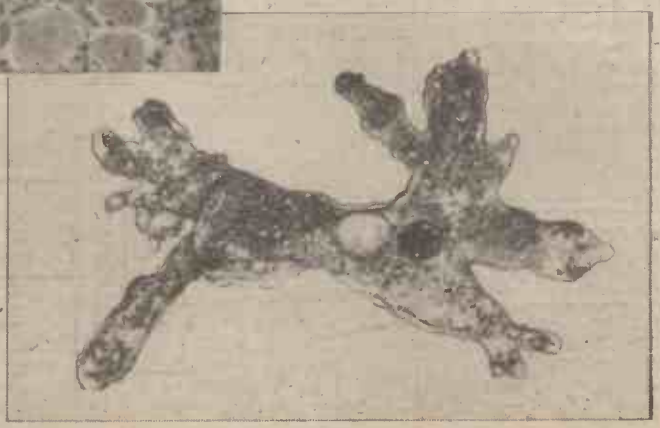
The amoeba constitutes a single, solitary cell of clear, jelly-like matter. As ordinarily found, its essential transparency is usually marred by the existence within it of numerous opaque specks, but these are merely inclusions of particles of food which the amoeba has ingested and taken temporarily into its substance. In actual size, the amoeba is only



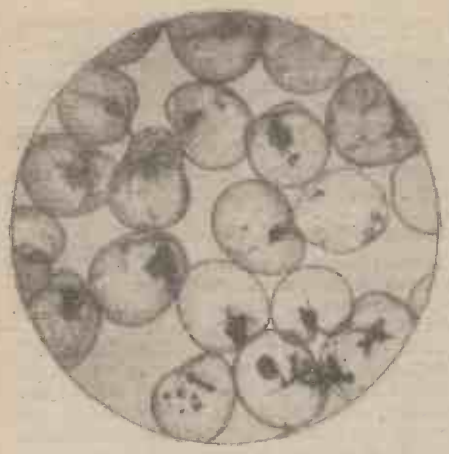
Nerve cells. A high-power photomicrograph showing the individual cells comprising a human nerve. It is such cells which are responsible for the transmission of pain, impulse, or other sensory messages from the brain to any portion of the body.

Again, in every animal body there are the epithelial cells which line the alimentary tract and serve to absorb nourishment into the body. No less important, too, are the various gland cells whose function it is to discharge special compounds, such as digestive juices, at various areas of the body.

Still more, we have skin cells, bone-forming cells, and even our very act of thinking is, in



Life's simplest form—the Amoeba. This single cell organism consists of a speck of protoplasm surrounding a dark "nucleus." The organism is able to crawl about by means of protruding "pseudopodia," or "false feet."



Luminous cells. A microscopic view of the single-cell organisms which impart luminescence to the waves of the sea round our shores at certain times of the year.

about a hundredth of an inch across, and it has practically no thickness. It is merely a speck of living jelly, being almost structureless in make-up.

Despite, however, its essential anatomical simplicity, this speck of jelly can sense the presence of its food, it can "walk" to the latter, can ingest (or digest) the particle of food and afterwards cast away the unrequired residue.

It is a highly sensitive creature. If you touch it with the fine point of a microscope needle, it instantly shrivels up into a globule of jelly. A mild electric shock has the same effect on it, as, also, has strong light or ultra-violet irridation.

The scientist could easily construct a minute amoeba for himself out of a speck of gelatine or albumen, but his creation, although identical in pattern with the real thing, would be dead and immobile. The life principle would be lacking.

"False Feet"

A most remarkable feature of the living amoeba or single-cell organism is its strange method of slow locomotion. This it effects by thrusting out of its irregular sides protrusions of jelly-like matter which are technically known as *pseudopodia*, or "false feet." It is seemingly able to extrude these gelatinous appendages in any direction. Hence, when it is in the vicinity of a particle of food, such, for instance, as a minute fragment of decaying leaf, the amoeba pushes out its "false feet," which latter slowly surround the food particle. By this mechanism, the amoeba completely surrounds the grain of food, absorbs it into its system, and, after extracting the available nourishment from the food-grain, simply flows away from the latter by means of its "false feet" mode of progression.

Microscopists have been able to obtain living amoebæ entirely free from ingested matter. In this condition, the cells are perfectly transparent. All the semblance of internal structure which they show is a central nucleus, dark in colour and apparently enclosed in a cyst or transparent bag within the jelly-like body of the organism.

Protoplasm

Such is a feature not only of the lowly amoeba but of all living cells. Hence it seems to be a fact that the cell unit of life is composed of a minute nucleus surrounded with clear jelly-like matter to which the term "protoplasm" is given.

Attempts to investigate the chemical nature of protoplasm have from time to time been made, but all of them have failed. We know, of course, that this protoplasm, which is a material of the protein or albumen family, is composed of carbon, hydrogen, oxygen and nitrogen. That sort of "rough" analysis is very easy going. But when it comes to determining exactly what particular type of a compound protoplasm is, or what kind of a mixture of compounds it constitutes, then even the modern resources of chemical science just fail, and fail badly, too.

Yet we must not be hard on the chemists in this connection, for the problem of the nature of protoplasm is a most formidable one. Most probably, the jelly-like material existent in cells, and which we term protoplasm, is inherently a complicated mixture of complex nitrogen-containing materials, the correct identification of which may not be made for many years yet.

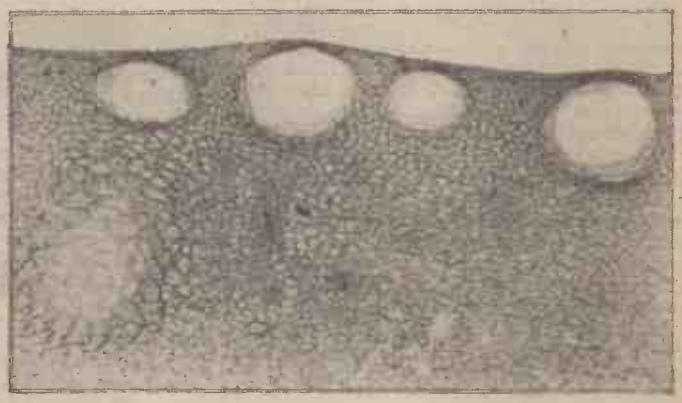
But besides the essential protoplasm, each single cell contains a little sugar (or mixture of sugars), some fat (or, alternatively, a fat-like material), together with a large amount of water and a few mineral salts, such as the chlorides and sulphates of sodium, potassium and calcium.

The single cell, clear and transparent as it appears to the microscopist's vision, is, therefore, in reality, a most complex affair. More than that, it appears to be electrically polar, having areas of negative and areas of positive potential, these, doubtless, being accounted for by the presence of ionisable salts, such as sodium chloride.

Electrical Interplay

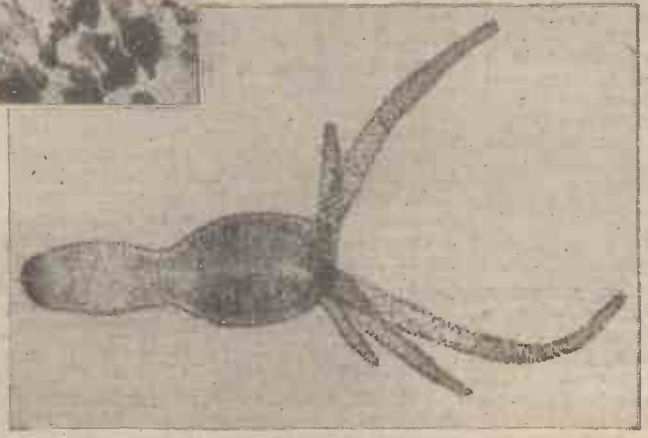
It seems clear, therefore, that the cell, or life-unit, is an enclosure within which chemical and electrical forces have their play and interplay. Possibly the electrical-forces, consequent upon the ionisation of the mineral salts, form the mainspring of the cell's energy and thus preside over the balance of its internal chemical reactions. But whether this at present extremely hazy notion of the internal mechanism of the cell is sufficient for us to conceive the cell as a mere machine operated, in some as yet unknown complex manner, by electrical forces instead of a complicated organism dominated by some externally derived "life-force" is a matter on which modern science cannot express any clearly defined opinion.

The function of the nucleus in the cell is very obscure. It seems to have something to do with the cell's power of propagating itself by "fission" or dividing-up into two separate cells, as is its wont. But, apart from this function, the nucleus exerts some powerful balance over the general well-being and



A photomicrograph of a section cut through the rind of an orange. It shows clearly the mass of oil-producing cells, and also the large glands or reservoirs just below the surface in which the orange oil is stored.

Black pigment cells in the skin of a frog. Note the almost identical pattern of all the individual cells. (Reproduced from a photo-micrograph.)



An octopus of our ponds. The Hydra, *a minute creature living in ditches and stagnant water. It consists of a number of cells, some of which are extensible and form tentacles which serve to capture and retain minute objects of prey.*

functional activities of the cell. Destroy, or even slightly damage, the cell's nucleus, and the remainder of the biological organism or mechanism at once refuses to function. This is true of all cells, not only of the amoeba cell.

Dissecting Cells

By using very fine and almost invisible silica threads actuated by precision screws attached to a microscope stage, modern researchers have found it possible in some small way actually to dissect living cells. They find that if a portion of the cell's outer envelope (containing the transparent protoplasm) is torn away, the cell has the power of repairing the damage and of thereafter continuing its function. But, on the other hand, it is found that if the extremely thin sac or envelope surrounding the cell nucleus is in any way torn, ruptured or damaged so that the contents of the nucleus (or even a portion of them) pour out or infiltrate into the clear protoplasm the whole cell instantly dies.

It almost seems as if the contents of the nucleus form a very active poison for the remainder of the cell, although probably, the whole irrevocably destructive effect of partial rupture of the cell nucleus may be based upon the neutralisation of electric potentials existing within the organism.

Is life, therefore, in this simple, lowly, ultimate guise, the product of purely electrical or chemical forces, as we have previously queried, or does it essentially consist of some extra principle added to the cell mechanism from an external source?

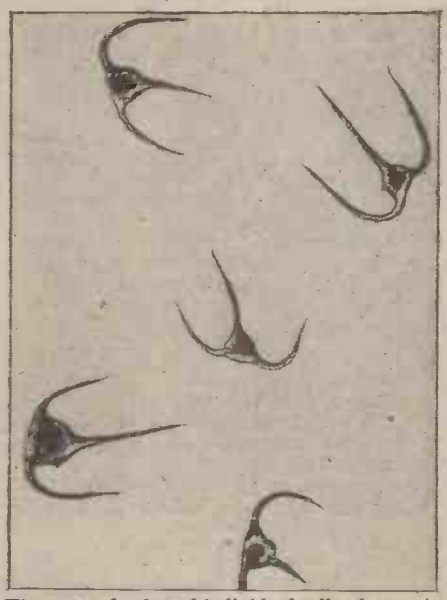
That, as Hamlet might have well remarked, is the perpetual question.

To those who conceive the life of a single cell or small group of cells as being purely mechanical or electrical, one might offer the following information:

The Stentor

There exists a lowly fresh-water animal known as the stentor. It has an upper trumpet-shaped "head" attached to a thread-like contractile foot or leg by means of which it anchors itself to a fragment of stone or a plant stem submerged in a stagnant pond or ditch.

When undisturbed, the stentor rears itself upon its elastic "foot" and fishes for its prey by means of a fringe of waving hairs (*cilia*) on its trumpet-like head. It has, also, the power of detaching itself from the plant,



The strangely shaped individual cells of a species of mould. Like the amoeba, they each constitute one unit organism of life.

stem or stone and of swimming off to some new place of attachment.

Now, some remarkable experiments have been made with the stentor, which experiments seem to prove that even an animal composed of a few single cells strung together has some semblance of memory or association.

Sand Bombing

In these experiments, fine grains of sand were carefully dropped on to the head of the stentor. At the first impact of the sand, the organism instantly retracted itself into a speck of jelly. After a time, it expanded itself again. Further grains of sands were dropped on it, and with precisely the same result. After the sand dropping had been repeated a few times, the creature apparently became "fed up" with its circumstances, and, at last, it released its hold and swam (or, rather, wriggled) away to another area.

After the stentor had again reared itself erect in its new area, the sand-grain dropping was continued. This time, the stentor only suffered two or three repetitions of this miniature bombing before it betook itself away to another "safe area"; and, finally, after the same creature had been carefully followed up and "bombed" with sand every time it took up a fresh anchorage, it ultimately wriggled away to a new place at the *first* sand-bombing attack instead of waiting for several of these "incidents" to occur before it finally made up its mind to change its quarters.

"Memory" or Mechanism?

Here, plainly, is some type of memory or experience-association in an organised group or assemblage of almost clear, transparent protoplasm cells.

It is difficult to regard this "mental" association as being just the result of some internal electro-chemical balance within the stentor's cells, although, of course, at the present state of our knowledge, one has no right to deny such a possibility.

To the expert observer of the present day, the single cell, be it a specialised cell of human nerve, muscle, flesh or blood, or even the malignant cell of the germ or bacterium, appears mainly as a highly complicated, highly ingenious physico-chemical mechanism. It obtains its energy by processes of chemical oxidation, just as our bodies in the mass do. It propagates itself and builds itself up in enormous numbers into organised plants and animals. Yet, at the same time, it shrewdly retains its own essential individuality.

Animals are agglomerated masses of cells. Is the reverse true, and are cells animals? Seemingly, they must be so in respect of the fact that they are endowed with animal life.

But whence springs their life?

Such a question must, as we have before said, remain unanswered. Perhaps, after all, with our very inferior and hopelessly inadequate knowledge of life's unit, the cell, we are experimenting with and theorising over, not the fountain spring of animal and plant life itself, but, rather, with the material unit of mechanism by means of which and within which the outside principle of life is enabled to make its appearance.

Such, it would seem, is the most rational explanation possible, at our present level of knowledge, of the cell's most peculiar and, at present, most inscrutable mystery.

Life's unit is clearly demonstrable to our eyes. We can see it working, and we have some dim knowledge of its mechanism, also. It is the initiation and direction of this life-energy within the cell which constitutes the most perplexing mystery.

Lie Detector Theory

By HEREWARD WAKE

LIE-DETECTING apparatus is attracting the attention of criminologists the world over, the U.S.A. probably being ahead of other nations in its use and applications. Briefly, the theory is as follows:

For a formal test the breathing ratio is taken with a *pneumograph* and an instrument called simply a *psychogalvanometer* which registers a sweat reflex in addition to a systolic blood-pressure variation. There are other checks as well; but the fundamentally significant data is derived from the blood-pressure, the apparatus employed being but aids to formal checking.

Recording Blood Pressure

The *sphygmomanometer* is that instrument with which doctors take blood pressure, a bandage being placed on arm and leg of the subject and inflated, the air being then slowly let out, a dial recording the pressure. After inflation, the blood flow is stopped, then as the air is released the first pulse beat is felt by the operator. That means the blood vessels' pressure and the bandage air-pressure are equal, so that the dial records both pressures, the readings being rapidly taken while the suspect is being questioned, enabling reading to be graphed against answers.

The assumption is that it takes more energy to lie than to tell the truth, as energy comes from the central nervous system, that is, from the motor centres of the head brain. This energy, inevitable if a lie is to be told, also affects the heart-beat rate, causing a slight or large increase in the systolic blood-pressure. Thus a lie cannot be told without the increased energy and the blood-pressure cannot help but be affected by the increased energy. Regardless how facial expression or voice-tone is artificially controlled, control over internal body mechanism is not possible, so that, theoretically at least, the better the liar, the better is he exposed.

The actual readings of the milliammeter make no difference as a general level is established before the questions are put. It is the variations from the general level that are regarded as being significant. The level found as a control-level is thus a reference one, the up and down fluctuations telling the answers. Readings vary from 130 to 135 normally, but can go up to 156 to 160—the steadier the pressure, the more truthful the answers. After-nervous effects or *end-effects* are not considered, that is, readings taken after the essential questions have been put, the nervous reaction of the suspect, when it is "all over" causing this.—*Proceedings of I.P.R.E.*

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THE WORLD OF MODELS

From Time to Time in these Pages "Motilus" has featured Model Work which has aided the War Effort, and this Month the Space is Devoted to Models of Modern Army Vehicles, the Prototypes of which form Part of the War Work of Rootes Securities, Ltd.

