THE AIRACOBRA

NEWNES

PRACTICAL MECHANICS

9D.

MAY 1942

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PRACTICAL MECHANICS

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Editor : F. J. CAMM

VOL. IX. MAY, 1942 No. 104

FAIR COMMENT — BY THE EDITOR

Our Cover in the Services

THE paper on which our cover is normally printed has joined the Services, where we hope it will distinguish itself as it has done in portraying each month one of the leading features. Our readers may not recognise it in its new form, for it will appear as a cartridge case or one of the many munitions of war for which paper is used. This slight change has meant a modification in the preparation of our cover design. This is purely a war-time measure and our readers will join with us in the hope that the war will be speedily concluded when, like so many of our readers, our cover will be demobilised and return to its peace-time occupation.

Our Readers in the Services

MENTION of the Services reminds me that many thousands of our readers are either in the Navy, the Army, the Air Force, or one of the various technical branches of the Services, where they are conducting themselves with distinction. Many members of the staff of this journal are there, too. Readers may have met some of them and received instruction from them. I receive a large mail from readers in the Services. They come from all over the world. Here is one written by a reader at present residing on a small island near the Equator. It is written to his parents : "Do I still receive PRACTICAL MECHANICS? Yes! Please keep on sending it every month ; it is one of the most sought-for papers in the hut, and everyone asks me to hand it over. I think this speaks volumes for the nature of the magazine." Owing to paper restrictions periodicals are not now so robust as they were, but in spite of paper shortage and rising costs in all branches of periodical production we consider we have a duty to the war effort to continue production of this and our associated journals, *Practical Engineering* (every Thursday) and *Practical Wireless* (every month).

Hints to Contributors—

I AM always glad to give careful consideration to manuscripts sent in by readers provided that those manuscripts are prepared by those who have experience of the subject on which they write. When sending in manuscripts, therefore, contributors should state their qualifications to write on the particular subject. Manuscripts should be written on one side of the paper only, and sketches should appear on separate sheets. Where there are separate figures they should be numbered Fig. 1, Fig. 2 and so on, and referred to sequentially in the text. There should be a 1in. margin on each side of the manuscript and sufficient space between the lines to permit of sub-editorial corrections. The name of the contributor should appear on the top left-hand corner of the first page of the manuscript, as well as on each rough sketch. Headings should be inserted at every 200 words or so. Intending contributors should also note our style. We use in. for inch and inches, ft. for foot and feet, yd. for yard and yards. Where articles describe the construction of a device, a photograph should be sent to indicate that the device has been made. Accepted articles are promptly used and promptly paid for, and a stamped and addressed envelope should be enclosed for the return of unsuitable manuscripts.

—And to Querists

WILL querists please note that queries *must* be accompanied by the query coupon cut from the current issue, three penny stamps, and a stamped and addressed envelope? Queries on separate subjects must be written on separate sheets of paper. The envelope in which queries are sent should have the word "Query" written on the left-hand top corner. We cannot undertake to answer questions over the telephone, nor can we undertake to answer legal queries. Those relating to patents should have the word "Patents" written on the top left-hand corner. We repeat that we cannot under any circumstances undertake chemical analysis, nor disclose the ingredients of commercial preparations. We know that many of these are not now obtainable. It is illegal to prepare and sell cosmetics without special permission to do so.

Bound Volumes

WILL readers please note that for the time being we are unable to undertake any further orders for the binding of the volumes of this journal. Indexes will continue to be issued, and readers should get their issues bound locally. An announcement will be made as soon as we are able to resume our previous binding arrangements.

Production

THE eighth report of the Select Committee on National Expenditure contains some interesting conclusions. It says that not enough attention has been paid to the importance of greater specialisation, and to distributing contracts so that each manufacturer may concentrate on a limited number of products suitable to him, thus providing a sufficient run on each type to make possible the most economical mass-production methods, with the further advantage of reducing the total amount of tooling required throughout industry as well as of skilled labour. In many cases manufacturers have been asked to make too many varieties of articles ; nor has enough attention been paid to directing contracts, labour and materials to the most efficient factories. There is a vast amount of efficient machinery which is not being used for anything near 24 hours in the day. The proper regulation of sub-contracting capacity still requires urgent attention. Main contractors are in many cases not kept sufficiently informed about Government plans such as impending changes which would enable them to prepare new lines of production in advance ; nor sufficiently consulted on programmes and design which are under consideration. This results in lack of continuity and work, and leads to waste of time and energy in research for new work and the preparation of tenders which are often abortive. Non-essential industries are still not properly regulated and man-power is absorbed in pushing sales of non-essential products.

At all points can be seen the importance of appreciating that industry is run by human beings, not mechanical units. There is a general symptom of so-called idle time which has attracted widespread public attention, and many newspapers have referred to this as slacking. This idle time is usually caused by change of design, and a certain amount of interruption is inevitable. Other causes are air raid damage, accidents, interruptions of shipping or inland transport, and there are interruptions to flow of production due to faulty work of sub-contractors, failure by sub-contractors to deliver components, or by departments to supply materials. Other causes are lack of balance in the labour distribution between various undertakings, and lack of contracts.

There cannot be adequate efficiency in production without a programme planned sufficiently far ahead so that a proper flow of manufacturing processes can be organised. Each part of the programme must fit in to a national plan, to settle which cannot be the function of any single department.

Another suggestion which is commended for consideration is that each important industry or industrial group should have a liaison officer to work with the three main supply departments, and that these departments on their side should be arranged so that the liaison officers would have definite points of contact, through which they could obtain, without delay, either decisions or information. This suggestion might help, not only to sift out important points from mere trivial and embarrassing complaints, but also to give manufacturers a real understanding of the position and relieve them of that baffled feeling, which is so common, of being able neither to get explanations nor decisions.

"V" FOR

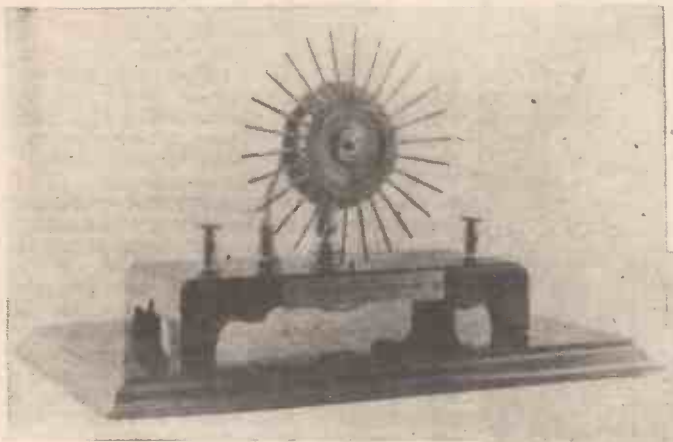
An Interesting Early Telegraph

By courtesy of the Postmaster-General.

The Central Telegraph Office about 1920. Messages in Morse were transmitted from here to the South Coast.

"SEND Vs."

The request from one morse telegraphist to another had nothing to do with propaganda.



By courtesy of the Postmaster-General

(Left) Wheatstone's A B C "step-by-step" transmitter as used about 1839. (Below) Wheatstone's A B C telegraph instrument — about 1840.

Considered to be suitable for the purpose of tuning up faulty receiving apparatus, the letter "V" (three dots and a dash) has always been used since the birth of morse keys and sounders.

Early Needle Instruments

You might perhaps think that machine telegraphy—such as teleprinters—displaced morse within the last decade; and you would be right.

"Then why raise the point?" you will ask. Well, since 1844, the astounding fact is that morse and machine have been indulging in a thrilling neck-and-neck race. For in that year a *printing* telegraph operated between Nine Elms and Wimbledon—a distance of six miles.

And it was only seven years previously that the first electrical telegraph worked between Euston and Camden Town, spanning one and a quarter miles. This "model" used five wires. An earlier piece demanded 35!

Five needles, however, were sufficient to convey telegraphic sense on the Euston-Camden Town line.

The wires were laid in grooves in baulks of oak and slips made from the same tree secured the baulks. This was satisfactory as long as the ground kept dry, but when it rained, trouble started. Insulation failed and rendered the system useless.

Early in 1840, however, the double needle replaced this instrument, and elaborate and sometimes highly polished cabinet work encased these early pieces of apparatus. Shorter needles introduced in 1862 were responsible for an increase in speed from seven to 45 words in five minutes!

Signals were transmitted by means of handles—one for dashes, the other for dots.

Prior to 1864, M. Bonelli, of Turin, invented a telegraph which printed the message in roman type. Roughly speaking, the types were set up from a fount in much the same way as an old-time compositor would operate. Five metal teeth, connected with copper wires, passed over the type and sent out currents.

At the other end of the line, a strip of paper, steeped in chemical solution, passed under five metal points. The sending telegraphist was responsible for producing very fair imitations of roman characters on the strip of paper. The system worked successfully between Liverpool and Manchester, and Paris and Boulogne.

By courtesy of the Postmaster-General.

Pollak-Virag Telegraph

We now come to the year 1898, when about 600 words a minute were transmitted by the Pollak-Virag telegraph.

The writing of the original apparatus was in morse characters, and consisted of curves above and beneath a central line which represented the conventional "dots" and "dashes" of the telegraphic alphabet. Of course, it required the services of a skilled telegraphist, but because of this the inventors concluded that their rapid telegraph was "too fast." Nothing daunted, however, they set about making the machine write in ordinary Latin characters, and by 1900 were able to announce that they could transmit written characters readable to the man in the street at the rate of over 30,000 words an hour! They were eventually able to send 40,000 words an hour, or nearly 700 words a minute!

The Pollak-Virag instrument actually worked between London and Glasgow at a speed of over 600 words per minute. But beyond a trial between London and Paris, for some reason, nothing more seems to have been heard of this marvellous speed apparatus.

Time marched on, and with it the struggle for telegraphic supremacy became more acute.

The Telewriter

Although its use has always been very limited, we must not forget yet another spectacular piece of work called the telewriter. The instrument is exactly what its name implies—a writing telegraph—and it is very simple to operate.

By courtesy of the Postmaster-General

Single needle telegraph instrument—1819.

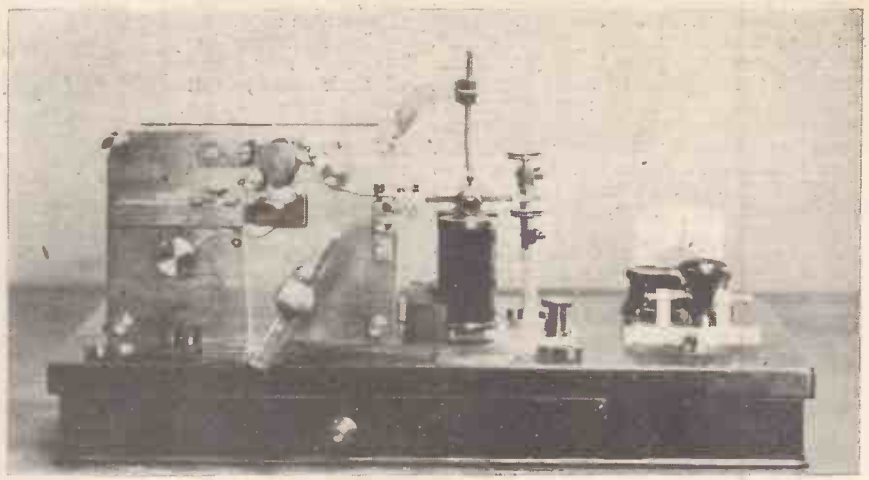
VELOCITY

Description of Instruments

Using a stylo attached by metal arms to the body of the apparatus, the sender writes on paper which covers an electrically charged plate.

At the receiving end, a pen, also supported by metal arms, reproduces exactly what the sending operator is doing—writes, scribbles and draws. At the will of the transmitter, it even dips its pen in an inkpot, always following the action of the pen at the distant station.

Telewriters are controlled through an automatic exchange operated by a private company. The system does not belong to the Post Office.



By courtesy of the Postmaster-General.

Direct inker telegraph instrument—1854.

ABC Telegraph

All police stations were once interconnected by the ABC telegraph. Like the teleprinter, it was "untappable." The writer remembers visiting a station when about 12 years of age and watching a policeman operating one of these instruments. I gazed at him in wonder and awe, as he proceeded to inform the inspector that a certain gentleman was on his way to the station. After 34 years of telegraphic duties, this accomplishment, although still interesting, would not have such an effect on me to-day.

Incidentally, the ABC telegraph once functioned in the Post Office. Not so many years ago, the instrument could be seen at the C.T.O. One worked to Scotland Yard, and another to a well-known West End firm. The apparatus could also be seen in many a village post-office, where the postmaster was proprietor of the local store. On one occasion, one of these gentlemen received a visit from the Head Postmaster of the district. He (the sub.) was engaged at the moment on the telegraph instrument. The Head said "Good morning" and was proceeding to speak about some official detail, when his subordinate testily remarked, "Don't interrupt. Can't you see I have two or three messages in my head?"