By "MOTILUS"

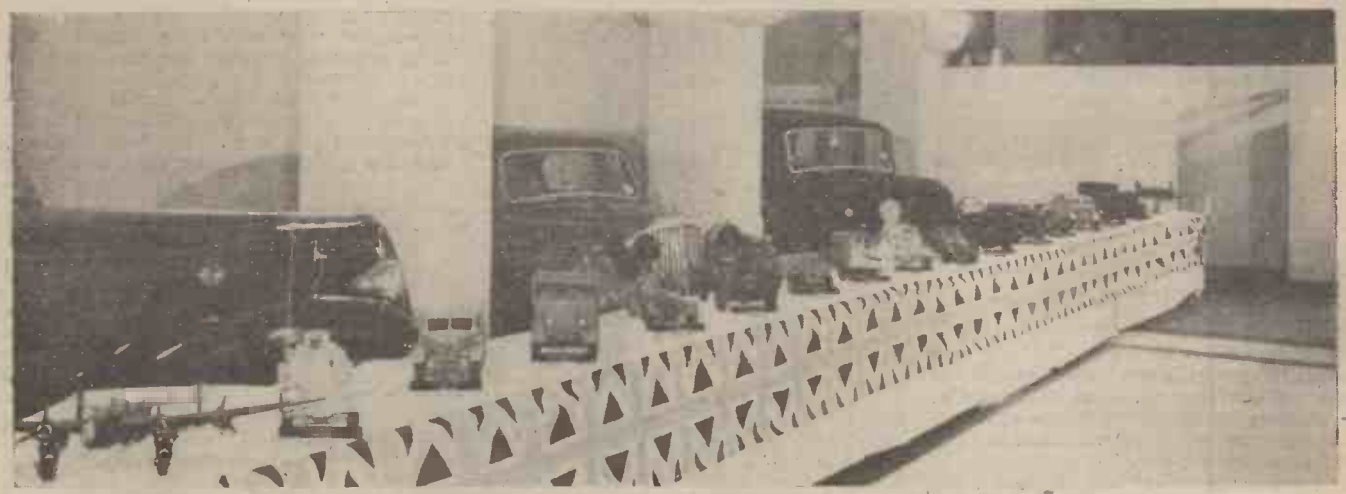


Fig. 1.—The series of models, built to the scale of 1/10th actual size, which were shown at the Rootes Press luncheon.

AS I have said before in PRACTICAL MECHANICS, the value of models as war weapons is considerable. They have played and are still playing a great part in the training of the Forces, in operational work, and in the identification of enemy war machines.

Fig. 3.—Model of the K.T.4 gun tractor viewed from close range.

Models also serve a valuable purpose in keeping records of progress of every kind, and in this issue I describe a specially interesting set of armoured vehicles, which appeared in model form at the luncheon held for the Press at Claridges in January by the famous Rootes group of companies.

In his speech, the chairman, Sir William Rootes, explained that now the security ban had been partially lifted, he was able to let his hearers know what the group (including as it does the Humber, Hillman, Sunbeam, Talbot, Commer and Karrier companies) had been doing during the war, and also a little of their activities in the vital pre-war years.

In 1936 they were called in by Lord Swinton, the Air Minister, to start the original Shadow Aircraft factory for the production of bombers. From the outbreak of war up to June, 1944, one in every seven of all the bomber aircraft the United Kingdom produced came from the Rootes companies.

At the beginning of the war Rootes group employed some 17,000 workers. To-day one in every hundred in war industry is directly working for the country through this group of companies for one of the four Ministries, M.A.P., Admiralty, Ministry of Supply, or Ministry of War Transport.

Assisting the Army

Besides the making of aircraft there has been the overhaul of damaged craft and engines, and the group has put its motor car manufacturing knowledge to the assistance of the modern army.

Sir William Rootes also stated, "Now we haven't made any complete tanks—Mr. R. R. Stokes please note! But we have produced 60 per cent. of all the armoured cars, 35 per cent. of all the scout cars, and in addition, more than 3,600 other armoured reconnaissance vehicles."

To give just three illustrations of the versatility of the organisation's work they

Fig. 2.—The Marquess of Donegall examining the details of a model of the Karrier K.T.4 gun tractor. Also in the picture are (left) Mr. Harold Heath, of Rootes Securities, Ltd., Mr. Alan Botwood and Mr. G. Geoffrey Smith.

Fig. 5.—Humber F.W.D. Utility car modelled to 1/10th scale by Bassett-Lowke, Ltd., Northampton.

have made practically anything from millions of bombs and fuse parts, to thousands of side curtains for American Jeeps—and have trained over 11,000 Army personnel in their own mechanical schools.

The vehicles modelled and on show at the Press Luncheon were seventeen in number:

The Handley Page Halifax Four Engine Bomber, Mark V.
Humber Reconnaissance Car, Mark III.
Humber F.W.D. Utility Vehicle.
Karrier C.K.6 Bridge Girder Carrier.
Special Humber Ironside Saloon built for the use of Their Majesties the King and Queen and Members of the War Cabinet during the London blitz, 1940-1.
Humber Armoured Car, Mark IV.
Humber Scout, Mark I.
Humber F.W.D. Mobile Recording Truck, as used by the B.B.C. on all war fronts.
Humber Armoured Car, Mark III.
Humber Ironside, Mark I.
Humber Armoured Car, Mark II.
Commer Q.15 G.P. Wagon.
Humber Reconnaissance Car, Mark II.
Karrier K.T.4 Gun Tractor.
Karrier K.6 3-ton Load Carrier (Winch model).
Humber Armoured Car, Mark I.
Firefly Aircraft (Fleet Air Arm).

Owing to the wartime conditions which still prevail, there are a number of vehicles still to be modelled, of which, for security reasons, no details can yet be given to the public, but all those mentioned here are, in the words of Mr. Rowland-Rouse of Rootes Securities, Ltd., "old jobs," though nevertheless a few details of their work make fascinating new reading to many of us.

Fig. 4.—Humber armoured car, Mark II, made to 1/10th scale by Bassett-Lowke, Ltd., of Northampton.

K.T.4 Gun Tractor

The photograph reproduced in Fig. 2, and taken at the luncheon, shows the Marquess of Donegall examining the details of the model Karrier K.T.4 Gun Tractor. This vehicle was manufactured in large quantities by Karrier Motors, Ltd., even before the war, for the India Store Department, and used by the Indian Army on frontier work. Later it came into use with Indian troops and others on many fronts in the various theatres of war. Fig. 3 shows a close-up of the model of the K.T.4 Gun Tractor, which is 1/10th scale.

Humber Armoured Car

It is interesting to know that the original idea of the Rootes Group producing Armoured Cars came from Colonel Leigh, of the India Office, in November, 1939. He made the request that an experimental chassis of the rear-engine type should be designed and built, using as many of the standard units of the Karrier K.T.4 Gun Tractor chassis as practicable. Following this up, Sir William—then Mr. W. E. Rootes—and Mr. B. B. Winter, Engineering Director of the Rootes group, visited a number of Army units in France, and were asked to press forward with an armoured car production. The result of this was the Humber Armoured Car Mark I, which was designed, tested, and in service in a very short time. Fig. 4 shows a model of the Mark II vehicle, made to 1/10th scale by Bassett-Lowke, Ltd., of Northampton. The prototype, in the natural course of progress, has been followed by the Mark II and again by Marks III and IV, each developed as a result of the experience gained almost daily by the use of the earlier type.

Another Bassett-Lowke model is shown

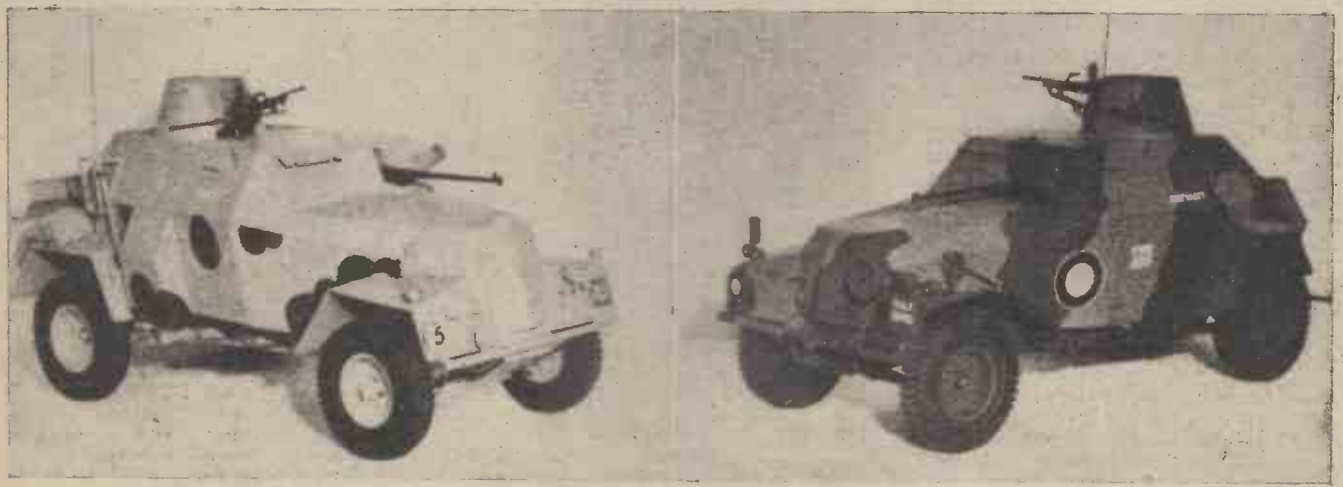


Fig. 6.—Humber reconnaissance cars Marks III and II, modelled by Bassett-Lowke, Ltd., Northampton.

in Fig. 5—the prototype of which is the Humber F.W.D. Utility Car, used in large numbers on various war fronts, as a staff car, a pick-up vehicle and a mobile wireless unit. The same chassis in turn is also the basis for the Humber Front Line Ambulance, and for the B.B.C. mobile recording trucks.

Reconnaissance Cars

Humber Reconnaissance Cars Marks II and III are the subjects modelled in Fig. 6. This particular vehicle was developed from the original Humber Ironside, designed in collaboration with General Ironside, who at that time was C.I.G.S. The vehicle was mounted on the Humber Super Snipe Chassis and was originally intended for Home Defence. The Mark II car was mounted on the same chassis, but the later Marks were mounted on the four-wheel drive chassis. Reports on the wonderful work done by these scouting vehicles has come from all fronts.

As regards the craftwork contained in the whole series of scaled vehicles, these have been built to a scale of 1/10th actual size, which allows the model maker to show a fair amount of detail. Studying the close-up pictures, it will be seen that the reconnaissance cars have guns fitted in the turrets and guns forward. One of the most interesting models is the Humber staff car (Fig. 5), which has all the interior fitments modelled, seats upholstered in leather, steering wheel gear, levers, etc., and also collapsible map table. The bodies of the models were made of selected hard wood and the chassis and fitments of metal, while the tyres were specially moulded to scale in rubber by the famous firm of Dunlop.

Although this article only covers a few of the models in this interesting series, it will be realised that model work of this type, in addition to making it easier to comprehend the purpose and external details of the vehicle involved, is an invaluable record of the armoured side of the modern Army of the Allies.

At the luncheon, where they were displayed, were many well-known personalities in the engineering world, as well as from Fleet Street, and among them we mention, last but not least, our worthy editor, Mr. F. J. Camm.

Uses for Repair Plates

An Effective Method of Carrying Out Simple Repair Jobs at Home

By "HANDYMAN"

IN many households to-day, when "make do and mend" is the rule, there are many simple repair jobs to furniture, and other articles, which can be cheaply and effectively carried out by the use of repair plates. These plates, which are made of sheet brass or iron, are obtainable in various sizes and shapes, as shown in the accompanying illustrations

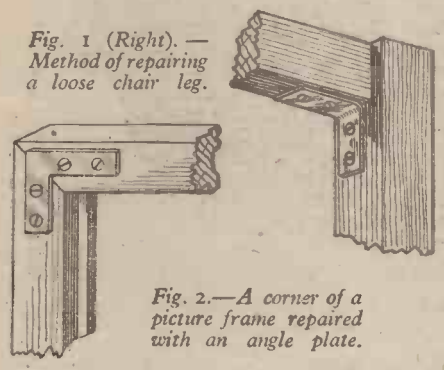


Fig. 1 (Right). — Method of repairing a loose chair leg.

Fig. 2.—A corner of a picture frame repaired with an angle plate.

and are provided with countersunk holes for fixing screws.

Loose Joints

A loose joint between the seat rail and leg of a chair can be made firm again by screwing an angle plate in the corner, as in Fig. 1, after applying a little hot glue to the joint.

Picture frames sometimes become loose at the corner joints owing to a fall. In such cases it is a simple matter to screw on a thin brass L-shaped plate, as in Fig. 2, after gluing the joint.

Loose joints are a common source of trouble with front garden gates, a broken tenon often being the cause. This can be remedied by means of an iron T-shaped repair plate, as at A (Fig. 3). When a top rail joint of a gate works loose it can be strengthened in the same way by a repair plate, either of angle pattern, or straight, as at B (Fig. 3).

If the repair plates are fixed on the inside of the gate, with the correct size screws, so that the heads of the screws come flush with the surface of the plates, and are painted over the same colour as the gate, they will hardly be noticeable.

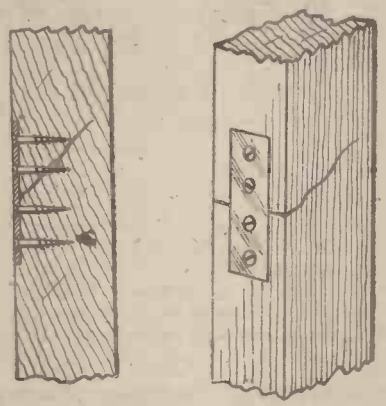


Fig. 4.—Details of a neat repair to a fractured piece of furniture.

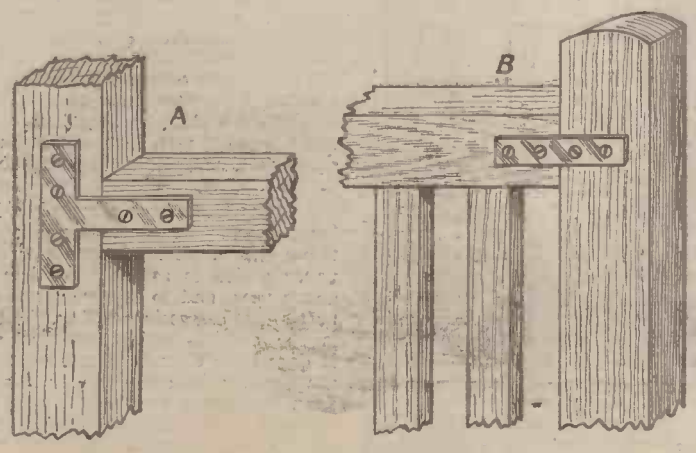


Fig. 3.—How repair plates can be used for strengthening loose joints in a gate.

Fractures

Where an upright, or leg of a piece of furniture becomes fractured, it can be made good by fixing a repair plate, as shown in Fig. 4. The wood should be recessed with a chisel

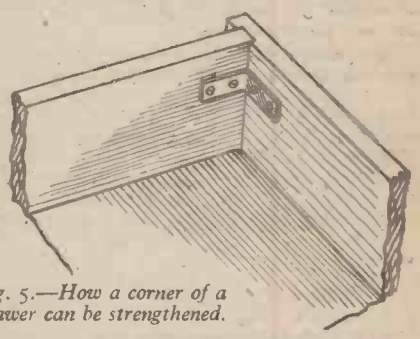


Fig. 5.—How a corner of a drawer can be strengthened.

so that the plate can be screwed in place flush with the surface of the wood. It would be as well to apply a little hot glue to the cracked part before finally fixing the plate.

Repair plates can also be used for strengthening the corners of boxes, and drawers, as shown in Fig. 5.

Deck Chair Repair

The weak parts of the framework of a folding deck chair are usually the notched

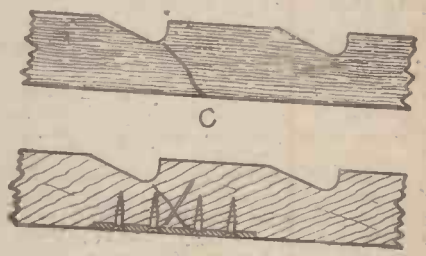


Fig. 6.—Using a repair plate to mend a fractured deck chair member.

parts of the sloping members which take the horizontal struts for adjusting the position of the seat. These members sometimes fracture at one of the notched portions, as indicated at C (Fig. 6).

In such cases a strong repair can be effected by the use of a stout brass repair plate. If the faulty member is completely severed, apply some strong waterproof glue to the two fractured surfaces, and fix the joint with one or two panel pins to hold the parts together while the glue is setting. Cut a recess on the underside of the member to take the repair plate, and fix it in place with four countersunk screws, as indicated in the sketch.