Single Needle Telegraph

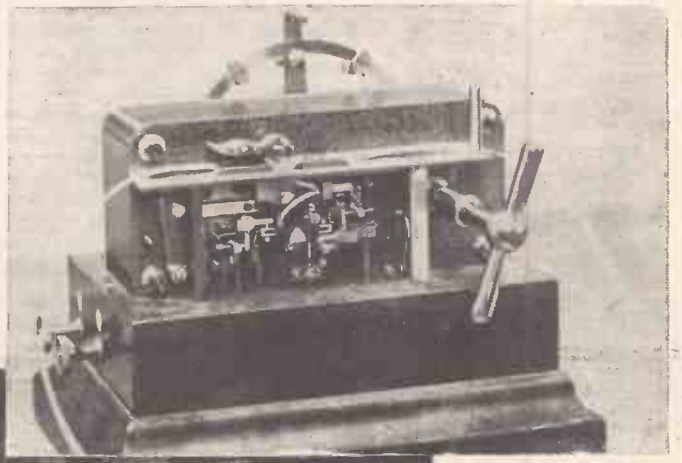
This instrument was also read at sight. The needle went to the left for dots and to the right for dashes. Signals were sent by a handle or tapper. Very often the clicking of the needle was sufficient for the telegraphist. He could hear the dots and dashes and wrote the message without looking at the instrument. This was a serious offence and strictly forbidden, until it was found that the operators could do their work more accurately that way.

Up to a short time ago all British railways made great use of the single and double needle, because of the large number of telegraph stations that could be worked on one wire.

Making a noise similar to a morse sounder, the double plate was more difficult to read. I could never understand the thing myself. The railways used this instrument quite a lot, and it was also used in the Post Office and South America.

The single current morse key was mostly used on telegraph wires that ran a short distance, or where there was not likely to be a lot of telegrams.

But if a wire connected a large town or city, a double current morse key would be used. Whenever the traffic increased, the operators would work duplex—that is, one sent and one received at each end of the line; four in all at the same time. Technical improvements eventually allowed for simultaneous despatch of a greater number of telegrams over one wire.



By courtesy of the Postmaster-General.

By courtesy of the Postmaster-General.

(Above) A Wheatstone transmitter of 1867. (Left) A Baudot operator gumming up a telegraph message.

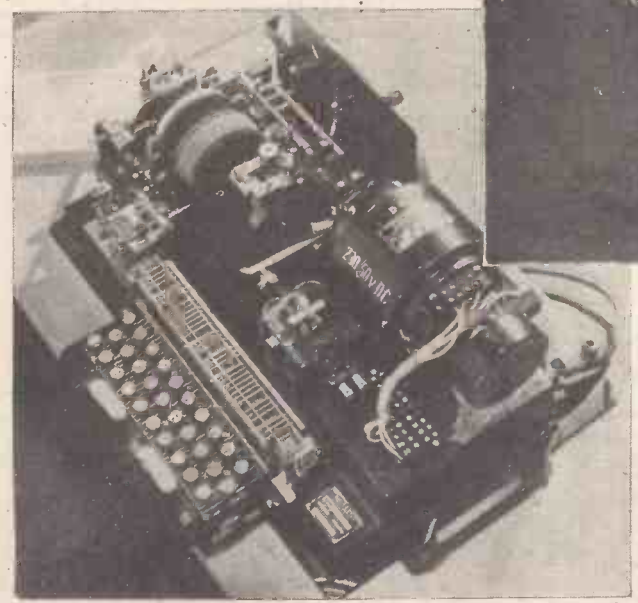
Thousands of Post Office operators have had to send 26 words per minute on the inker. This is a morse key connected to a recording tape. It showed us what our dots and dashes were like; good or bad.

Wheatstone Transmitter

Although it took only a few months to learn to send and receive at this speed, there were other jobs which had to be done before a telegraphist could be fully qualified. One of these little jobs was operating the Wheatstone instrument named after the inventor.

Before a message could be sent by this process, a slip had to be prepared. These slips were perforated by what were known as punching sticks and the stick perforator.

The operator, with a stick in each hand,



By courtesy of the Postmaster-General.

A modern teleprinter with cover removed.

perforated at a speed of 25 words per minute. The slip contained a number of messages or a long newspaper message. It might, therefore, be several yards in length. When completed, the slip could be run through a Wheatstone transmitter to six or seven towns which were on the same wire. The sticks were eventually replaced by pneumatic perforators. These instruments perforated as many as eight slips at once, so that the message could be sent to, perhaps, 48 places at the same moment.

At the receiving stations the signals came out in morse on a blue paper tape at anything up to a working speed of 200 words per minute through a Wheatstone receiver. The receiving telegraphist used to tear off every few messages, which were handed to another operator to write up into telegrams from the dots and dashes.

Creed Re-perforator

But another instrument took the place of this receiver. It was known as the Creed Re-perforator and Printer. Instead of being received as morse characters, a perforated

(Above) A Wheatstone transmission slip. (Right) An undulator slip for wireless or cable as received from a Wheatstone slip at the transmitting station.

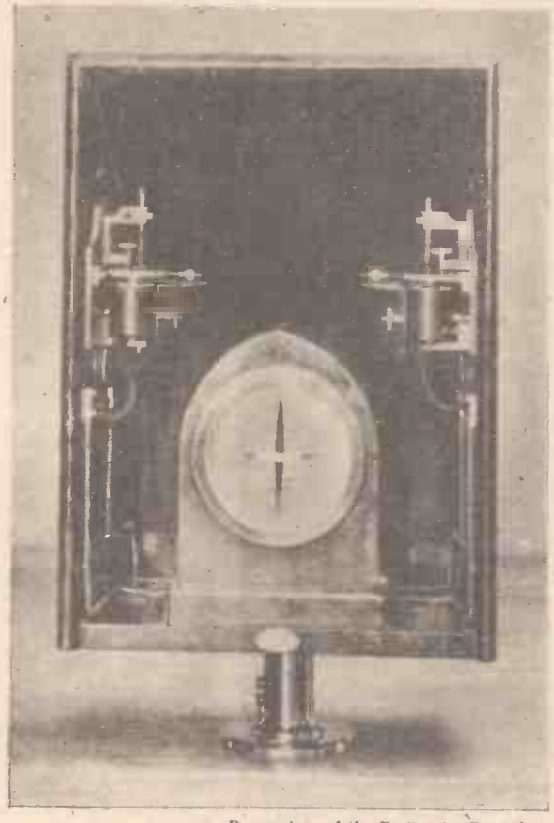
By courtesy of the Postmaster-General.

graphist was once astounded to know that "The Almighty has ordered two new bruisers." Had this been allowed to reach Fleet Street, the Admiralty, no doubt, would have felt flattered. Cruisers might very well be called "bruisers," too.

Some telegraph stations were not usually joined up to each other. Sometimes one had a lot of messages, or a long message for another, and they were then connected by means of a repeater. This saves a lot of time, as the messages did not have to be taken off and sent again. It also released two operators for other duties.

Band of Transmitters

About 50 years ago morse operators were introduced to a marvellous instrument which is not worked on the dot and dash



By courtesy of the Postmaster-General.

A double plate sounder of 1836.

Wheatstone slip came out. This was put through the printer and the messages were then printed in roman letters and figures on another piece of slip, which was gummed on to a telegraph form.

In their turn the pneumatic perforators were gradually replaced by machines which looked like typewriters. This seems to have been the inventor's idea—to turn everything into a typewriter. Thus, we had an instrument called the Kleinschmidt, and then the Gell, to perforate the Wheatstone slips.

Morse telegraphists have been very proud of their work, and some were better operators than others. A few could send 42 words per minute, and some have written this down from a sounder.

Humorous errors have often occurred through the morse, but, fortunately, the messages have always been corrected before they reached the addressees. A tele-

By courtesy of the Postmaster-General.

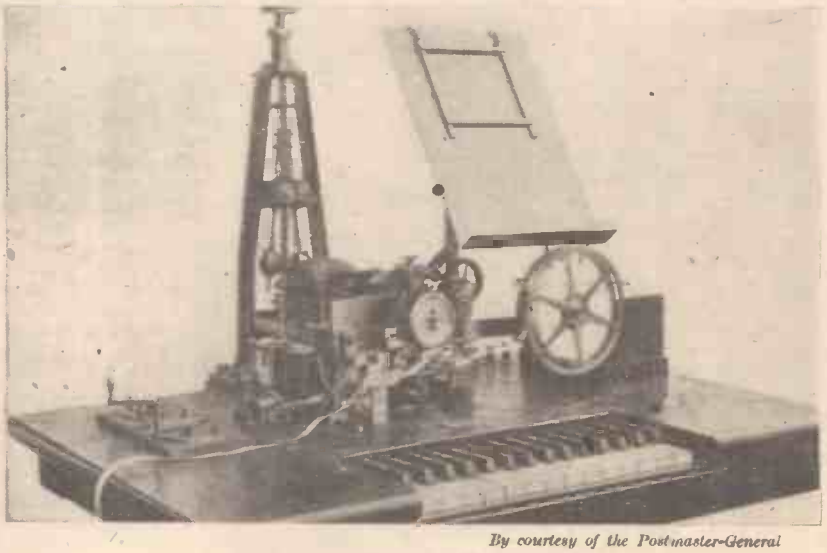
The Gell perforator telegraph instrument of 1906.

principle. It was invented by a Frenchman named Baudot, and eight operators can work this instrument at each end of the line, apparently simultaneously. In appearance it is like five piano keys. The operator pushes these keys down with the first, second and third fingers of the right hand, and the first and second fingers of the left hand. The instrument itself is controlled by what is called a distributor, which sends a cadence to each key. The distributor is made so as to deliver the cadence at different moments, and the operator must keep time with the knocking every time he sends a letter. Many hundreds of these cadences are put to each key per hour, and the operator can send 60 short messages in that space of time.

The Teleprinter

Morse, Wheatstone and Baudot have gone to make way for the teleprinter, which is now the chief instrument for sending and receiving telegrams. An operator must be able to send 70 messages per hour. The received messages are printed on a tape, and this is gummed on to a telegraph form.

Old-timers are proud that the letter "V" in morse has been ingeniously used as a simple yet most effective piece of propaganda.



By courtesy of the Postmaster-General

Hughes' printing telegraph instrument.

The World of Aviation

New American Fighter : Plastic Trainers : The Heinkel 113 : All-Canadian Training : An Amphibian Aircraft

Lysander 'planes dropping containers by parachute to advancing troops. These containers hold ammunition and other supplies.

New American Fighter

SPECIMENS of a new Rolls-Royce Merlin aircraft engine in large production at the Packard Works in America have arrived in Britain, and have won approval from the experts. This is one of the first practical results of the interchange of blue-prints between British and United States aircraft industries. The engine is similar to that in production here. Big contracts were placed for the production of the engine in America. According to American reports, one of the first 'planes to be equipped with the engine is the Curtiss Hawk P40F—the new fighter recently disclosed by the United States War Department. This machine is a development of the Kittyhawk. The new Rolls engine has increased the speed of the Curtiss Hawk P40F by at least 50 miles an hour. The 'plane has also more formidable fire-power and a higher "ceiling."

Twin-engined Fighters

AN aircraft which has attracted the attention of designers for some time past is the twin-engined fighter, the Westland Whirlwind. This machine has four cannon and a reasonably good range. Both in this country and the United States the twin-engined fighter has always been regarded as offering certain special advantages. These advantages consist of suitability for night work, great range, and to the carrying of a heavy load of cannon armament. Another twin-engined fighter is the Bristol Beaufighter, which is not so fast as the Whirlwind, but instead it has more powerful armament and a greater range. Also, we must not forget the Lockheed Lightning twin-engined fighter, which is in production in the United States.

The Lancaster Bomber

A MACHINE which we will soon be hearing a lot of is the Lancaster bomber, which is now in quantity production in Canada. Little is yet known about this bomber, but it is considered to be the fastest of the heavy bombers. As they are produced these machines will presumably be flown across the Atlantic to this country.

The American Mustang

A NEW American machine which is now in operation with the R.A.F. is the Mustang. It is a single-engined fighter fitted with the ordinary bicycle and tailwheel undercarriage. The radiator of the Mustang is situated under the centre part of the fuselage.

Plastic Trainers

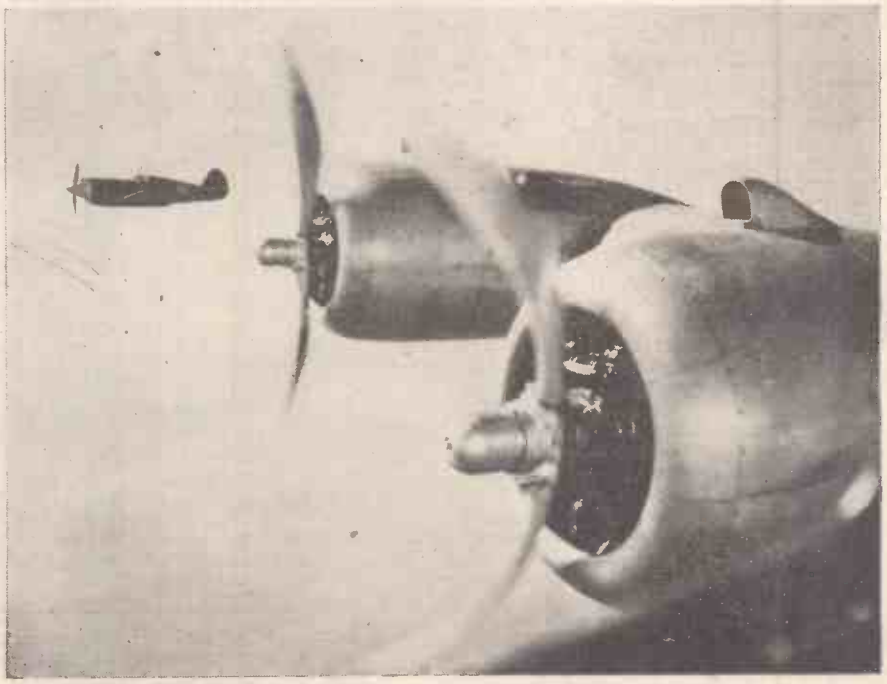
TRAINER aircraft made entirely of moulded plastic plywood are to be turned out at the rate of 500 a month by the Langley Aviation Company of America and other U.S. aircraft firms. Very great economy in price and quickness of construction will be effected by using the plywood. No nuts or bolts are required in the assembly, and America has an unlimited supply of the necessary wood. The result should be a strong and efficient primary trainer. Twin-engined machines of this type have been tested over New York with complete success, and the Langley firm has an ambitious programme for a post-war switch-over to private aircraft of this build to sell at less than £200 each. The "moulded" trainer will be used both by the U.S. Air Force and the R.A.F.