Masters of Mechanics—102

John Gutenberg

The Story of the Invention of Printing

THE invention of printing by means of separate and movable types is generally hailed as one constituting a triumph of invention which well-nigh revolutionised the habits of mankind.

Its initiation necessitated the mind of a master mechanic no less than that of a creative artist, for the early printing types had to be laboriously cast from metal, accurately hand-cut and finished, assembled in "frames" and then placed in presses of a then novel design.

History still offers a few unsettled problems to the individual who would take upon himself the task of tracing the genesis of printing to its earliest origin. Some say that printing by means of movable types was known to the Chinese in Old Testament times, but all such statements merely beg the question, since it has, unfortunately, become all too common to relegate to the ancient Chinese origins which cannot altogether be determined from the known records of history.

The art of block printing is very old. You draw a design on the smooth surface of a block of wood. Then you carefully cut away to a depth of about a third of an inch all the wood surrounding the design so that the latter becomes a projection on the wood surface. You have then a form of "wood block," and by inking the design on the block you can make crude printed copies of it on paper.

"Block Books"

This sort of thing was known and used for a long time before printing by means of separately assembled types came into being. In fact, a few people even went so far as to cut letters in wood blocks and to use such blocks for printing from, a process which, no doubt, they derived in some way from the time-honoured Chinese picture-writing methods. A few of these "block books" competed with the manuscript copies of books which were then usually the products of painstaking and industrious monastic scribes, although, for most purposes, the manuscript copies were invariably preferred to the products of this block printing.

Printing, as we now know it, was given to the world when it first dawned upon a human brain that it would be possible to construct separate letters in wood or metal and, after aligning these together in the form of words, to make ink impressions of them on paper.

One historical narrative assigns the above fundamental idea to the brain of a Dutchman named Lawrence Coster, who was born about 1370 and died about 1440. Coster lived in the old Dutch town of Haarlem. He was a block printer by trade, and a persistent story has it that he took pleasure in cutting out letters in the smooth under-bark of trees for the amusement and instruction of his grandchildren. One day, while engaged in this occupation, he noticed that a freshly-carved wooden letter which was still moist with the sap of the tree gave an impression of itself on a fragment of parchment in which it was wrapped. This gave the worthy Coster the idea of printing by separate types, and, before long, he had made a quantity of wooden type for himself, designed a press, and had mysteriously announced his invention to his associates in Haarlem.

So the story has it. The narrative first came to us in the writings of one Hadrian Junius, another Dutchman of the sixteenth century, who stated that it was passed from one generation to another "as a lighted torch passes from hand to hand without being extinguished." In our times, however, Junius's picturesque story is universally discredited in consequence of intensive investigative work which has been put into the life career of another early block printer, by name John Gutenberg, of Mainz, who is now claimed by all recognised authorities as the true originator of type printing.

John Gutenberg. From a portrait taken in his later years.

Gutenberg experienced a comparatively rough life. He was one of invention's "unfortunates." Neither fame nor riches came to him as a result of his invention. He was looked upon in some ways as a rascal and an impostor, and when, eventually, the practical benefits and utility of his printing system began to be appreciated, his invention was pirated right and left. Hardly anyone rose up to champion Gutenberg's claims to priority in the matter of printing by means of separate and movable types. He got into financial difficulties, became, even, involved in semi-political struggles, sank into relative poverty and (according to a legend) went blind before he died about February, 1468.

Reproduction from an old wood block depicting the early printers of Gutenberg's time at work with a wooden hand-printing press.

John Gutenberg was born at Mainz some time between 1394 and 1398. His father's name was Friele Gensfleisch. He was the youngest of three children; and was born while his parents were living on the estate of Gutenberg, in Mainz. His parents took the name of "Gutenberg" from the estate on which they lived, and their children did the same.

We know little about John Gutenberg's earlier career. His father was one of the town nobles of Mainz, but Mainz, at this period, was in rather a bad way. It had undergone several decimating visitations of the dreaded Plague, and many of its industries had been lost. The town itself had got into debt, and its inhabitants found themselves taxed exorbitantly. There was nothing but struggle and strife in the place, a fact which resulted in many people leaving the town and seeking a living elsewhere.

Among these civic emigrants was John Gutenberg. He went to Strasbourg, some distance away. Legal documents prove that he was at Strasbourg during the years 1434-1444. For a portion of this time he was a member of the goldsmiths' guild, a fact, however, which does not necessarily prove that he ever actually engaged in such work. Indeed, Gutenberg, during much of his life, seems to have been content to live off the proceeds of the family estate.

Secret Art

Three years after going to Strasbourg Gutenberg entered into partnership with three citizens of Strasbourg in a mirror-making business. The agreement respecting this partnership still exists (or *did* exist in pre-war days), but from this purely legal document we are unable to gain any tangible notion of the true nature and aims of the business. There appears to have been a question of some "secret art" which Gutenberg at that time was in possession of. Whether this "secret" was concerned in any way with printing, who is to say nowadays? Gutenberg may have had alchemical aims, and have thought himself the possessor of some hitherto unknown chemical operation or process, fantastic or otherwise. On the other hand, the idea of the separate and movable printing type may have alighted upon him during his sojourn in Strasbourg. Whatever the "secret" was, however, it had, by the agreement, never to be imparted to any other outside person.

In 1445 Gutenberg returned to Mainz, his home town. In the museum in that town there was a small fragment of a printed paper which is assumed to date from the above year, and to represent one of Gutenberg's first essays in printing. Whether such is the case, however, there is no telling. It does seem certain, after a consideration of the facts, that some time around the year 1445 Gutenberg attained his first success in printing, and that the world's first hand-printing press was invented by him either at Mainz or at Strasbourg.

The Cradle of Printing

Great controversy has raged around these considerations, some authorities considering Strasbourg to be the "Home of the Press," others asserting Gutenberg's home town of Mainz to be the "Cradle of Printing."

Whatever may be the truth of the matter, there is no doubting the fact that from the year 1445 onwards Gutenberg engaged wholeheartedly in the new printing technique which he had evolved. There is a story that he carried out most of his early trials secretly within the desolate confines of an uninhabited monastery nearby.

What the modern world of technical historians would like to know is exactly how and precisely when John Gutenberg got his basic conception of his printing invention. An educated man himself, Gutenberg must undoubtedly have had a knowledge of manuscript books and of woodcut and block printing. As a goldsmith, he must have been something of a metallurgist and a chemist. We must credit him with some acquaintance with metal working even although he may never have practised the goldsmith's trade commercially. He would, therefore, be familiar with the mode of casting metals in moulds.

It would seem, therefore, that in this latter familiarity we have some clue to Gutenberg's origin of printing by means of cast types. Sand was used for metal-moulding previous to Gutenberg's time, as, indeed, it is in many instances in our own time. But John Gutenberg, having conceived the idea of making metal types for printing purposes, realised at once that he could not adopt the sand-casting method, for sand does not form a permanent mould.

Lead Moulds

Instead of sand, he selected a metal for the purpose. This metal was a soft one—lead. The process which Gutenberg seems to have worked was this: he very carefully cut out his letters in brass, and, providing some suitable mounting stick for these, he constructed a number of metal punches, each punch being provided with a different letter. Each brass punch was struck into a smooth-surfaced block of lead, thereby making a clear impression of the letter, which impression would be used as a mould for the type.

At a later date, engraved steel punches were used instead of the weak brass ones, but, with this alteration in detail, this method of type-casting persisted for very many years.

Such was Gutenberg's invention of printing. Naturally the cast types were very rough. They had all to be carefully hand-finished by grinding and polishing, a task which was tedious and time-consuming in the extreme. Yet it was a business which lasted for centuries, almost, indeed, into our own times.

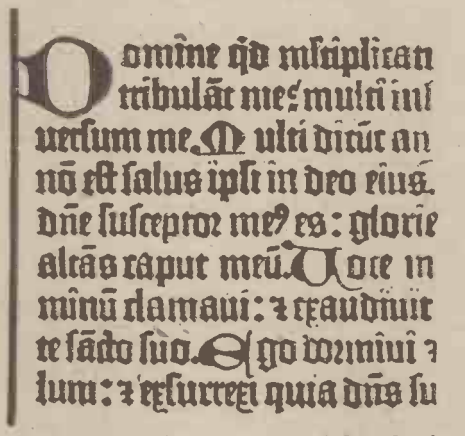
Smaller inventions of Gutenberg consisted of modes of "composing" or assembling his types into the printed lines of letters, and of the construction of "frames" to hold the assembled type firmly in position under the press.

The first press which this inventor used was an ordinary wooden linen press operating on the principle of what we now term the old-fashioned office copying press. Gutenberg himself does not appear to have done much to improve the details of his press. To the end of his life he seems to have been content with converted linen presses of one description or another. In fact, these old wooden presses survived until the end of the eighteenth century, when, about the year 1800, the Englishman, Lord Stanhope, brought out the first iron printing press.

One of Gutenberg's first aims as soon as he had perfected his printing method was to issue a printed edition of the Bible. For this project financial means were essential. Gutenberg, for this purpose, sought the aid of a citizen of Mainz named John Fust. The latter individual helped Gutenberg out to the tune of 800 gulden, a fair sum in those days. But this sum went nowhere. It was quickly expended in preparations for the printing of the Bible.

Legal Action

Again John Fust lent a helping hand. He offered to pay an annual sum of 300


Domine qd multiplicati
tribulãt me? multi insur
gunt mecum. Multi dicũt ani
mæ meæ non est salus ipsi in deo ejus.
Tu aũt domine susceptor meus es: gloria
mea & exaltans caput meum. Voce mea ad
dominum clamaui: & exaudiuit
me de monte sancto suo. Ego dormiui &
somnum cepi: & resurrexi quia dominus su

A reproduction of a page of one of Gutenberg's books, showing the nature of the hand-cut and hand-cast type which he used.

gulden to Gutenberg provided that Gutenberg would let him have a share in the printing business. This Gutenberg refused. The result was that there seems to have been a first-class row between John Gutenberg and John Fust, the latter wanting his money back and resorting eventually to legal process in order to obtain payment.

Gutenberg, being the loser in the action, found his funds exhausted. Fust, on the other hand, went off and joined forces with one Peter Schöffer, and between them they managed to set up a press and to print several book editions. How they did this without prior knowledge of the art is not known. It is supposed, however, that, as a result of Fust's successful legal action, Gutenberg had to hand over his press, lock, stock and barrel, to Fust.

Reproduced from an old illustration depicting Gutenberg experimenting with his printing types in a disused monastery near Mainz.

What line Gutenberg took immediately after the affair with John Fust we are not aware. He seems to have occupied much of his time in fighting what we would now term "actions for infringement" and in raising funds to undertake such activities. Nevertheless, he must, in one way or another, have continued actively with his printing invention, for there is plain evidence that, in the year 1457, he was still in Mainz, and was then engaged in operating a press in conjunction with a town councillor of the city, one Konrad Humery. Whether this individual Humery played the rôle of financial partner or formal employer of Gutenberg is a matter in dispute. It is, however, a detail of little consequence.

A Political Refugee

Had John Gutenberg been satisfied by confining his attention solely to printing he might have well made a respectable fortune and have lived out his days in peace. But the restless John seems to have been a man of quick impulses, to have been possessed of little tact, and to have had a genius for rubbing people up the wrong way.

He became involved in political matters. They appear to have been exciting enough, so much so that Gutenberg found himself obliged to flee from the town in 1462. But he quickly returned, his former zest for political activities much quieted. Indeed, he was an old man at this time, although he still possessed the spirit and the fervour of youth. He was a poor man, too, for his press had been destroyed, and his means of earning a living had departed.

A new Archbishop of Mainz had been appointed by the Pope. He was a kindly individual, this Archbishop, and he took pity on Gutenberg, realising his inner creative genius, and the many rough deals which Fate had meted out to him.

Exempt from Taxes

In 1465 Gutenberg entered the service of the Archbishop of Mainz (a document gives the date as January 17th of that year). The Archbishop provided him with food and clothing, gave him a small annual allowance, and arranged that he should be exempt from all town dues and taxes. Thus circumstanced, the inventor of printing lived his life out under the Archbishop's gentle protection. He is supposed to have gone blind about this time.

Old John Gutenberg was no longer alive on February 25th, 1468, for a document of that date refers to his recent death. His decease appears to have taken place in the January or February of the latter year.

Such, very briefly, in the life-history of printing's first creator. It is an unsatisfactory life-history from many points of view. Yet it is probably the only narrative which historians will ever be able to piece together, for the footprints which this strange personality contrived to make upon the sands of Time have, in many places, become hopelessly confused and obscured, while, in others, they have been obliterated altogether.

Like many another inventor, John Gutenberg got little out of the game. At first his new system of printing from separately assembled types was vigorously opposed by the book-copying interests. Soon, however, people began to realise that an entirely new era had been introduced by the invention of this type-printing. When type-casting became a specialised business, printing attained a recognised status. It spread up and down the Continent and (through the efforts of our famous and justly celebrated William Caxton, of Westminster) into England. There was now no rooting out of the "new-fangled mechanick" invention of printing as the contemporary manuscript copyists would have liked to have done. Printing had become a business and, as such, had come to stay until the end of civilisation.

Letters from Readers

Future Inventions

SIR,—I heartily agree with the views set out so well by the letter from Prof. A. M. Low in your April issue, and am writing a letter therefore to repeat a suggestion for a remedy even though the time may be late.

An appeal should be made through authoritative channels of our industrial world for the promotion and development of an Institution of Inventors.

This can be done through existing organisations with the addition of co-operation and capital only. New buildings, organisation and maintenance of new working staffs can come later, if wanted.

The basis of organisation of an Invention Institution can be divided into three main sections :

(a) An experimental department for the investigation and correction of inventions proved inefficient on commercial development in the first stages and for investigation work in general in the various branches of science applicable to industry.

(b) A department for the unbiased analysis of the scientific press, run on a loose-leaf system, so that information can be bought as wanted at so much per sheet.

(c) A department for the reception, criticism or rejection and introduction of inventions to industry by correspondence, negotiation and exhibition, and to assist the inventor in legal and financial advice of an unbiased nature.

Section (a) could be created by an expansion of our Department of Scientific and Industrial Research, any research departments of our existing institutions, associations and universities working in co-operation with them, the former being the centre-depot for all.

Section (b) could be created through our existing institution—A.S.L.I.B.—working as the nucleus of a central collecting station, introducing its photographic method of abstracts. Each institution could handle the periodicals and publications dealing with their own line of subjects, but all would produce results in a standard loose-leaf system common to all. This could be started now by the addition of a few to their administrative staffs, these being chosen from the older brains of the country, who would analyse the publications of the last five years and have results ready for the technical brains of our Forces who are returning to the industrial world on the establishment of peace and want to get up to date with the facts they have missed through their war activities. By practical trial over a number of years it has been proved that such a system is possible and I am sure the main part of the work could be achieved by six to ten intelligent abstractors at each institution in under a year. This would produce something which would be thoroughly appreciated by those returning from the Forces and would give a stimulus to trade in all sections which would be invaluable.

Section (c) could be created by the information and organisation of the Institute of Patentees which has done the work of sorting, correspondence and organising exhibitions of inventive talent of this nature with success since 1919 in a small but efficient way.

With regard to expenditure, this could be provided by private enterprise, backed by the Government on a scheme of seven years' allocation of £2,000 per annum subscribed by one to two hundred of our industrial personalities, costing each the equivalent of £200 per annum at the present rate of taxation, if their incomes exceed £10,000 per annum. The Government's backing could be provided by the profits of the Patent Office, which I understand are in the neighbourhood of £200,000 per annum. Such a scheme has had practical proof both before and during the war by the Mellon Institute of America.

I am sure that the subject is one of first national importance now and one that is growing as peace comes nearer in sight, as our main Allies in war will become our opponents in peace. National effort should be devoted to that of the quickest development and maintenance of our export trade, and no better stimulus to that can be the introduction of our inventive talent to industry through unbiased channels such as an institution.—SIR A. MOIR (Westminster).

Ultra-violet Ray Lamp

SIR,—In the March issue of PRACTICAL MECHANICS there is an article by K. K. Thomson on an Ultra-violet Ray Lamp. It is based on the assumption that the inner envelope of the standard 250 volt 400 watt mercury vapour lamp is made of quartz ; this is incorrect.

I obtained an Ediswan lamp of this type, fitted a choke, etc., and tried it on my arm for four hours in half-hour periods, decreasing the distance from 1½ft. to 3ins. No pigmentation resulted.

I then acquired an old lamp and broke up the inner envelope. Extracting a large piece I heated it in a flame until hot, then dipped it in water; it was covered with a network of cracks. Had this been quartz it would not have cracked, having practically no linear expansion. On making inquiry of one of the technical staff of B.T.H., I was told the 400 watt standard lamp is a low pressure lamp and toughened glass is sufficient for the inner envelope. The 80 watt and 125 watt high pressure lamps have a quartz inner envelope. That a special method had to be used to seal the wires in the tube since the wires melted before the quartz.

The lack of necessity for it, together with the difficulty of production, make it unlikely that any of the manufacturers use quartz in the standard 400 watt lamp.—A. C. WILSON (Glasgow).

SIR,—With reference to the article on ultra-violet ray lamps in the March issue of PRACTICAL MECHANICS I should like to draw your attention to the following errors which have occurred.

(1) The commercial mercury vapour lamp of 400 watts is not supplied with a quartz inner tube. This apparently only applies to the smaller lamps, 80 and 125 watts.

(2) Your contributor describes ultra-violet rays as of long wave-length ; as is well known they lie in the region 2,000-4,000 Ångström units, and are therefore much shorter than rays in the visible spectrum.

(3) It is possible to obtain efficient reflection of the ultra-violet by means of polished aluminium. At least 80 per cent. reflection is obtainable at 2,500 Å., and about 90 per cent. from 3,500-4,000 Å. As the article stated that such reflection was not possible, this information may be of assistance to readers, in obtaining more efficient operation.—G. L. ASHMAN (Tottenham).

SIR,—On page 188 of the March number of PRACTICAL MECHANICS and included in the article "An Ultra-violet Ray Lamp" there reads as follows :

"These rays, which are of long wave-length, have very little penetrating power. . . ."

Should not this have read "short" wave-length ?—C. J. WILLIAMSON (Scalloway).

[*You are quite correct. The paragraph should have read : "These rays, which are of short-wave-length have very little penetrating power. . . ."*—ED.]

Fighting Forest Fires

SIR,—It has been with much pleasure that for some time past I have perused your very interesting publication, which is particularly welcome in the absence of similar American publications, and which in any case supplies information of a kind that they do not.

One particular matter that has greatly interested me for a number of years is that of scientific fire fighting, fire control, and fire prevention. Now it is probably not much known outside Australia but it is a fact nevertheless that this country in general, and the State of Victoria in particular, is undoubtedly the worst forest fire and grass fire country in the world. Until recent years "black Thursday" of 1851 was considered the worst bush fire period in the State's history, but in 1939 there arose a holocaust of a nature which the writer feels certain has never been equalled in the United States or any other part of the world.

Day after day for a period running into weeks there raged an inferno that consumed three-quarters of the forest lands of the State causing damage to timber alone estimated at about eight million pounds.

Subsequently, early in 1944, there arose a conflagration, this time confined to several of the best grass lands of the State in which many miles of the foremost grazing areas were laid waste while at the same time the great electrical generating centre at Yallourn, a brown coal mine area about 100 miles from Melbourne, was very nearly wiped out.

The severity of both these fires may be judged from the fact that in the fires of last year thirty people were either incinerated or subsequently died of burns, while in those of 1939 seventy people perished.

Damage due to the latter fires was estimated at £2 million, yet the community slumbers on, the State Government only under pressure bringing in a bill to create a country fire authority.

The bill which soon became law was based on the recommendations of the Royal Commission, a county court judge, who was appointed to inquire into the outbreaks.

His recommendations were based on data of American origin ; the writer has since perused a considerable amount of data of this type and formed the opinion that American forest fires are as nothing compared with those of Australia, much of whose one per cent. forest area may yet be obliterated, while a further destruction of grazing lands and stock may produce a meat shortage of a kind never before known.

Knowing something of this menace for many years, the writer gladly undertook in 1936 the task of assisting a Russian engineer with tests on the fire extinguishing properties of certain chemicals. They were highly successful but it has long been apparent to the writer that to have any real effect on the enormous fronts on which such fires burn, sometimes one hundred miles or more, the only practical way would be by the release of fire extinguishing smokes or vapours from aeroplanes or by dropping containers from planes either into the fires or in the path of advancing fires.

This point was discussed with the Russian who said he did not think that Titanium Chloride had any fire extinguishing properties.

Be this as it may, any suitable formulæ that have would be very welcome here and the writer would greatly appreciate any help given in that direction. I have read with much interest brief mention of German claims to be able to fire-proof forests but would welcome fuller information. N.P.M., April, 1941. There is also the question of protection for fire-fighters.

While the provision of asbestos suits and smoke filters may be practicable for members

of country fire brigades, something simpler is needed for the ordinary country resident who may be called uppon to defend his home or that of his neighbours, hence the writer learned of experiments by the Royal Air Force on immunity from petrol fires with great interest. It was described in the October, 1941, issue of Newnes PRACTICAL MECHANICS.

There is also the bombarding of smoke described in the April, 1941, issue—conditions similar to those described have been known here; more information would be appreciated.

There is also another matter of a kind which is of much interest to the Commonwealth authorities here, namely, that of the Mellon Institute mentioned in the June, 1941, issue.

I have forwarded a copy of this article to the relevant minister, who referred it to the C.S.I.R. which, prior to learning of it, was inclined to dispute that the Mellon Institute was an organisation which helped inventors and stated rather that it was an institution which offered research facilities to industry.

I would welcome any additional supporting evidence.

A further matter which is of much interest to the local mining authorities is that of prevention of silicosis and miners' phthisis which is common in any country where gold mining is carried on. Hence more complete information re the McIntyre-Porcupine mines mentioned in page 436 of the September, 1941, issue would be greatly appreciated.—E. W. CHAMBERS (Heidelberg, Victoria, Australia).

"The Phenomenon of Light"

SIR,—In his article, "The Phenomenon of Light," in the April issue, the author states in effect that in rushing away from an incoming light beam, the apparent speed of the latter still remains the same, and it takes no longer to reach you than it would have done had you rushed towards it.

I have held a belief to the contrary. Here is an example to illustrate my point.

Suppose an observer to be a short distance from a railway station and in a good view of it. He sees a train leave the station. Now, if he could recede from his observation point at a speed greater than that of light he would see the train going back to the station and the smoke and steam returning to the funnel of the engine.

If my impression is a wrong one, perhaps the writer of the article could explain why.—R. H. WALLIS (Bristol 6).

[*Can our readers spot the obvious fallacy?*—ED.]

Items of Interest

Powerful Lightweight Tractor

A NEW lightweight tractor capable of drawing a two-furrow plough in the heaviest soil, and with a three-wheel design which gives it an extremely small turning radius, has just been announced by Mr. Denis Kendall, M.P.

The motive power of this new tractor will be provided by the 6 h.p. (rated) three-cylinder engine (developing 20 h.p. in the tractor), designed for the Kendall-Beaumont car, which is expected to revolutionise the small-car market after the war both in price and performance.

The new Kendall tractor is expected to be put on the market as soon as tests are completed and will cost £100, a figure that should bring it within the reach of practically every small farmer.

The three-wheel design will permit the tractor to be used for both ploughing and row-cropping without any alteration to the wheel arrangement. Mass production, at the rate of 50 a week, is expected to begin within the next three months. The tractor will be made at Grantham, Lincs.

Lighting by Balloons

WHEN the dim-out ceases to modify the lighting of our streets and normal illumination is restored, there will be an opportunity for new methods of lighting to be adopted.

It has already been proposed to illuminate large ground areas by means of captive balloons furnished with light-reflecting surfaces, in combination with searchlight apparatus intended to direct beams of light upon these surfaces.

Relating to such a method of illumination is a device for which an application for a patent in this country has been accepted. This invention is designed to ensure that beams of searchlight are continually directed towards a balloon's reflective surface.

The new contrivance arranges for the searchlight automatically to follow or respond to the movements of the balloon when airborne.

For Pipe Smokers

INNUMERABLE attempts have been made to produce an ideal tobacco pipe. It is often said that a pipe is the most hygienic method of smoking; but even this method is not without drawbacks.

When a pipe is being smoked, moisture is formed at the bottom of the bowl. This moisture causes the lower layers of tobacco to become damp and unsmokable. Hence a certain amount of tobacco has to be thrown away each time the pipe is smoked.

Hitherto the solution of the problem has been essayed by furnishing an absorbent spiral through which the smoke has to pass. However, this filtration has a tendency to eliminate the aroma from the tobacco smoke.

In the case of a new invention which has made its début, the bottom of the bowl of the pipe consists of a removable plug, in the hollow of which is a spiral of paper to serve as a ventilated platform for supporting the tobacco.

It is an advantage if the inlet to the mouthpiece is practically level with the top of the spiral.

HOLIDAYS AWAY FROM HOME
EDITOR'S ADVICE

OWING to paper restrictions you would be well advised to ask your newsagent to reserve your copy of PRACTICAL MECHANICS *until you return, if you are going away for your holidays. Otherwise your copy may be allocated to the person whose name is next on the newsagent's waiting list, and this will lead to difficulties on your return.*

Should you so desire, your newsagent would probably agree to post copies to your holiday address if you pay postage. In any case, please help by letting him know in advance what you wish him to do, as it will not be possible to increase supplies to holiday resorts.

Non-skid Tyre

AN improved non-skid tyre tread is the object of another invention for which an application for a patent has been accepted by the British Patent Office. It is claimed for this device that it has many of the advantages of treads with either large or small volume tread anti-skid configurations, while at the same time avoiding their faults.

The new device aims to provide a tyre tread construction that is stable and resists skidding without localized injury either to the tread or the carcase of a tyre.

This invention has a tread formed with a number of anti-skid tread elements or configurations. All the sides of these are serrated, forming small ribs projecting outwardly from the sides and spaced in relation to the tyre axis.

Resilient Seats

AN inventor has devised a contrivance relating to beds, seats, etc. He points out that for these articles it is usual to employ coil springs, covered by upholstery. There are disadvantages associated with this method. The springs tend to weaken or break, or they sag at certain parts.

One object of the invention is to provide a seating surface which may be easily substituted for worn seats.

The invention comprises a resilient surface for seats composed of a series of spaced flat elastic wholly rubber strips. At their ends are openings for the reception of anchoring members carried by the frame for supporting the resilient surface.

Ipswich and District Society of Model and Experimental Engineers

AS a result of the efforts of a few very enthusiastic model engineers, a meeting was arranged on March 4th at the Picture House, Ipswich, which was kindly loaned by the management for the purpose, with the object of forming a Model Engineers' Club for Ipswich and the surrounding districts. Thirty-seven very keen supporters were in attendance, which left no doubt that the club would be a great success.

Mr. Braid, of Messrs. Reavell and Co., Ltd., was elected chairman, also were all the officers.

The object of the club would be to promote interest in anything engineering by means of lectures, papers and friendly discussions, for which monthly meetings are to be held. Negotiations are well in hand to acquire premises for a club room and workshop, also a track for miniature passenger-carrying locomotives, some of which have already been built, and others are in the course of construction.

The hon. sec. is Mr. K. W. Day, 14, Ashcroft Road, Ipswich.

CORRECTIONS

"Bristol Hercules Engine"

IN a short description of this engine which was published in the January issue of "P.M." it was stated that the sleeve contained four ports. There are, of course, only three ports, one for inlet, while the remaining two serve alternately as inlet and exhaust.

"Instruments for Cars and Aircraft"

OWING to a draughtsman's error the drawing of a small rotary pump on page 124, January issue, shows the rotors too small. The peripheries of these wheels should run as close as possible to the casing, and not with a clearance.

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.

Spray for Insect Pests

PLEASE suggest a non-poisonous chemical addition to ordinary paraffin oil which would make it more deadly when used as a spray for flies and other insects.—A. J. Elmphray (Lerwick).

METHYL salicylate (which is synthetic oil of wintergreen) can be added to paraffin for fly spraying. It has a strong smell which all flying creatures dislike, and it is not poisonous. Similarly, pine oil can be used. Another liquid is Terpineol, which is pleasant-smelling. This can be mixed 50 : 50 with methyl salicylate. These liquids should be mixed in the proportion 1 part (by volume) to every 80 or 100 parts of paraffin. They are obtainable from Messrs. A. Boake, Roberts and Co., Ltd., "Elleslie," Buckhurst Hill, Essex (emergency address), price about 3s. per lb.

It should be noted that the liquids will not actually kill the flies; they will merely discourage them. Materials for the making of fly-killing sprays (such as pyrethrum extracts) are at present unobtainable.

Cement Mixture for Making Tiles

CAN you give me the correct formula for mixing cement with sawdust for making tiles? How is the sawdust treated, and what proportions of cement and sawdust are needed for a hard tile, as I want to polish same?—S. J. Clark (Wolverhampton).

MIX together 2 parts of sharp sand and 1 part of clean sawdust. Take equal parts of this mixture and Portland cement, and then slake it with water in the usual manner. Place the resulting mixture in wooden moulds of the requisite size and allow about three or four days for setting.

Another type of hard tile can be made by the magnesium oxychloride process. Take 2 parts sand, 1 part sawdust, 1½ parts of calcined magnesite. Mix these intimately. Then dissolve 40 parts of magnesium chloride in 6 parts of water and slake the above mixture with this solution until a thickish paste is obtained. This is placed similarly into moulds and allowed to set.

Calcined magnesite and magnesium chloride are obtainable from any laboratory furnisher or chemical suppliers, as, for instance, Messrs. J. W. Towers, Ltd., of Widnes, or Messrs. Harrington Brothers, Ltd., 4, Oliver's Yard, 53A, City Road, London, E.C.1. All parts mentioned above are calculated by weight.

These mixes can be coloured, if required, by the incorporation of a small quantity of pigment, such as red oxide, green chromium oxide, brown ochre, etc.

The polishing of the tiles will have to be done by hand under water, using for the purpose an emery stone and finally a softer abrasive such as whiting.

Paints for Shoes: "Liquid Waxes"

CAN you supply me with a formula for making paints for applying to the bottoms of ladies' shoes? These paints are applied to the soles after they have been scoured on a finishing machine, and when dried they are burnished with the pads of the same machine. As far as I can make out, something is required of the nature of oil-bound distemper with waxes added to help to create a shine in the burnishing.

Also, could you supply me with a formula for the making of liquid waxes? The wax is used on a chain stitcher. The reason for preferring liquid wax is that no gas or electricity is available for heating purposes, and in such circumstances liquid wax has to be used.—J. A. McIvor (Drogheda).

PAINTS for leather soles, etc., are usually of highly secret composition and we cannot get any precise information concerning them. They appear to comprise a mixture of an emulsified wax plus a certain amount of shellac, say about 10 per cent. of shellac. We think that you would be able to obtain more definite (and possibly secret) trade information on this particular point if you write to the Director, British Boot, Shoe and Allied Trades Research Association, 19, Bedford Square, London, W.C.1.

There are many types of so-called "liquid waxes." Some are merely solutions of wax or mixtures of waxes in various solvents. Others comprise wax emulsified with water.

In your case we think that a wax solution such as the following will serve your purpose well, but its exact strength must be a matter for your own experiment and trial. The formula is an average one for polishing purposes:

Yellow beeswax, 1 oz.
Paraffin wax (or, better, Ceresin wax), 4 oz.

Melt the above and then stir in gently:

Turpentine (genuine), 17 oz. (to which, if required, may be added about ½ oz. of pine oil or some other medium to give the product a pleasant smell).

Another type of "liquid wax" is the following:

Turpentine (genuine), 100 parts.
Shellac, 150 parts.
Zinc oxide, 30 parts.
Methyl alcohol, 25 parts.

Mix all the ingredients together until the product is fairly free from lumps. Then strain through coarse cloth, and bottle. This preparation dries in the air after applying.

For the sake of completeness we give below a formula for a variety of emulsified wax, but we do not think you will be able to make this, on account of the scarcity of the materials:

Carnauba wax, 87 parts.
Stearic acid, 10 parts.
Triethanolamine, 4 parts.
Water, 400 parts.

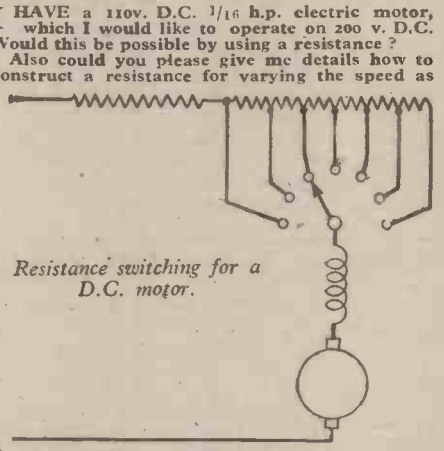
Heat the water, stearic acid and triethanolamine to boiling point until the stearic acid has completely melted and a smooth soapy solution is obtained.

In a separate vessel melt gently the carnauba wax. Then pour the molten carnauba wax in a very slow stream into the boiling solution prepared in the above manner. The solution should, if possible, be stirred mechanically at a high speed.