Woman Test Pilot

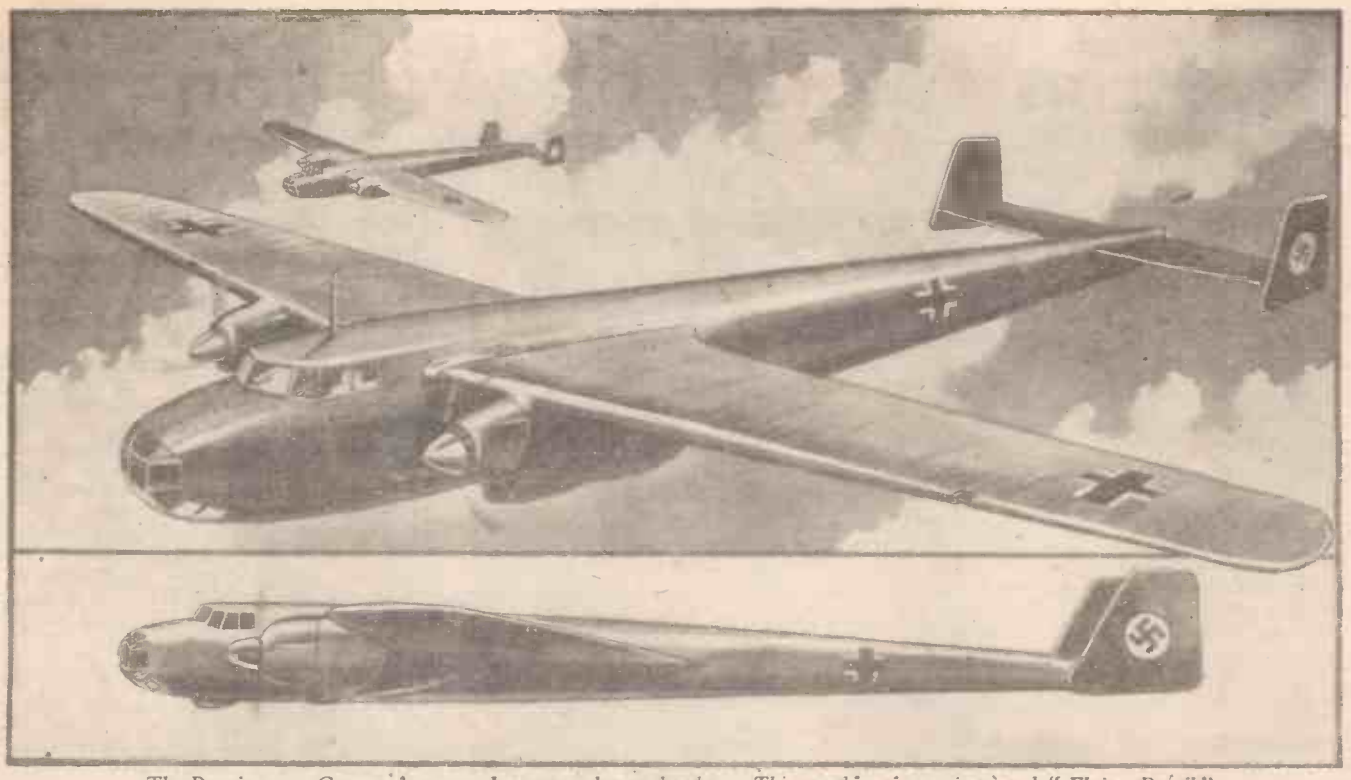
MISS ALMA MEFLIN, of New York, is the only woman test pilot in America. She tests the 'planes of the Piper Aircraft Corporation before they are passed on to the U.S.A. army. To-day she has more than 1,100 flying hours to her credit, and has, for a while, held the altitude record for small aeroplanes, one of which she took 21,050 ft. over the Rockies.

New Machine for Luftwaffe

ACCORDING to official reports the Heinkel 113 is considered one of the best machines in use with the Luftwaffe. It is said to have a speed of nearly 400 m.p.h., and its armament consists of two cannon and two machine-guns. This otherwise good machine is vulnerable to wing hits, however, where its cooling system runs. All German fighters now carry the formidable new Mauser cannon, possibly the best cannon in the world except for the Russian Schpitalmy tank-busting cannon.



A close-up view of the two starboard engines of the Douglas B-19 bomber. Each engine develops 2,000 h.p.



The Dornier 217, Germany's newest long-range heavy bomber. This machine is an improved "Flying Pencil," having a range of 4,500 miles and a speed of 300 m.p.h.

The Versatile Hurricane

OF all the fighters now operating in this war the Hurricane must be considered the most versatile. These fighter-bomber machines with their terrific fire-power have accounted for more enemy aircraft than any other type now in service with the R.A.F.

Torpedo Bomber

MR. A. V. ALEXANDER has stated that a new type of torpedo bomber is now coming into active production. It is a successor to the Swordfish and the Albacore, but is much faster than either of these machines. It is thought that the new machine will operate from aircraft carriers.