Motor Resistance

I HAVE a 110v. D.C. 1/16 h.p. electric motor, which I would like to operate on 200 v. D.C. Would this be possible by using a resistance?

Also could you please give me details how to construct a resistance for varying the speed as much as possible of either the above motor, or a 200-230 v. D.C. or A.C. one.—R. Santilli (London, W).



Resistance switching for a D.C. motor.

WE do not advise running the motor in series with a resistance from the 200 volt mains unless the field coils of the motor are connected in series with its armature. In this case, and assuming the motor has about 20 commutator segments or more, you could use a series resistance of 45 ohms which is capable of carrying 1.8 amps. For this purpose you could use 21 feet of 31 s.w.g. ferry wire. The speed of a series motor normally rises considerably on reduced load, and the series resistance will still further increase this tendency, so it is not advisable to run the motor unloaded.

The amount of speed variation obtainable with a given resistance will depend on the load against which the motor is operated. For example, against full load torque the motor would run at approximately one third of its normal speed if you use double the length of ferry wire in series. This wire could be mounted on a suitable former capable of withstanding 200 deg.C., one half of this wire being tapped at various points and connected to a speed control switch.

Making Papier Mâché

WILL you please give me instructions on how to make papier mâché—A. G. Smith (New Milton).

THE following are the ingredients necessary to make a lump of papier mâché a little larger than an ordinary baseball and weighing 17 ounces:

Wet paper pulp, dry paper, 1 ounce; water, 3 ounces; 4 ounces (avoirdupois); dry plaster Paris, 8 ounces (avoirdupois); hot glue, ¼ gill, or 4½ tablespoonfuls.

While the paper pulp is being prepared, melt some best Irish glue and make it of the same thickness and general consistency as that used by cabinet makers. On taking the paper pulp from the water squeeze it gently, but do not try to dry it. Put in a bowl, add about 3 teaspoonfuls of hot glue and stir the mass up into a soft and very sticky paste. Add the plaster of Paris and mix thoroughly. By the time about 3 ounces of the plaster have been used, the mass is so dry and thick that it can hardly be worked. Add the remainder of the glue, work it up again until it becomes sticky once more, and then add the remainder of the plaster.

Squeeze it vigorously through the fingers to thoroughly mix the mass, and work it until free from lumps, finely kneaded and sticky enough to adhere to the surface of a planed board. If it is too dry to stick fast add a few drops of either glue or water and work it up again. When the paper pulp is poor and the mâché is inclined to be lumpy, lay the mass upon a smooth board, take a hammer and pound it hard to grind it up fine.

If the papier mâché is not sticky enough to adhere firmly to whatever it is rubbed upon it is a failure and requires more glue. In using it the mass should be kept in a lump and used as soon as possible after making. Keep the surface of the lump moist by means of a wet cloth laid over it, otherwise the surface will dry rapidly. If it is to be kept overnight or longer, wrap it up in several thicknesses of wet cotton cloth and put under an inverted bowl. If it is desired to keep a lump for a week, to use daily, add a few drops of glycerine when making, so that it will dry more slowly.

Wood Sections for Microscope Slides

I SHOULD like to know how to make sections of wood suitable to be viewed under a microscope. I have made sections of stems, etc., but understand that this is difficult, and requires a special technique. I have found in the past that these so-called "difficult techniques" are quite practicable with sufficient patience and perseverance.—J. K. Page (Guildford).

THIN sections of the various timbers for microscope slide preparation are generally cut "dry," it being found that this method best preserves the original nature, characteristics and appearances of the wood.

For the preparation of the thinnest of wood sections, a microtome is necessary. You can obtain such an instrument for the work indicated from Messrs. Flatters and Garnet, Limited., Oxford Road, Manchester, 13. Microtomes are usually rather expensive.

It is quite possible, however, to cut timber sections of medium thinness by means of an ordinary sharp razor, the fragment of wood being held tightly between the thumb and fingers of the left hand and the razor being operated by the right hand. A good deal of practice is necessary here, and before undertaking the job it would be advisable to soak the fragment of timber in spirit for about half an hour. This softens the tissues somewhat and causes them to swell, so that the actual cutting is made rather easier. Nevertheless for very accurate work, the timber sections should invariably be cut "dry."

Fuller's Earth for Filtering

COULD you give me some information on fuller's earth for filtering lubricating oil? How is it prepared for filtering? Is it a practical proposition for quantities of 100-150 gallons?—H. W. Lloyd (Cardiff).

FULLER'S earth is merely a species of dried clay with or without admixture of a certain proportion of dried siliceous matter, such as groundrock. In England, the fuller's earth, as ordinarily marketed, is a dried clay which is naturally contaminated with a certain amount of limestone. It has a greyish appearance, and it possesses a large capacity for absorption. Hence its use as a stain-removing material, and as a filtering substance.

The "earth" is quite cheap, and can usually be obtained from any paint stores. If not, inquire from any firm of chemical suppliers and/or drysalters in your district. In small amounts, the stuff will cost you up to 6d. per lb., but purchased in large quantities, it would, of course, be much cheaper.

It would be quite practicable to filter lubricating oil through a bed of fuller's earth and thus to rid the oil of its impurities, but the speed, efficiency and convenience with which this could be done in any particular

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An * denotes that constructional details are available, free, with the blueprint.

case would be governed by the viscosity of the oil, the degree of its contamination, the temperature of the oil, and the quantity of fuller's earth in the filtering bed. Hence, from the particulars which you give us, we cannot say definitely whether you would find it a practical proposition to filter up to 150 gallons of oil.

You will have to make experiments yourself to determine this question. A 6-in. layer of fuller's earth should give adequate filtration. Possibly, you will have to "open out" the fuller's earth by admixture with it of up to 25 per cent. of its weight of clean, sharp sand, otherwise the fuller's earth may become "caked," and thus refuse to filter.

Begin your experiments by using a pound of fuller's earth in a small canister and filtering the oil through this.

In nearly every instance, the speedy filtration of oil requires the assistance of pressure to speed up the filtration. Mere slow percolation of the oil through a filter bed, whilst effective, is not satisfactory for commercial usage.

Checking Field Coils of D.C. Motors

I SHALL be glad if you can give me any information on checking field coils of 220 v. D.C. series motors when in position.—E. A. Jenkins (Neath).

WE think the simplest way of checking the field coils of series D.C. motors in position, is to compare the voltage drop across each coil by means of a low reading voltmeter when a constant current is flowing through the coils. If one coil shows an appreciably lower voltage across its ends than do the other coils, this is an indication that the coil is short circuited. The required constant current of about 50 to 100 per cent. of normal full load current could perhaps be obtained by running the motor on a constant load. If not, it may be obtained by short-circuiting the armature, and feeding the series field coils from the mains, or even from a battery of accumulators, in series with a regulating resistance for current control.

Silvering Lamp Bulbs

COULD you give me details of how to silver electric lamps, to act as a reflector? I wish to use this type of lamp in an episcope.—T. McGeough (Newry).

WE are not perfectly clear from your query as to the exact manner in which you wish to silver your electric lamps, but we presume that you wish to silver merely a portion of the outside of the glass bulb so that this will act, in part, as a reflector.

The job is not an easy one, and, for success, it demands some practice. However, you may proceed in the following manner:

Make up the following solutions:

Solution A.—Dissolve 60 grains of silver nitrate in 1 oz. of distilled water and pour this solution into a boiling solution of 48 grains of Rochelle salt in about 1 oz. of water. On cooling, filter the resulting liquid and make it up with distilled water to a total volume of 12 fluid ounces.

Solution B.—Dissolve 60 grains of silver nitrate in 1 oz. of distilled water, and then add strong ammonia *drop by drop* until the copious white precipitate which is first formed has nearly (but not quite) dissolved, leaving a slightly cloudy liquid. Then make the solution up with distilled water to 12 fluid ounces, as in solution A.

To perform the silvering operation, mix equal volumes of solutions A and B, and hold down into the mixed solution the lamp whose glass bulb is to be silvered on the one side. The silvering operation will take about three minutes, after which the lamp is gently rinsed in water and then dried.

The most scrupulous cleanliness must be observed during the whole of the silvering operations. All vessels and dishes used for making up the solutions, and for the silvering itself, must be well cleaned out beforehand, preferably with nitric acid. This applies, also to the lamp glass itself. If the slightest trace of dirt is present, the layer of silver will not adhere to the glass.

The mixed solutions rapidly deteriorate and only keep good for half-an-hour or so, but the separate solutions will remain in good condition for a few weeks, provided that they are kept in the dark and, of course, in perfectly clean bottles.

Chromium Plating

WOULD you please give me the answer to the following queries:

Can I run a small chromium plating vat by a 12-volt 80-amp. accumulator, and, if so, what resistance would be required?

Can I get the necessary salts anywhere in London which only require mixing with water, and what metal would be used as the anode?

What means is there of testing the solution to keep it up to the correct strength?

Can chromium be deposited direct on to brass or copper?—W. F. Willshire (Romford).

THE following is a good formula for chromium plating salt:

Chromic acid, 55 ozs..
Sulphuric acid, 0.55 oz.
Water, 1 gallon.

Operate the above bath at 40 deg. C. (100 deg. F.), using anodes of lead, or, better still, of lead containing 6 per cent. of antimony (antimonial lead), this alloy having a better resistance to attack. The liquid should be maintained in a glass vessel or one of antimonial lead.

Bright deposits of chromium require from 120 to 150 amps. per sq. ft. of surface under plating. Hence, unless you are plating fairly small surfaces, your 80-amp. accumulator will not supply a sufficiently heavy current. An e.m.f. of 4 volts is ample.

In wiring up, connect the bath electrodes, accumulator, voltmeter and small variable resistance in series, with the ammeter in parallel.

Chromium is by no means an easy metal to plate. It necessitates a heavy amperage. It is best deposited on nickel, but it can be satisfactorily plated direct on brass or copper.

There is no simple way of testing for solution strength of the electrolyte. Your best plan is to make further additions of chromic acid from time to time, but these additions should only be very few unless the bath is being continually worked.

You can procure the above materials from the following firms: Messrs. Baird and Tatlock (London), Ltd., 14-17, St. Cross Street, Hatton Garden, E.C.1; Messrs. Griffin and Tatlock, Ltd., Kemble Street, Kingsway, W.C.2; Messrs. A. Gallenkamp and Co., Ltd., 17-29, Sun Street, Finsbury Square, E.C.2.

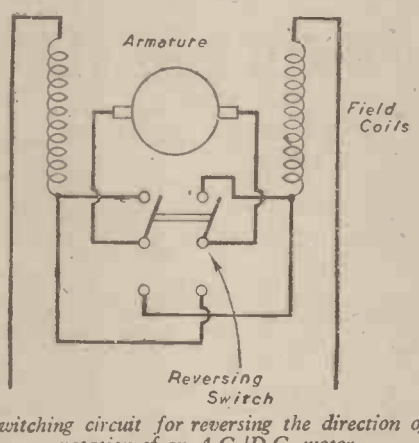
We believe, however, that a special chromium-plating salt is obtainable from Messrs. W. Canning and Co., Ltd., Great Hampton Street, Birmingham, 18, although whether this is supplied only to the trade we do not know.

In this latter event you might find that the following firm would be willing to assist you with materials: Chromium Portable Plater Sales Co., Ltd., 169-173, Hampstead Road, N.W.1.

Reversing an A.C./D.C. Motor

I HAVE a small A.C./D.C. 200-260 volts, 6 amps., electric motor, which I am now operating with alternating current.

Is there any method by which I can repeatedly keep reversing the direction of rotation of the motor, "at the touch of a switch," without having to dismantle the motor, except for any primary adjustment?—R. K. Preston (Ulverston).



Switching circuit for reversing the direction of rotation of an A.C./D.C. motor.

THE motor is evidently a series machine and can, therefore, be reversed by reversing the current through the armature. We presume you will allow the motor to slow down before starting up in the reverse direction. A double-pole two-way switch could be used to reverse the connections to the armature, as indicated in the sketch. A small ironclad switch would be suitable. If the brushes are not fitted in the neutral position, you may find the motor runs better in one direction than the other. Should this prove a serious disadvantage, it may be possible to move the whole of the brushes forward slightly in the same direction as the original rotation. We suggest about 16 deg. movement for a 2-pole motor or about 8 deg. for a 4-pole one.

Slackening Rusty Nuts

CAN you suggest anything to cut the rust of nuts that are seized up? I have tried Rustol and penetrating oil but these work too slow on the nuts.—J. Huggins (Enniskillen).

YOU can make an excellent penetrating oil by mixing approximately equal parts of paraffin oil and methyl salicylate (oil of wintergreen) to which a little ordinary lubricating oil—or, better still, colloidal graphite—has been added.

This penetrating liquid will loosen the tightest of nuts, but it takes time to do so, usually about five minutes to 20 minutes. There is no penetrating oil or other substance which is capable of loosening rusted-up nuts instantly. In all cases it is very necessary to give the liquid time to seep down into the finest crevices.

The alternative way of tackling the problem of loosening the bound nuts is to apply heat to them in one form or another, whereby the nuts or the bolt will expand. This expansion will proceed at an unequal rate (relative to the surroundings of the nut or bolt) and the resultant effect will be a loosening of the parts. A red-hot iron may be used to apply heat to a bolt shaft or to a nut.

Electro Plating

I AM trying to do a little electro-plating, in an amateur way. For the battery I have made up three Daniell cells. I can only get the diluted sulphuric acid 1.250 for the cells; is this strong enough? The cells only register .75 volts and I understand they should be just over 1 volt. When I tried to copper-plate some thin steel sheet the deposit was a copper-coloured jelly-like substance which could be wiped off with a rag. The surface then appeared a dull silver colour which easily rusted. Can you say what was wrong? Where could I get a nickel anode and salts for nickel plating?—H. Comins (Oldham).

THEORETICALLY, a Daniell cell should give just over 1 volt, but, in practice, the e.m.f. of the cell hardly reaches 1 volt. The fact that your Daniell cells only register 0.75 volt points to some internal resistance in the cells. If you can eradicate this, then the e.m.f. will increase accordingly. However, for plating purposes an e.m.f. of 0.75 volt is quite satisfactory.

The sulphuric acid which you are using is suitable. If, however, you wish to procure the concentrated acid and to dilute it yourself, this acid can be obtained in small amounts (on personal call) from Messrs. J. W. Towers, Chapel Street, Salford (near to Victoria Bridge), Manchester.

Without knowing the composition of your plating solution, we are afraid that we cannot express a true opinion as to the cause of its failure to give satisfactory results. Assuming, however, that the solution is approximately correct in composition, it looks as though you are using too heavy a current.

The following are two good formulæ for copper plating, the cyanide formula being rather the better:

Acid copper plating.
Copper sulphate, 27 ozs.
Sulphuric acid, conc., 7 ozs.
Water, 1 gallon.

Use at temperature of 75 deg. F. Brass or copper anode. 0.75 to 1 volt e.m.f.

Cyanide copper plating.
Copper carbonate, 5 ozs.
Sodium cyanide, 10 ozs.
Photographer's "hypo," 1/64 oz.
Water, 1 gallon.

Use at temperature of 100 to 110 deg. F. 0.75 to 2 volts e.m.f. Copper anode.

Copper and nickel-plating salts can be obtained from any of the following firms: Messrs. W. Canning and Co., Ltd., Great Hampton Street, Birmingham, 18; Messrs. R. Cruickshank, Ltd., Camden Street, Birmingham, 1; Messrs. Johnson, Matthay and Co., Ltd., Hatton Garden, London, E.C.

Any of these firms (particularly the latter) should be able to supply you with a strip of pure nickel to act as an anode.

Electron Radiation

IS there any method of producing a flow of electrons other than in a gas-filled or evacuated glass envelope (such as a cathode-ray tube), and, if so, is there any physical danger? I believe I have seen it stated that if ultra-violet light is directed on to a zinc plate electrons are liberated. I do not wish to use ultra-violet if you can suggest a better method, but how can ultra-violet be produced safely, and does the zinc deteriorate?

Are there any fluorescent substances which are permanent in air which can be procured by the amateur cheaply.—R. H. Norton Dawson (Hampstead).

ELECTRONS are evolved from any heated body. The higher the temperature of the heated body the more intense the electron flow. Thus, an ordinary red-hot wire evolves electrons freely.

When certain wavelengths of light fall upon metals they liberate electrons. It is quite true that electrons are liberated from a clean zinc surface when ultra-violet rays fall upon it, this action forming the principle of one type of photo-electric cell. The zinc, or other metal which acts as an electron-liberator, does not deteriorate. As a source of ultra-violet rays you can use either a carbon arc or a mercury-vapour lamp, both unscreened by glass.