All-Canadian Training

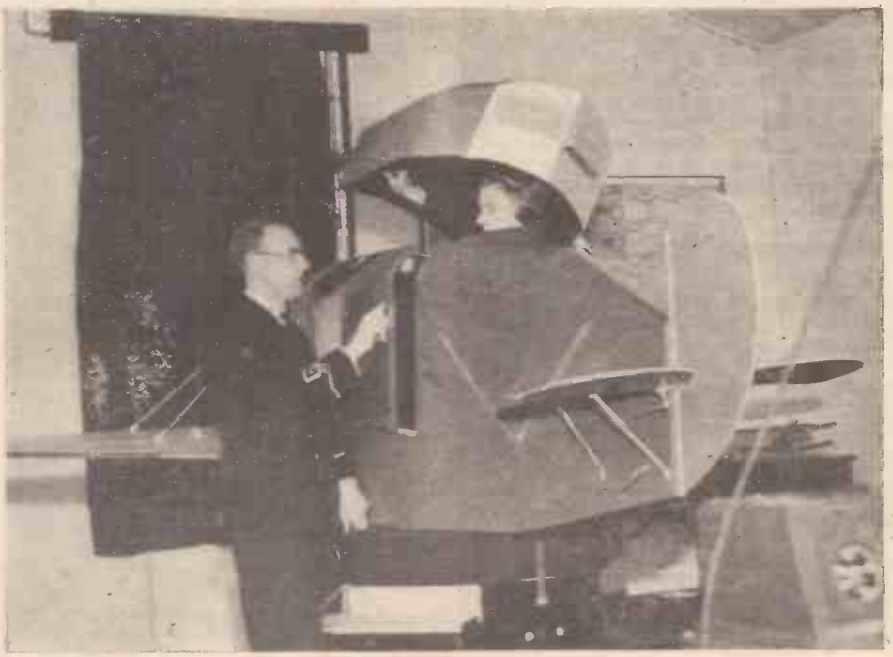
THE first all-Canadian advanced trainer to be built in any quantity in Canada is the Fleet 60, which is now known as the Fort. No doubt, the 'plane gets its name from Fort Erie, where these machines are being built by the Fleet Aircraft, Ltd. The Fort is of all-metal construction, and is a two-seater low-wing monoplane. The rudder, fin, flaps and ailerons have fabric coverings and the machine has a fixed undercarriage.

An Amphibian Aircraft

THE Goose, which is the R.A.F. name for the Grumman G-21B, is one of the few amphibian aeroplanes operating in this country. It is a high-wing monoplane with a wing span of 49ft. and has a maximum speed of just over 200 m.p.h. It is used by the R.A.F. as an ambulance for Air-Sea Rescue Service. It has a crew of four, is armed with two machine-guns (one fixed, the other mobile) and bomb racks can be fitted under the wings. This machine is also used by the Royal Canadian Air Force for coastal defence work.

Examination of Aircraft Parts

ENGINEERS were not slow to realise the value of X-rays in the examination of metal parts, and this technique is now quite common to arger manufacturers. The latest development is the installation at the Triplett and Barton Laboratories, U.S., of fully automatic units, to examine as a routine the castings used in Lockheed Hudson 'planes. Four machines are in operation, and radiograph 20,000 castings a day, mainly light alloys, such as those of aluminium and magnesium. The castings pass on a conveyor table under the X-ray beam, the latter unit being raised and lowered by a robot control to deal with each casting separately. The movement of the parts being examined is synchronised with the switching on of the beam, one negative a minute being produced. This mass examination technique has made it possible for Lockheed designers to legislate for more castings in their 'planes, an objection in the past being the difficulty of checking up on every small part for freedom from flaws. Ordinary inspection would not be able to detect internal flaws, at least not without a detailed examination. Steel and bronze parts which are too bulky for the automatic units are taken to manually-operated X-ray machines. But to examine castings of deep section it is necessary to use X-rays of considerable penetrating power, and with this object in mind the above Laboratories have installed a 440,000-volt X-ray outfit.



A naval airman receiving instruction in the Link Trainer, a device for training a pupil airman on the ground, under flying conditions. The Link Trainer is a safe method for teaching blind flying, and a naval airman can learn the rudiments of this art before he takes to the air.

THE AIRACOBRA

The U.S. Army Air Corps' newest fighting 'plane, the Airacobra.

THE illustration shows the newest fighting 'plane of the United States Army Air Corps—the Airacobra. It is manufactured by the Bell Aircraft Co., of Buffalo, N.Y., and is designed for a speed of 400 miles per hour at an altitude of 36,000ft. In addition to four machine-guns, the 'plane carries a 37 mm. cannon firing high-explosive shells, and all are operated automatically by a push-button in the pilot's cockpit.

Seven years ago the Bell Aircraft Co. laid it down as a policy that powerful cannons were necessary to give decisive fire power to single-engine defensive fighters. Centre-line firing—firing through the nose of the 'plane—is the most accurate method, and so in the Airacobra the cannon is rotated where the engine is normally placed. The exceptional speed, the firing power of the 37 mm. cannon added to six of the usual .3 and .5 calibre machine-guns, the adaptability to volume production and many other features have proved the sound design of the Airacobra. The machine is being made for the United States and the British Air Forces, and it is appropriately known as the "Cannon on Wings." It will be seen from the photograph that the pilot has excellent vision, and tests show that the 'plane is easily manœuvrable, and that a high degree of streamlining has been adopted. It is fitted with tricycle landing gear which was pioneered in this country and developed more recently by General Aircraft, Ltd.

The Airacobra is the American counterpart of the latest Hawker Hurricane and Typhoon, which are fitted with cannon. Other details of the machine are not yet released for publication. It is expected that technical details will soon be available.

Efficient Gas Firing

A Brief Description of Turbulent Burners

FOR the gas firing of furnace settings of all types, large and small, in the engineering and metallurgical industries, whether using producer gas, coke oven gas, blast furnace or town gas, of outstanding value for economical working are the range of latest design "Gako" turbulent burners supplied by Liptak Furnace Arches, Ltd., of London (68, Victoria Street, S.W.1). These are available in a considerable number of sizes and modifications, although the basic principles of the design are the same.

Essentially they consist of separate and independent valve control of the gas and air supply, which are also split up in the burner into a number of independent thin layers or streams, each of which is given a twisting or whirling motion by means of spiral guides or passages. The result is an extremely intimate mixing of the gas and the air with rapid completion of the combustion, giving a short globular flame with high CO_2 and little excess air. Another feature is that the operation is under low pressure conditions, generally, 2–4in. w.g., which eliminates all "stratification," that is, non-uniform furnace temperature.

Simplicity and Accessibility

Special features of all the designs are the simplicity and accessibility, with no moving parts of any kind, while all that is necessary is to open a hinged door for cleaning and full inspection without disturbing the burner casing and the pipe connections. Because of the design, resulting from extensive experience of a large number of installations, two gases also of different qualities can be burned separately or together, such as town gas, coke oven gas, producer gas, and blast furnace gas. Cold or preheated air can also be used, either at atmospheric pressure or slightly above, say up to 4in. w.g., already mentioned.

It is emphasised that no one design of burner will give the best results for all furnace conditions, and the main advantage of "Gako" construction is the range of modifications available, one or other of which will give maximum efficiency for specific installations. In this connection the long experience of the firm is also particularly valuable.

Another important development is the introduction of automatic control equipment including an integral electric motor supplying the low pressure air, which gives not only extremely efficient combustion of the gas, but enables both the latter as well as the air to be automatically regulated without difficulty, varying the speed of the motor and degree of opening of the gas supply valve. Automatic operation can be controlled by the temperature at any specific point in the furnace setting, and also in the case of steam boiler plant by the pressure.

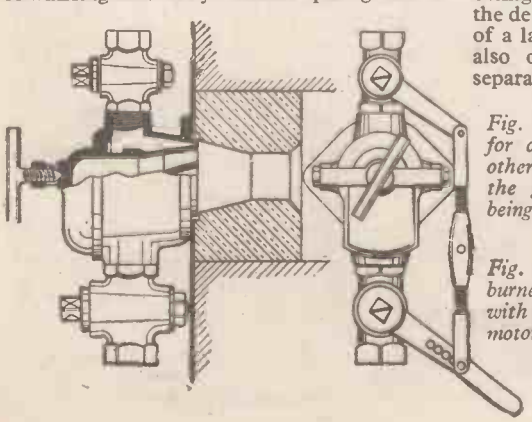


Fig. 1 (Left).—A "Gako" burner for coke oven gas, town gas, or other gas and pressure air supply, the gas and air control valves being connected together by linkwork.

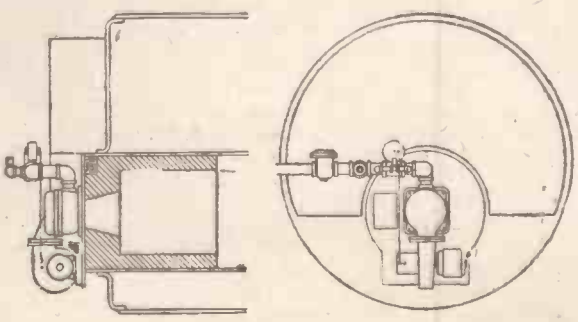


Fig. 2 (Right).—A "Gako" gas burner of the forced draught type with automatic control and integral motor-driven fan for operating steam or hot-water boilers. (Liptak Furnace Arches, Ltd., London.)

The Steam Engine

Its History and Development

WHILE the principle of converting the potential energy of steam into mechanical power, by means of a steam engine, remains the same as it was in the days of Richard Trevithick, there has been a steady improvement in the design of this power unit over the intervening two centuries. The reciprocating piston and the crankshaft is still there, but to stand in front of a modern high-speed engine is to realise how much headway has been made; it is silent, smooth, and offers no external indication that steam is the source of power. One sometimes associates little jets of escaping steam with steam engines, and, indeed, leakages past the piston rod or from valves have not been an uncommon feature of them, but imperfect gland packings are signs of inefficiency in other quarters to-day, and can hardly be attributed to the design of engine.

That the steam engine should have been invented by a British subject is not surprising, and its development in a country where coal is indigenous is natural. Nevertheless, one may be excused for thinking that better use could be made of our coal supplies in the generation of steam and its use for mechanical power than has been the case, and steam engines should not be allowed to make way so wholeheartedly for diesel power. It is possible that the plentiful supply of fuel may have taken away some of the incentive to greater efficiency in steam generation, and made low-pressure steam rather more commonplace than it should have been in Great Britain, but in later years much progress has been made towards tightening up the outlook in this field.

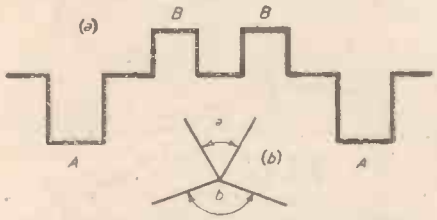


Fig. 2.—Diagram of a crankshaft for a four-cylinder unit.

To-day the British steam engine ranks among the best in the world, both for design and workmanship.

Basic Principles

One may be excused for being at first puzzled as to how steam operates an engine, until it is realised that the former is really energy in, as it were, gaseous form. To convert water into steam a considerable amount of heat must be put into it, and the heat, which is a form of energy, passes into the molecules of water, and causes them to vibrate and expand. So one can think of steam as molecules of water which have acquired a considerable amount of energy. There is a tendency for these molecules to revert back to their liquid state, or contract to water again. Thus, if steam is brought into contact with a cool surface the agitated molecules give up their energy to that surface in the form of heat, and revert to the contracted state; that is to say, they condense to water. It is not difficult to regain the heat-energy from steam, in the *sensible* form, in this way.

But in the steam engine the heat is not recovered completely, but only in part. Let us assume that the steam enters the cylinder at 400 deg. F., or 235 lb. per sq. in. pressure. Now that pressure will drive the piston down in the usual way, and in doing so it will, naturally, expand, the idea being shown diagrammatically in Fig. 1. When a gas—and steam may be considered as a gas—expands it cools, and so the steam falls in temperature. In effect, it has lost some of its thermal energy, that energy being yielded up as internal

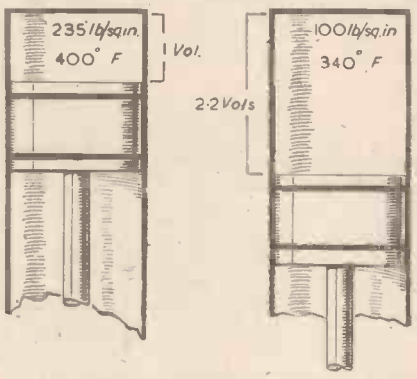


Fig. 1.—Diagrams representing the expansion of steam in a steam-engine cylinder.

work. In this way the potential energy, or heat, is translated into work. If the expansion has resulted in a drop in steam pressure from 235 lb. per sq. in. to, say, 100 lb. per sq. in. gauge, the theoretical fall in temperature would be about 60 deg. F. In practice the amount of heat lost would depend also on the rate of conduction away from the cylinder, and such factors as the piston stroke and speed.

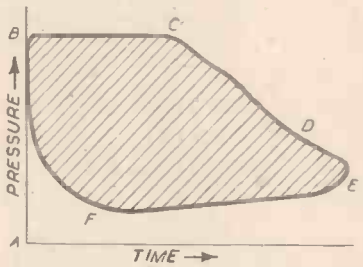


Fig. 3.—A typical indicator diagram.

General Types

Steam engines fall roughly into two major classes: vertical and horizontal. The former are often of the high-speed type, and smaller than the horizontal ones. These two broad classes can then be subdivided into single-cylinder engines, compound, tandem-compound, and, a later development, the Uniflow engine. The steam may have its energy extracted more fully by what are called triple and quadruple expansion engines, which, as their names imply, expand the steam in three and four stages respectively. This enables as much of the energy to be utilised as possible, the steam being brought down to a low pressure for condensing to atmospheric pressure and return to the boiler as water. Reference to condensing brings one to a further division of engines into condensing and non-condensing types. The former pass the exhaust steam through a cooling device, and so enable it to go back to the boiler, thus conserving water, while the latter pass the steam into the atmosphere or to a process, without attempting to recover the water. The non-condensing engine usually consumes up to 50 per cent. more steam than the condensing type. Reference to the Uniflow engine will be made farther on in this article.