Before commencing any experiments we would strongly advise you to read up any modern books on light, television and allied subjects which may be available in your nearest library, since the liberation of electrons (and their subsequent direction and utilisation) is not such an easy matter as you seem to think. There is no danger connected with an ordinary electron flow in the sense which you infer.

By your use of the term "fluorescent" do you strictly mean "fluorescent," or do you mean "luminescent?" In other words, do you refer to a material which glows under the influence of ultra-violet light, or do you imply a material which is luminous in the dark? Solutions of eosin, fluorescein and acriflavin are fluorescent. Ordinary vaseline or petroleum jelly is fluorescent, as are many mineral oils. Luminescent materials are barium, strontium, calcium and zinc sulphides. In our experience, the best of these is "luminescent zinc sulphide," which is procurable, price about 3s. per oz., from any large firm of laboratory suppliers, such as The British Drugh ouses, Ltd., Graham Street, City Road, N.1.

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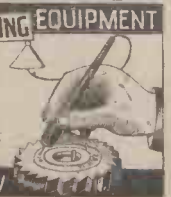

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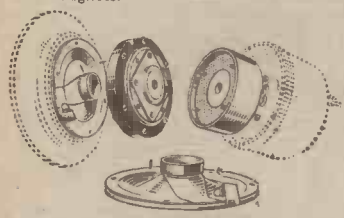

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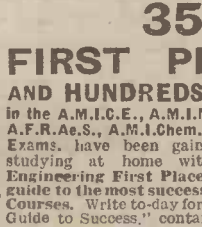

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THE Cyclist
Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

The Interim Report

THE Interim Report of the Committee on Road Safety has just been published. The committee consisted of five members of the Ministry of War Transport, one member of the Home Office, one member of the Ministry of Education, one member of the Ministry of Information, one member of the Scottish Home Department, three members representing the police, and five members representing the Royal Society for the Prevention of Accidents.

The report is in some respects a tendentious and minatory document. It points the accusing finger, when it should be mainly concerned with finding causes and cures. It blames road users for accidents. It is noted that there was not a member of the public on the committee to give the public point of view. It would appear from this document that the M.O.W.T. does not lay any blame at its own door for failing to make the roads conform to modern tendencies and progress. It forgets that the Road Fund was introduced by Lloyd George for the specific purpose of making new roads and improving old ones.

The Chancellors of the Exchequer during the past twenty years have successively rifled the Fund to balance the Budget and adopted methods which in ordinary business would have landed them in the dock, for misappropriation of public funds is an offence. If a tax is imposed for a specific object, and an assurance given by the Prime Minister of the day that the Fund would not be used for any other purpose, we maintain that that is misappropriation.

The Ministry of War Transport having failed to bring the roads up to date now seeks to blame road users because road travel is expanding beyond their own road plans. It threatens further legislation and blames the public for its own ineptitude. It thinks that the accident problem can be solved by improved methods of propaganda, and by imposing fines. These methods have been tried before and failed.

The principal recommendations are that responsibility for road safety measures should be shared by local authorities, that remedial methods should be adopted quickly (what remedial measures?), propaganda must be consistent and continuous and directed to all types and ages of road users, the Highway Code should be the basis of all propaganda and that it should be revised, local safety organisations should be set up in all local authority areas, the support of the Press and the B.B.C. should be sought, approved expenditure incurred by local authorities on local road safety should rank for Government grant, roadside advice should be given by the police, a universal speed limit should not be imposed, and the 30-mile limit should be applied with discretion.

Driving tests for applicants suffering from diseases or physical disabilities should be reintroduced immediately, driving tests should be made more searching, control of the return of traffic to the roads should be effected by means of a basic ration of petrol for private motoring for a short period, cyclists should be required to report accidents in which they are involved, and massed-start cycle racing is "undesirable."

The report goes on to suggest that bad or inadequate road conditions should be remedied by vigorous action. Those responsible for the planning of roads and their layout and for town and country planning should have regard to the principles of segregation of traffic and classes of traffic, traffic signs and signals should be improved, the parking of vehicles in busy streets should be prohibited and adequate parking spaces should be provided.

Surely the Ministry of War Transport understands by now that cars are parked in busy streets because there are not adequate parking places, nor a sufficient number of garages. The London County Council has for years opposed the construction of garages in London. The police have opposed public parking places.

We do not agree with the report when it suggests that accident investigation and review should be undertaken by the police, and the engineers of the Department and Highway Authorities. The police have shown a marked partiality in their reports in the past, and have largely relied upon third-hand evidence. After supporting the Alness Report on some aspects of road safety, and disagreeing with it on others, the report goes on to state that there should be intensive research with regard to vehicle lights and the prevention of dazzle.

The main clauses affecting cycles and cyclists are: That pedal cycles should have two efficient brakes, cyclists should be compelled to carry bells on their machines, cycles should carry a red rear light at night in addition to a red rear reflector and white patch (now law), the provisions of the Road Traffic Act, 1934, with regard to the carriage of passengers on pedal cycles should be clarified, and pedal cycles should be required to conform to a standard of fitness.

The Alness Committee stated that they realised early in their deliberations that there is no single or sovereign remedy for the solution of the problem submitted to them. They also appreciated that the remedies to be recommended by them would have to be, if not dramatic, at any rate drastic in their character, having regard not only to the existing magnitude of the evil but also to the steady annual increase of motor vehicles on the roads. In other words, though they were satisfied that there is no panacea for the mischief, they must seek, and if possible find, a long-range policy.

We shall deal in later issues with this report in detail.

Massed-start Racing

THE report states: "We understand that, despite the action taken by the Ministry of War Transport and the Home Office to discourage this form of cycle racing on the highway, an attempt is being made by one body of cyclists (the B.L.R.C.) to popularise it. At present the roads are comparatively free from congestion, and massed-start cycle racing is not, therefore, open to such strong objection as would be the case in peacetime. But there is little doubt that it is the desire of those responsible for encouraging this form of cycle racing to introduce it on a scale and on lines comparable with similar racing on the Continent.

"We are clear that massed-start racing, as distinct from time trials, is likely to give rise to danger both to those participating in the events and to other road users, and we recommend that if the efforts of the Departments concerned to discourage this form of racing do not achieve the desired results, consideration should be given to the introduction of stronger measures. At the present time no legal offence is committed by holding massed-start races on the highway unless obstruction or danger is caused to other road users. The police have been recommended by the Home Office to watch these activities with special care and we support this recommendation as we view with apprehension any extensive use of the highway for this type of racing."

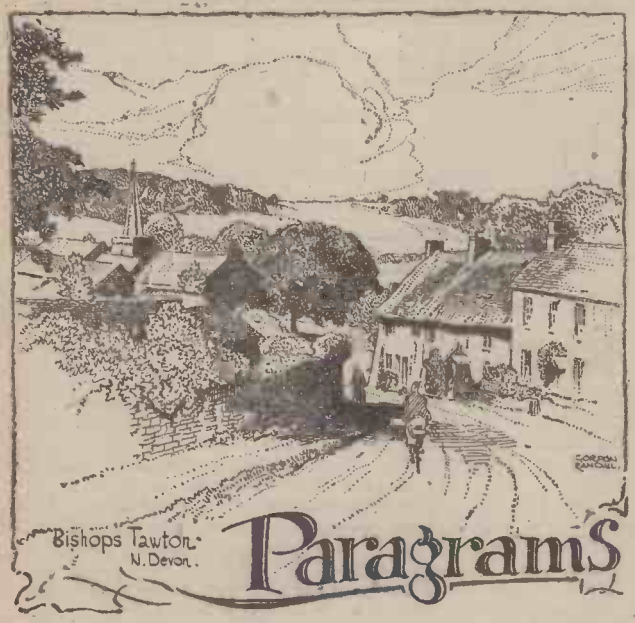
The police *have* been watching this type of racing with special care and have expressed their views in favour of it. The only apprehension which this particular committee feels is the apprehension raised by two rival bodies—the N.C.U. and the R.T.T.C. It was admitted to us by the M.O.W.T. that the only letters of complaint they had received had been from these two bodies, who are obviously concerned to see that a form of sport likely to prove more popular than track racing and time trials (indeed even during the war it has proved more popular) was killed at birth. The view of the committee therefore on massed-start racing—a view expressed without hearing the B.L.R.C. side of the question—is one which does not carry weight.

We can assure the M.O.W.T. that massed-start racing will continue and any move towards legislation to make it illegal will be fiercely contested in Parliament itself. We cannot accept the position that the N.C.U., the R.T.T.C. and a few northern members of the C.T.C. are to decide the future of cycle sport, nor can we accept the view that 50,000 members of these bodies are entitled to impose their will on 10 million cyclists, for whom they falsely claim to speak.

We ask the committee: Who was responsible for *prompting* it to include in its report the above statement against massed-start racing? What gave rise to their "apprehension"? Was it the chain rattling of the N.C.U.? Was the N.C.U. represented on the committee?

Note to C.T.C. Members

WE invite C.T.C. and N.C.U. members to write to us stating whether they are, or are not, in favour of rear lights. We are conducting this referendum in the interests of statistical accuracy. We want to find out whether these bodies can justly claim to speak for 50,000 cyclists.



N.A. Chairman

A. J. BRADBURY, president of the Manchester Wheelers, has been elected chairman, for the third consecutive year, of the National Association of Cycle Traders, of which he is also president.

Bevin Boys

F. LOVE, Southgate C.C.; R. Dickson, Carluke C.C., and N. McKendrick, Goldberry C.C., are among those who have been directed to work in the mines.

Activity in India

E. HALL, Sittingbourne C.C., is serving in India, where he has ridden in several events.

Oxford City's Loss

FLYING OFFICER LEONARD KING, D.F.C., Oxford City Road Club, has been killed in action.

Rotherham Wheelers Celebrate

ROTHERHAM Wheelers have celebrated their 25th anniversary.

Crook Wheelers

A COUNTY Durham club, the Crook Wheelers, is being re-formed.

N.C.U. Losses

A. DEVONPORT, popular official of the N.C.U., London Centre, has died in France as the result of an accident. He was serving with the Forces. A colleague, F./O. L. Claydon, is known to be a prisoner of war.

Kentish Wheeler Decorated

PILOT OFFICER C. MANSFIELD, Kentish Wheelers, has been awarded the D.F.M. for gallantry during flights over the Danube and Rumania.

Calleva's Record

TWENTY-SIX members of the Calleva Road Club are serving with the Forces; four have made the supreme sacrifice.

Grantham's Coming of Age

GRANTHAM Road Club this year celebrate their coming of age.

St. Christopher's Loss

W. BRITTAIN, prominent member of the St. Christopher (Leeds) C.C., has been killed in action. He was serving in the R.A.F. and lost his life while in action in Burma.

Pilot Officer's Return

PILOT OFFICER F. W. BATTERBURY, well-known South London clubman, who was reported missing from air operations last year, has returned to this country.

Speedy Boys

POST Office telegraph messenger boys have formed their own cycling club in Portsmouth. With a membership of almost 40 it is known as the Telegraph Messengers' C.C.

Ray Peebles Wounded

RAY PEEBLES, Wolverhampton Wanderers, has been wounded while serving in North-West Europe.

H. T. Franklin Dies

H. T. FRANKLIN, founder member of the Victoria C.C. and former official of the Eastern Counties Cycling Association, has died at his home in South Devon.

Enthusiasm

LANCE-SERGEANT R. ELLIS, Highgate C.C., who is a prisoner of war in Germany, has started a series of lectures on cycling in the camp where he is interned. He is not the only club cyclist in the camp as he has met, among others, Fred Johnson, Moncton C.C., A. Hunt, Stretford Wheelers, and Jack Read, Birkenhead North End C.C.

Southgate Promotion

R. S. PHILPOTT, Southgate C.C., has been promoted major. He is in the Indian Army and is holder of several club long-distance records.

Westerley Champion Killed

THE Westerley Road Club champion of 1941, Sgt. G. Strong, has been killed in a flying accident. He was serving in the R.A.F.

Garside's Decoration

PETTY OFFICER THOMAS GARSIDE, Beds Road Club, has been awarded the D.S.M.

Local Appreciation

RESIDENTS of the Gartcosh district of Glasgow subscribed £100 as a token of esteem and good wishes for Pilot Officer W. Hendry, third member of the famous Clydeside time-trialists, to commemorate his award of the D.F.M.

Southgate Decoration

CPL. J. GRAHAM, Southgate C.C., has been awarded the Military Medal for bravery in Italy.

News of Purves

IT is believed that James Purves, pre-war Vegetarian C. and A.C. stalwart, who was twice captured as a prisoner of war, has been released from an Upper Silesian coal mine where he was working.

Addiscombe Losses

K. COX, Addiscombe C.C., has died of wounds sustained in fighting in France, and his club mate, L. Martin, is now presumed lost at sea following enemy action some weeks ago.

Clubmen Casualties

C.S.M. F. BAILEY, Manchester Wheelers; Cpl. J. Hanson, Huddersfield Road Club; J. Pickford South Lancs Road Club, and S. A. Orrell, Norwood Paragon C.C., are included in the ever-growing list of clubmen who have made the supreme sacrifice.

Decorated

L. O. HARRISON, North Road C.C., has been awarded the D.F.M.

Special Air Service

C. F. VALENTINE, Southgate C.C., who was doing some prolific rides two years ago, is now a sergeant in the Special Air Service. He saw active service behind the lines after "D" Day.

Club Revived

THE Ilford Road Club is to be revived. Since the outbreak of war a skeleton committee has done its best to maintain contact with the many serving members.

Dukinfield Jubilee

DUKINFIELD C.C. celebrates its diamond jubilee this year.

Trader's Illness

G. T. ROBERTS, hon. sec. London Branch of the National Association of Cycle Traders, is ill and has resigned office.

A. J. Wilson Dies

THE death has taken place of A. J. Wilson, the famous old-time cyclist. He was 87.

Dunlop Sports

DUNLOP sports will be held at Fort Dunlop, Birmingham, on Saturday, June 30th.

Yiewsley Road Club Awards

TWO members of the Yiewsley Road Club have received the D.F.C., the latest recipient being W. E. G. Thorby.

F./O. P. Watkins, D.F.C.

F./O. P. WATKINS, De Laune C.C., has been awarded the D.F.C.

Morrison Injured

FLIGHT SERGEANT DONALD MORRISON, D.F.C., Glasgow Wheelers, has been seriously injured in a road accident.

Phœnix Pedallers

THE latest Forces cycling club is the Phoenix Pedallers, which has been formed among cyclists in Ceylon.

Around the Wheelworld

By ICARUS

A. J. Wilson Passes

ONE who can rightly claim to have been the W. G. Grace of cycling, namely, A. J. Wilson, known to readers of cycling literature as "Faed," died on Tuesday, March 20th, at the age of 87, after a long illness.

Born on February 17th, 1858, Arthur James Wilson can justly claim to be one of the few who founded the sport and the pastime, for he was associated, not only with the sport, but also with the industry and the cycling Press.

Although he suffered, from the age of 12, from the affliction of deafness (hence his pen-name of "Faed"), he did not allow this to interfere with his racing and business career. In his early days he was keen on the tricycle, having for some time previously distinguished himself on the Ordinary. He was trained as an engraver, being employed in the manufacture of woodcuts for illustration purposes.

His main successes were on the tandem tricycle, the Sociable, and the tricycle, on which from 1870, when he was only 12, he commenced to race. It was in 1880 that he formed a club for tricyclists—the North London Tricycle Club, later the N.L.C.C. It was under the badge of the club that he did most of his early racing, and early in his career he took to the cinder track and hill climbing. He raced on the Sociable at the Alexandra Palace track, and rode against some of the stalwarts of the day, including R. J. Mecredy (Arjay). In those days open road events were unknown so "Faed" formed the North Road C.C. to promote road races in which the best riders from other clubs could compete. He was the first president of the N.R.C.C. and he rode in its first fifty on June 19th, 1886, an event which he won with C. E. Lyles on a tandem tricycle in 3 hrs. 16 min. 28 sec., a figure which he beat on September 22nd, 1886, with G. P. Mills this time as the partner, in 2 hrs. 46 min. 3 sec.

In 1891 he covered 164½ miles in 12 hours with J. J. MacCarthy on the tandem tricycle. At this time the N.C.U., cowering before the dirty attitude of the police force of the time, who were kotowing to the horse-drawn vehicle brigade and prosecuting cyclists on the flimsiest pretext, had thrown road sport overboard. I have already quoted the famous resolution of March 8th, 1888, made by E. Hecht, which requested clubs to refrain from holding road races, precluded N.C.U. officials from assisting in them, and withdrew N.C.U. homologation of road records.

We see to-day the N.C.U. making the same mistake in connection with massed-start racing: However, Hecht's proposition was carried by 63 votes to 18, so Wilson promptly resigned his position as timekeeper, and formed the Road Records Association, of which he became first president, a position he retained for many years.

He wrote a vast amount of matter concerning cycles and cycling, and in 1879 he joined the staff of *Bicycling News*, the oldest cycling journal in the world and of which the present writer was the most recent Editor. He became its Editor and later joined Lacey Hillier in promoting the lively journal, *Wheel World*. He joined Mecredy in 1889 in Dublin to start the *Irish Cyclist*, and it was during this period that he met Dunlop and the Ducros brothers in connection with the Dunlop tyre which was just coming on to the market.

Wilson became the London Business Manager of the Dunlop Company, and later Publicity Manager. He then founded the firm of A. J. Wilson and Co., which handled the Dunlop Publicity until 1928.

His cycling books are still much sought after and include *Riding Rhymes*, the *Chronicles of Duffersville*, *Two Trips to the Emerald Isle*, and many others, which fortunately grace my bookshelves. I have read and re-read them many times.

He founded the Cycle Trades Benevolent Fund, and was a frequent contributor to this journal. His passing will be regretted by a vast circle of those who knew him, and of his influence on the trade and pastime. A memorial service took place at Holy Trinity Church, Marylebone, on April 10th.

A Cyclist's Views

APROPOS our Leader last month on the subject of rear lights, I have received the following letter from Mr. F. Selwin, of Finsbury Park, N.4:

"As a new reader of your publication PRACTICAL MECHANICS and with it THE CYCLIST may I congratulate you on your leading article in CYCLIST under "Rear Light Bill Passed," and crave space to have this letter published? The broad outlook and common sense in your leader, and the paragraph titled "Hig" by Icarus are a real pleasure to read.

I am urged to write this letter because both as a citizen and as a road user, pedestrian, cyclist, motorist, and motor cyclist, I am appalled at the magnitude of the road casualty figures, at a time when none but essential (?) vehicles are on the roads, and seriously interested in anything which will help to increase road safety for all.

To find such statements as made by Mr. F. J. Urry under the paragraph "Rear Lights" on the pages following your leader and the page by Icarus, is disconcerting.

I would contend that statement, and refute the remark about eyesight, as I have been medically examined three times in the past three years, and passed fit not only to hold a driving licence, but to carry out operational flying duties. Such thoughtless remarks as these do the author no good, nor do they benefit his cause. Mr. Urry has evidently not had the horror, as I have, of sitting at the roadside, while a friend died in his arms as the result of a collision with the back of an unlit lorry. I would strongly urge Mr. Urry to stand at the gates of any large factory, and note the numbers of clean white patches and efficient reflectors he sees coming out. Better still to mount a real cycle and follow any arterial road after dark when the roads carry crowds of people returning home either at the week-end or during the week, when discourteous motorists with both headlights blazing dazzle the oncoming traffic. At such times a rear light well placed is not an advertisement, it is an insurance policy against accident. No one insures because they want to get hurt or killed, they insure because they feel they are covered if anything should happen. Has Mr. Urry ever thought to ask himself another question: "What is it that you can see best on the road on a foggy night, when sensible people ride or drive on pilot or side lights?" Is it not the red rear light shining from the invisible vehicle in front? Finally, it isn't every motorist or motor cyclist who uses "the full power of his headlights" all the time."

The Cambrae Race

FOR the information of the Ministry of War Transport here is a quotation from the entry form issued by the Clarion who organised the Cambrae Road Race, and finally ran it on lines exactly similar to B.L.R.C. rules: "Although the roads are closed competitors should not assume that they will be clear. Always be prepared for an emergency. Remember the promotors are not responsible for damage which may be suffered by competitors or spectators." It is clear the roads were *not* closed.

Yet this race was supposed to have been run under N.C.U. rules which do not permit races on roads not closed to the public. The simple answer, of course, is that the N.C.U. knows perfectly well that it has no powers, nor has the local authority the power, to close the roads for racing.

The B.L.R.C. has issued a statement of policy in which it repeats that it exists to encourage and promote in Great Britain all forms of amateur and professional cycling, based upon international practice and in conformity with U.C.I. rules. Copies of the pamphlet are obtainable from J. Kain (the national hon. secretary), 24, Disraeli Road, London, W.5.

British "Best-all-round" Competition

A QUESTION has been put to the R.T.T.C. regarding the application of Condition 12 of the Competition (page 54 of the Council's handbook) to the case of a rider who changes his club.

In order to remove any uncertainty which may exist in the minds of riders, it is desired to make clear that in events under the jurisdiction of the Council this condition applies only to events which are included in the competition.

The performances of a rider for the purposes of the team section of the competition will not be affected by his representing another club in events which are not included in the competition.

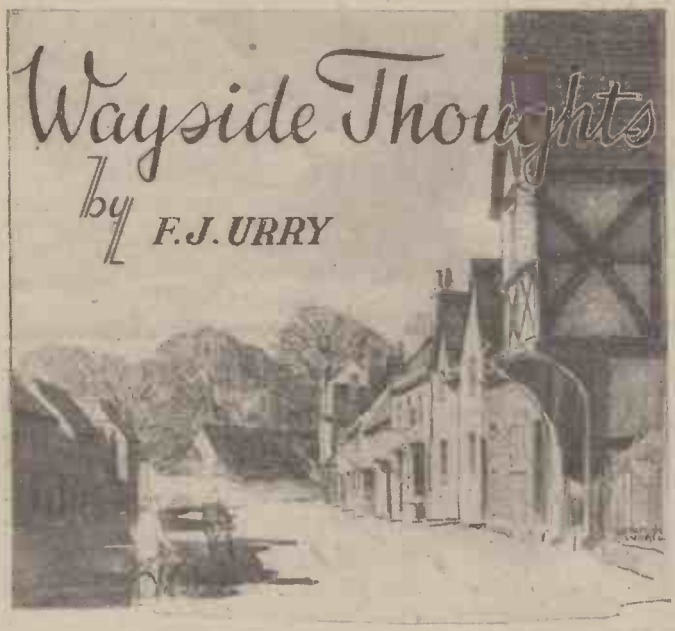
B.L.R.C. North-Eastern Section

THE first event of the recently formed North-Eastern Section of the British League of Racing Cyclists, which was a Low Gear 25-mile Time Trial, was held with success on Sunday, March 25th, 1945. The leading times were the fastest recorded in this area for a long while for any similar event. Out of an entry of 34 only three failed to start. The leading times were as follows:

	Hrs.	Min.	Secs.
1. L. Wilson, Northern Coureurs	1	7	3
2. W. McCarthy, Northumbrian R.R.C.	1	8	1
3. R. Sowerby, Northern Coureurs	1	8	16
4. K. Hicks, Ridley C.C.	1	10	50
5. W. Graham, Northern Coureurs	1	11	28
6. J. J. Pearson, Northern Coureurs	1	11	45
7. F. Watson, Northumbrian R.R.C.	1	11	46
8. R. Leftwitch, Northern Coureurs	1	11	46

First handicap, W. McCarthy; second handicap, L. Wilson.

Fastest team, Northern Coureurs; Fastest novice, J. Hann, Northern Coureurs.



Better Goods

EVER since the war started and we were compelled to carry rear lights by Order in Council, we cyclists have complained bitterly that the lamps—or some part of them—have been so poor in quality that reliability of the light properly functioning was never certain. Now that rear lights are fastened on us for ever, the time has surely arrived for a complete overhaul of the means to carry out our liability with more certainty than has been the case since September, 1939. We want better batteries, better lighting bulbs, better lamps and lamp connections and better dynamo sets. Possibly they will cost us a trifle more in the first place, but their longer life should prove to be a considerable economy. The tinsel things of to-day are not good enough for permanent wear. How bad they are as far as the battery lamp is concerned, I know from far too practical experience. It is easy enough for the Government to tell us that rear lights on bicycles are simple and troubleless. I wonder if such cheerful critics have ever tried to change a fractured bulb on a night of storm, or fix one of those flimsy connections that so often defy rectification? Years ago we had good lamps; they were made from brass sheet and riveted, and did their job with a high degree of reliability. But the wretched tin-plate things of to-day that rust in a fog, or "short" in a shower are a nuisance and a worry to the regular rider, and our lamp makers ought to know and correct the trouble. I see that someone recently suggested all new bicycles should be equipped with lighting sets; a car is, why not a bicycle? Not for me! I can and do ride many more thousands of miles without a lamp than with one. Why should I travel round with three or four pounds of additional weight for no purpose? The motorist is not so burdened being pushed about by his iron horses.

Only the Best Wanted

I HAVE said often enough in these columns that the full joy of cycling can only be experienced by the owners of the very best type of bicycle. If the gist of my correspondence is any indication of the public trend in this direction, then the truth embedded in pleasurable cycling is surely getting home. Individuals may differ in the kind and type of specifications they fancy, but it is remarkable how insistent they are on the question of quality. I wonder if this fact is really understood by the makers? There is any amount of money waiting to be spent on bicycles and their equipment directly first-class goods are again available; but at the moment there is little indication of the return of the very best to the public market. What is the snag? Is it lack of material or labour or a combination of both? I know this, that unless the trade can "get a move on" and supply the waiting thousands with the fine products it is capable of manufacturing, many cyclists will get tired of waiting and seek other avenues along which to burn their leisure. And that would be a pity. In letter after letter I am asked if it is *yet* possible to get so-and-so; there seems to be more bicycles for sale but they are all of a rather sad wartime sombreness, and lack the mark of quality. I should hate to see the industry descend to plain utilitarianism which seems to be the danger our habits have been forming during these years of war. Is it not possible to shake them or the Government Control out of this lethargic state and so restore to themselves and us, their customers, a decent pride in the articles they make for the pursuit of happiness? This is not a criticism of destruction; but an ardent desire expressed by many people, Services and civilians, for the best in bicycles with "price no object," that invariable comment underlined in most of my letters.

Good Luck

AS a matter of fact I have recently ordered a new bicycle because I found a maker who had a very small stock of pre-war tubing, a pair of stainless steel rims and a pair of high-class brakes. Such a rare chance was too good to miss, so I promised to see what I could find in the way of tyres, a speed-gear, saddle and rubber grips. Between us, the maker and I have solved the shortage handicaps, and soon I hope to be riding a bicycle that may not be a post-war model, but will certainly be as good as anything the pre-war cycling world could make. As this will be the first new bicycle I have acquired for five years, I too am not particularly concerned as to its cost, or the troubles that have gone to make it a worthy example of what a bicycle should be: I am only too happy to feel the thrill of bestriding a new machine at a time of the year when I can give it plenty of mileage exercise. For that simple and enjoyable excitement of possessing a new bicycle never quite departs from the mental and physical make-up of the ardent rider, and though your critical faculties increase as you grow older it is seldom you find them of service when you are trying out a high-class machine made to your pet specification and set to your exact position ing. Let me say at once that I have been most fortunate in obtaining this machine, for I know my friend the maker could not build another like it now, and that the pre-war open-sided tyres that will adorn it are, I should imagine, one of the last pairs available in this Midland area. I mention these facts because so many people seem to think I have some secret sources of supply, and could if I would, introduce them to the happy places. As a matter of fact I should only be too glad to publicise the supply of the good goods if I knew of them, and most certainly shall do so directly they are available.

A Suggestion

I HATE to feel all "muffled up" when riding a bicycle, and have never yet been able to seek comfort from an overcoat of the conventional kind when awheel. Yet the bitter weather of late January called for something extra than a heavy jersey, for warm as that garment is in calm weather, the wind, with the edge of a whetted knife, goes through it in tiny draughts to seek and chill the forefront of the rider. So I bethought me of a friend who might perchance have enough Grenfell cloth in stock to make me a light, easy-fitting windproof garment to slip into when the bitter breezes are prowling round, and once again I was lucky. This coat takes up no more room in the bag than a sweater, slips over an ordinary coat, has storm cuffs, and a couple of big pockets to take all the oddments the average man collects, and, indeed, is a real utility garment. It has been cut about a couple of inches longer than an ordinary lounge coat, so there are no tails to get mixed up with mudguards or brakes, and it doesn't seem to matter how carelessly you fold it; creases are unknown. I think it is going to be very useful for cool weather riding, and maybe a spare to take touring when one's ordinary light jacket can be securely tucked away on rainy days and this over-all substitute given the dirty work, as it were. The lumber type of jacket—borrowed from the golfers—might be quite good, but for me it lacks pocket room and allows the draughts to circulate freely round that portion of my anatomy which is said to be the seat of lumbago, and I don't like it. I believe there is a call for a coat of this type among regular riders and tourists, and I commend the idea to our cycling clothiers.

The Glory of the Night

I WAS out for a night prowl recently when there was no moon, but the stars were a mass of jewels on the velvet background of the sky. How frequently we say: "It's a beautiful night outside," and leave it at that; yet I know few things more soothing than a quiet ride under the stars when the urgency of the day has slowed to the occasional swiftly passing presence of a long-distance lorry, and only the owls and a predatory fox barking his challenge, seem to be alive. And the lorries: their restored lighting has given them extra speed, and now they pound along at what seems to be a terrific pace, though probably it is not so high as we imagine for the simple reason that their noise adds attention to their passing. That they can now see their way seems to me to be quite positive, for on a straight stretch of the London-Liverpool road I stayed to watch a convoy of them passing at intervals, and after they had gone stepped out the distance from which the road ahead of them was clearly lit, and had disturbed the verge-feeding rabbits, and found it was approximately 632 yards. In view of the rear-light controversy, and the many opinions expressed which so obviously lack the backing of experience, I thought this information, on the spot as it were, may be interesting. Before I reached home a great covey of 'planes went over, all lit up, and made for me quite a pyrotechnic display as the goose-flights ranged the night; and long after them came a lone roamer of the skies, whose lights mingled with the stars, and seemed almost to be one of them which had tired of its fixity, and like the writer, wanted to roam. The silence, shot with the sibilance of the small night noises and the quiet wind, came to me, the distant warm lights of cottage windows, and the unmistakable scents that this old earth was thinking of the summer to be; and so I came home refreshed and very thankful for such simple things.

Dirty Weather

ON my way to work or home when the rain teems down, I get well bespattered by the passing motors. I have become inured to it and seldom take any notice; it is part of the penalty we cyclists have to pay as the price of our freedom, although such is not usually considered in any regard when the arguments are advanced suggesting the cyclist has so very much for which to thank the motorist. One very dirty morning I received most of a puddle full of mud flung over me by a very urgent car whose driver cut in, glanced back at my discomfiture, and waved his hand, whether in friendly apology or in a "serve-you-right" frame of mind I do not know. I wondered at the time, and I wonder now, what would be said of cyclists if they did or were capable of doing, such things to motorists? For it is a fact that the huge majority of motorists are decent in their manner of overtaking when the roads are bad, as I know full-well; but the few thoughtless and reckless ones can make life very unpleasant for short periods by the rude use of their vehicles' giant strength and speed. A small point of complaint, but one that bears hard on tempers when there is really no need for it.

Growing Old

IT is generally agreed that when you go down hill you go faster, but when you descend the slope of the years you go slower—but it seems faster. I am quite content that it should be so, and as it is inevitably the fact, that is just as well. The thought came to me some days ago when I timed myself over the home-to-work journey and discovered I took an average three minutes longer than was the case immediately pre-war. Had anyone told me the six miles of urban and town riding needed another half minute a mile to provide me with comfortable going, I should not have believed it; but time is a fixed measure that takes no account of age. Its speed is constant, yours is not, and in the natural order of things cannot be. A little check up on these lines is a very good corrective for anyone, if only because it measures your otherwise un-noted physical declension, and suggests that growing old gracefully is one of the major virtues for living at all. I don't know I am slower, or that I am growing old; I have to bring the stop watch to prove the charge; which is far more satisfactory to me than the thousand and one reasons many of my friends juggle with to excuse their want of vitality. If you ask me why my outdoor life is so happy, I have only one reply—cycling.

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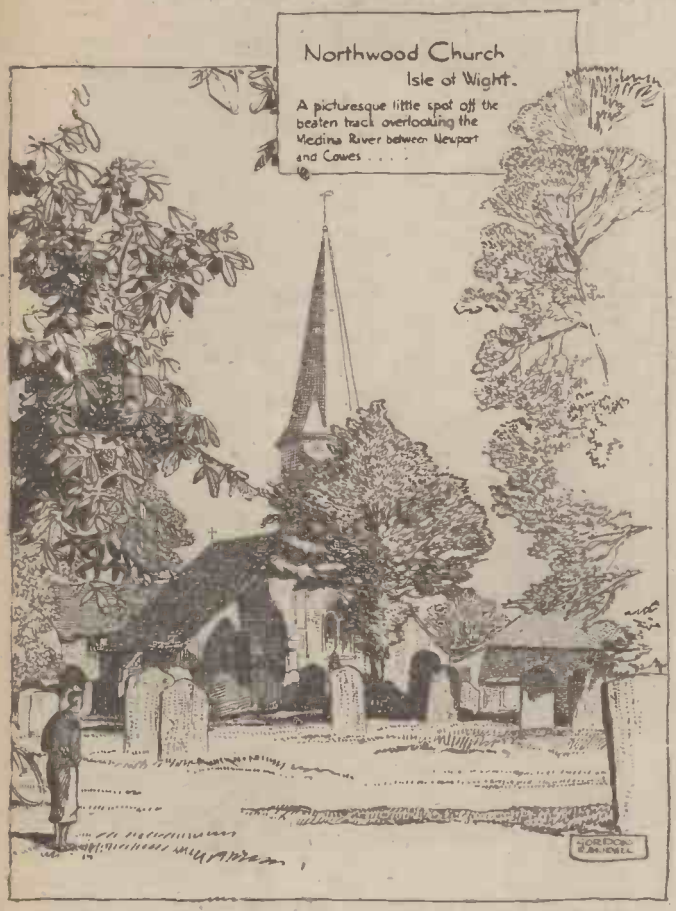
CYCLORAMA

By H. W. ELEY



Spring is Really Here

I FANCY that King Winter's reign is over, for to-day the sun is warm on my back, and the daffodils are all a-bloom, and there is every sign that spring has turned the corner. And who greets the return of spring with more ardour than the keen cyclist? Who longs for the sunny days more than the man who, when they come, can take his bike out and ride out into the countryside? The seasons mean much to the cyclist, and although I am an all-the-year-round rider, and find joy and charm in riding in October, and even in January, I am glad, all the same, when I can ride out and greet the spring. Soon . . . and there will be meadows golden with buttercups, and the fringes of the by-pass roads will be aflame with dandelions.

Old Cycling Journals

IT is always good when a contributor receives letters from readers, and the Editor kindly sent me on a communication recently from Mr. G. Rodell, of Harpenden, who mentions that he remembers his father receiving cycle trade journals carrying illustrations of cycle scouts in the Matabele War. One picture had the caption, "On the trail of Lo Benguella." Mr. Rodell's father was a cycle builder, and in the early days advertised the "Fram" machine. He also assisted in the manufacture of one of the earliest dynamos, made by Ferranti Thompson and Ince—the dynamo now being on exhibition in the Science Museum at South Kensington. In passing, Mr. Rodell mentions that when in South Africa he had a Zulu boy working for him, whom he christened "Bicycle," owing to the fact that the boy wore, through the enlarged lobe of each ear, a length of Bluemels' pump, about 4in. long! Thank you, Mr. Rodell, for these interesting reminiscences! A whiff of history is always welcome!

England's Prettiest Village?

IT is always cropping up, this question as to which English village can lay best claim to the title "the prettiest of all." Personally, I rather deplore this comparing of beautiful villages, for we have so many which are lovely, and, after all, it is really a matter of taste. There are cyclists who will tolerate no challenge to the claims of Kersey, in Suffolk. There are others who find their ideal village in Wiltshire, and others who vow allegiance to some of the villages of the South Downs. Not so many plump for the villages of the north, but I have a soft spot for some of those old villages in the good part of Staffordshire, near to the Derbyshire border—Marchington, Needwood, Hoar Cross, and Cubley. A little more austere, perhaps, than the villages of the softer south, but, to a Midlander, full of beauty and charm. However, I like to take my England as a whole, and find "prettiest villages" wherever I ride. It is the best way.

Wise Words

"PUNCH" has recently been inviting leading industrialists to say something about British industry, its part in the war, and its coming part in the reconstruction period. Sir Bernard Docker, the chairman of the B.S.A., said some true things about the cycle industry:

> ". . . where would our dispersed war industries have been without the bicycle? How would the A.R.P., police, postal and other public services have carried on without the bicycle? When would wartime housewives have found enough time to get through their work without the bicycle? Even in the fighting line, and despite the complexity of modern war equipment, the bicycle plays an essential part. No better method could be devised for the silent movement of airborne troops in enemy territory than the folding parachute bicycle . . ."

These are wise words, and a welcome tribute to the cycle industry. At last the ubiquity of the cycle seems to be receiving its due praise!

"Beeropolis"

JUST another name for Burton-on-Trent, the world-famous centre of the brewing trade. I cycled through the streets of Burton recently and sniffed again the familiar heavy aroma of malting, and rode carefully over the railway lines which cross some of the main streets. Mountains of barrels alongside the sidings; the chuff-chuff of little locomotives drawing trucks loaded with casks of the famous Burton ale—destined for many far-off destinations. Quite a unique town, this Midland centre of brewing, and an ancient one too, for I was reminded by a native that one may still see the ruins of a monastery there, along the banks of the wide Trent. Nearby there are quite delectable villages—Newton Solney, Drakelowe and Rolleston-on-Dove, where once the forbears of Sir Oswald Mosley lived in a great mansion—now gone the way of most mansions and "vast estates."

Salute to a Schoolmaster

TALKING to a headmaster of a preparatory school the other day, I was delighted to hear that once a week he lectured every child who came to school on a cycle on the principles of road safety and wise riding. Charts were used, demonstrations given, and my friend reported a welcome freedom from road accidents. "Teach them young" is the golden rule, and I am sure that more instruction in schools about rules of the road would have beneficial results. We have still far too many accidents among children—and parents do not seem to do much to inculcate the right ideas.

In Better Supply

FROM observation, I fancy that the shortage of bicycles has been very largely remedied. In any case, an inspection of many cycle agents' windows recently indicates that plenty of bikes are now on sale, and one notes with satisfaction the pleasing variety of models. The British cycle manufacturers, faced for long with intricate problems of materials, and serious labour difficulties, have done a grand job . . . and now they seem to be turning their attention to that vital matter of export business, and one reads that their plans are truly on the grand scale. Well, if ever a British product enjoyed a world-renowned fame, it is the British-made cycle . . . and we may be sure that its reputation for excellence will never be sullied.

"Teas Provided"

IN the good old days, how welcome that sign used to be to the cyclist who had travelled many miles, and who asked of life nothing better than a pot of tea, and a big plate of bread and butter. How well I remember the wondrous meals which used to be provided in little wayside cottages; meals served with the affability and courtesy which used to be characteristics of the Road. All who have ever belonged to cycling clubs will hope that when the days of rationing are over, and—presumably — fresh butter, and fresh eggs will again be part of the normal tea menu—we shall again be able to dismount at the picturesque cottage, go inside, and enjoy high tea. May the day come soon! There is only one unpleasant memory I have of "teas on the road"—and that is the place which styles itself "Ye Olde Tyme Tea Shoppe." May we be preserved from this!

A Veteran Passes On

THOUSANDS of "old timers" and a host of folk in the printing and advertising worlds will have mourned the death of A. J. Wilson . . . the one and only "FAED"—one of the early cycling journalists, a fine advertising man, and a pioneer of the early days of the pneumatic tyre. For several years A.J. was in charge of Dunlop advertising, and the agency he founded, and which handled some of the best motor and cycle accounts, will long be remembered by the old school.

A corner of Chipping Campden.

Notes of a Highwayman

By Leonard Ellis

Britain's Touring Grounds (6)

ALTHOUGH small in area the Cotswolds are deservedly popular as a touring ground, and may be regarded as one of England's gems. I say small in area, and I would qualify that by adding that I am thinking of the Northern or Upper Cotswolds. Perhaps I am mistaken, but my impression is that cyclists generally do not tackle the northern and southern sections in one trip, nor do they regard them together as one touring area. The Northern Cotswolds lie broadly in Gloucestershire, but parts are in Warwick, Oxford, and even a small part is in Worcester. There is no other tract of country exactly like the Cotswolds, with their multitude of thatched roofs, their yellow stone houses harmonising so gloriously with the rich red-yellow of the soil, and the amazing collection of colourful gardens and beautiful cottages. There is a charm about the region that is almost indefinable, because no one would say that it is scenically superlative. Large tracts are just rolling hills and valleys with only the overall mellowness to recommend them. The hills are alluring, but they are not grand. The lanes can be equalled, and even outshone, in the Chilterns and elsewhere, and it is by no means so well-wooded as many other regions. That sounds almost like adverse criticism, but it is not; it is merely an attempt to discover by elimination just where the charm lies.

Beautiful Villages

WE are finally driven to the conclusion that nowhere else can one find so many lovely villages within a small area. None of the villages is unattractive, and most are beautiful in the extreme. Nowhere else will the thatch, the stone, the earth and the flowers be found to blend so pleasingly and in such profusion. The world-famous villages can be recited like a catalogue: Stanton, Stanway, Ford, Ebrington, Snowshill, Upper and Lower Slaughter, Upper and Lower Swell, Bibury, and so on. It is difficult to single out any one as the best, as opinions differ on such points, but I think that most will agree that Bibury is just sublime. Here we have the village green surrounded by typical cottages, the old church covered in wistaria, the clear-running river where you can watch the fat speckled trout almost ready to eat from your fingers, but don't be misled—they can't be caught. Here you see a row of cottages so superlatively beautiful that they have been taken over by the Society of Arts. It is not only in small villages that the Cotswolds excel. There is a number of small country towns that are extremely interesting both pictorially and historically. Of these Chipping Campden and Burford can be singled out as two outstanding examples of the perfect, unspoiled, old-world country town.

An Old-world Town

YOU can walk round Chipping Campden enthralled at every step by the successive vistas of stone mullioned windows, overhanging eaves, quaint inns, dark little doorways offering peeps of delightful gardens, quaint old shops with "pop bottle" or "bull's eye" windows, and then to the old market hall, a picture in itself. Everyone will realise the suggestion of bygone prosperity or see the shadow of long-forgotten industry. In addition to these two towns, Northleach, Moreton-in-Marsh, Stow-in-the-Wold and Winchcombe are all particularly attractive, and a paradise for the photographer. Bourton-on-the-Water is called the Venice of England, because of the numerous little stone bridges spanning the stream that meanders through the main street. Bourton and Broadway are both very beautiful, but one notices with a tinge of regret that they have become so sophisticated that the real charm of the Cotswolds is almost missing. The Southern Cotswolds are probably finer from a scenic point of view, the hills are loftier, and they may be more wooded. There is much to see and enjoy, including Painswick, where 99 fine-clipped yews thrive in the churchyard, and all efforts to grow the hundredth are doomed to failure, or so the legend says. Then there is Nailsworth and other attractive places, and there is also Stroud, which, although by no means unattractive, seems to spoil the effect by having become to some extent industrialised.

Ebrington, in the Cotswolds.

My Point of View

By "Wayfarer"

The Joy of It All

CIRCUMSTANCES beyond my control kept me away from cycling for exactly three months during the winter which it is now almost safe to assert is past. This is a long period for one who, normally, cycles every day and whose week-end leisure is given up to the best, the most enriching of all pastimes. The joy with which, about the middle of March, I resumed cycling can better be imagined than described. My first business, of course, was to get back into form—a process which still proceeds at the time of writing. I recall that, on coming out of the Army in 1918, after hardly seeing a bicycle for a year and a half, the same task had to be faced, and that only a few weeks elapsed before I was able to do my century of miles in a day. But, alas and alack! I am now 25 years older!

So I have been gently "playing myself in," with half-days of 40's and full days of 60's, and with 10 miles a day between week-ends to help the muscles to function properly. But what interests me much more than the distances achieved is the fact that once again I am indulging in a joyous exercise: that once again, by my own efforts, I am making the road and the hedges slip by; that once again I am conscious of "the wind on the heath"; that once again my wandering wheels are taking me back to the happy scenes of old, and to the tiny houses where I have been wont to pause for meals.

Possibly some of the many gradients which are to be found in the Midland shires have become (temporarily) a bit steeper since my brief but all too long absence; possibly the winds (for the time being) have blown more strongly, and with greater shrewdness, than was to be expected. Nevertheless, I have not consumed much "acid," and I am conscious of progress in getting back to form.

The joy of it all! I have looked anew at the hills which ring my home town, beginning with Edge Hill and ending with the Wrekin. One day I saw with perfect clarity, about 50 miles away, the Black Mountains standing up behind the Malverns. I felt that I had come into my own again, for these long-distance views, whether seen in the Midlands, or from the Chilterns, or in Yorkshire, or elsewhere, are the particular par of our glorious and radiant heritage which makes so great, so compelling an appeal to me, and which causes me to be more than satisfied to leave to other people "the pictures," the theatre, and other artificial attractions of lesser degree.

Things Lost

IT is an easy step from this point to two aspects of the three months of non-cycling to which reference has been made. For a portion of that period my activities were restricted to eating and sleeping—both pleasant occupations as hobbies, but not as a full-time job for a growing lad! In my many waking moments I had ample opportunities for thought, and I was able to conjure up cycling pictures in abundance, dwelling on the achievements of the past and looking forward to the possibilities of the future. Thus the time passed quickly enough, and the loneliness of a private ward in hospital was dissipated by reason of the legacy of much cycling in days gone by. For our great game does fill the storehouse of the mind with a rich harvest of joyous memories—a noble pageantry of things seen and things done.

When I "came back to life" and was able to resume business, though still ranking as a non-cyclist, I discovered that the week-ends meant nothing to me. Normally it might almost be said that I live for Saturday and Sunday, but, so long as cycling was out of the question, well, Saturday and Sunday meant just as much (or as little) as Tuesday and Wednesday, or Thursday and Friday. However (to quote one of Kipling's soldiers), "that's all shove be'ind me." I am getting back to form as a cyclist, and week-ends are once again full of significance—in anticipation, in realisation, and in retrospection. The things lost have been regained.

Delayed Repairs

A SHORT while before Easter I looked in on a cycle-man who carries out some of my very few repairs, and mends the occasional punctures I bring home with me (he has just seen to a perforation which I have been carting about since last October!) and I found his workshop pretty full of bicycles awaiting attention. In response to my "Busy?" he said that the work was getting on top of him: he had had to keep some of his customers waiting for three weeks. "A lot of these jobs," he added, "could have been brought to me a couple of months ago, and I would have welcomed them during the winter slackness. But no, they are kept until Easter is within sight, and then there's a gaudy rush." The hard school of experience has its lesson for us all, if only we will condescend to learn. A job well done in January is a better proposition than one not so well done—or perhaps not done at all—immediately before Easter. What "goes" for Easter applies also to Whitsuntide and the August Bank Holiday week-end. Moral: get the job done early: avoid the eleventh hour.

The Price of Safety

IT is probably true to say that all the incidents and accidents that happen to us, as cyclists, contain a warning and a lesson. For example, a few Sundays ago the attention of a friend of mine—a cyclist of considerable experience and skill—was attracted by a low-flying aeroplane, the clamour of which drowned the noise of a motor-car approaching from behind. Not unnaturally, my friend looked up at the aircraft: not unnaturally, he made a slight swerve in the process. Just at that moment, the motor-car, going at a fast pace, overtook him and actually scraped the skin off the fourth knuckle of his right hand. This must have been an extremely narrow escape for my friend. Possibly the motorist was seeing how near he could go to the cyclist without "downing" him—a genial habit practised by some motorists—but I cannot help thinking that my pal was entirely to blame for allowing his attention to be distracted from the job in hand. As the old tag has it, "the price of safety is eternal vigilance." Thus, the policy for every cyclist should be *never* to relax his attention. Much can happen in a matter of seconds. So take care first, last, and all the time.

Will Others Please Copy?

SIR WILLIAM WOOD, a vice-president of the L.M.S., wrote this a few weeks ago: "The railways have never suggested that the roads belonging to the community, and paid for by it, should be denied to the community. . . ." A refreshing statement which might well be borne in mind by others.

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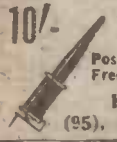

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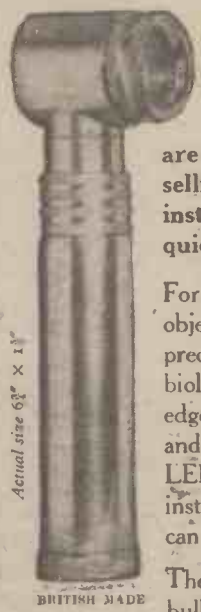

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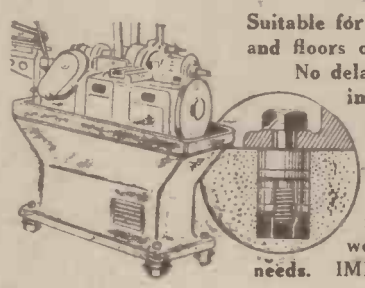

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