Some Design Considerations

Certain types of engine are more suited to particular work, although they may not offer the best mechanical and thermal efficiency. Thus, for rolling mills, simple or tandem compound units are often employed, while for the generation of electricity small, high-speed engines are clearly indicated, it being presumed that the dynamo set is not large. This type, where it is a compound engine and fitted with Corliss valves, is highly efficient. Then again, certain types of valves are more suited to work of one class than another. There are poppet, slide, piston and Corliss valves, all of which may possess their own special advantage. The valve is a very important part of any engine, for it can make or mar efficiency, as will readily be understood. It is not sufficient to arrange for steam to be admitted to a cylinder and to drive the piston. The steam must have an unrestricted outlet, and it is here that the valve must operate cleanly, have a quick response and, of course, show minimum wear with time. Much thought has been devoted to this aspect of engine design, particularly with high-speed units.

It is not possible to do more than glimpse at the problem of engine design, and by way of example, the crankshaft of, say, a four-cylinder unit will be considered. Clearly, if four cranks arranged as in Fig. 2 are allowed to rotate there will be primary and secondary forces to deal with as well as couples. These can be balanced by arranging for the crank weights A to bear a certain ratio to the inner crank weights B. The cranks will be arranged so that they make angles with each other as shown in Fig. 2 (b), which is an end view of the crankshaft. In addition, there will be an optimum distance between each crank or web along the crankshaft. When balanced, with the pistons also taken into account, an engine should run with little or no vibration, and where the latter is present to any extent it is an indication that insufficient attention has been given to the matter, although to-day, sufficient is known about the subject to enable designers to produce quite smooth-running engines, even at high speeds.

In slow-speed horizontal engines the problem of balancing crankshaft and piston tends to be simpler, but, owing to the greater masses involved, care has to be exercised. For large pistons of long stroke it is usual to provide guides for the piston rods, called crossheads, while slippers and guideways can also be brought in to help in the smooth functioning.

Fig. 4.—Section of a slide-valve.

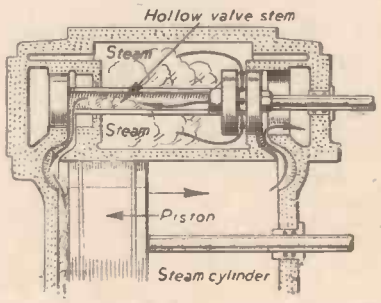


Fig. 5.—Sectional view of part of an engine cylinder showing a piston valve for controlling the distribution of steam.

How Efficiency is Measured

Generally speaking, the thermal or overall efficiency of an engine is measured by the ratio of steam input to power output. The mechanical efficiency ranges between 70 per cent. and 90 per cent. approximately, which represents the ratio of brake horse-power to indicated horse-power. The latter can be obtained from an automatic record of the pressure cycle in the cylinder, and a typical indicator diagram, as it is called, is shown in Fig. 3. The steam is admitted to the cylinder at a particular pressure, represented by the height on the graph, or indicator, AB. The piston is driven forward, the inlet valve being open, and the pressure remains sensibly constant to C. The valve then closes and the piston is driven forward by the expanding steam, which is unable to make its escape. The expansion brings about a fall in pressure as seen from C to D, when the exhaust valve opens. The pressure now falls to a minimum value at E, when the exhaust stroke proper begins, the pressure remaining at a roughly constant low value until the exhaust valve closes at F, when the inlet valve admits a new charge of steam for the next cycle. The pressure rises rapidly to the maximum steam pressure being used; that is, back to B, for the whole process to be repeated. The area of the enclosed space of the indicator diagram so formed enables the I.H.P. to be calculated. The record of these pressure variations is plotted or traced on a card by means of a pen actuated by a link, which is in turn connected to the cylinder of the engine.

Power

The horse-power developed by an engine is proportional to the stroke and diameter of the cylinder, the steam pressure on the piston and the number of strokes per minute. In other words, the calculated horse-power, or I.H.P., is expressed by:

$$\text{I.H.P.} = \frac{P\ L\ A\ N}{33{,}000}$$

where L=stroke, in inches, A=area of piston, in inches, P=pressure of steam, lb./sq.in., and N=number of strokes per minute, while the denominator is the conversion factor for these values into horse-power, one h.p. being equivalent to 33,000 ft.lb. per minute. It will be seen that size and speed are the objects for which to strive if power output is the main consideration, but both of these are limited by design. In practice it is often found that a small high-speed engine is more suitable than a larger, low-speed one, for the latter would not only entail greater cost to manufacture but would take up more room. The above equation holds for a single cylinder engine, but in a multi-expansion engine, that is to say, where the steam is fed into a succession of cylinders, each operating with a lower pressure than the previous one, the value of P is computed from the mean effective pressures in all of the cylinders.

Steam pressures vary according to the class of engine, and may be as low as 30 lb. per sq. in for single-cylinder condensing units up to hundreds of pounds for multi-expansion engines. The first, or high-pressure cylinder, will take steam at about the pressure of the boiler in which it is generated, and the intermediate and low-pressure cylinders may bring it down to one-half and one-third respectively. Thus, if the boiler pressure is 200 lb./sq.in., the low-pressure cylinder would receive steam at about 75 lb./sq.in.

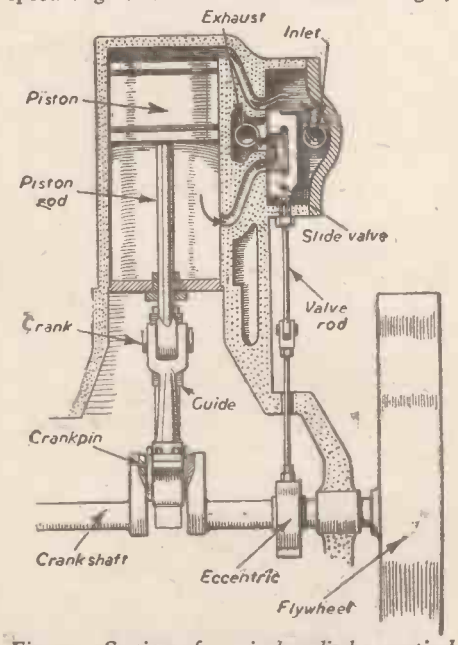


Fig. 7.—Section of a single-cylinder vertical steam engine, showing the chief working parts.

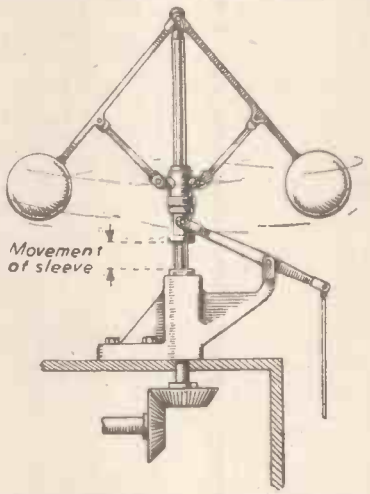


Fig. 6.—The Watt-type governor, now superseded by the spring-loaded governor.

Valves

Reference has already been made to the importance of the valve in an engine. The three commonest types in use are slide, piston and poppet, the Corliss pattern also being widely employed. A typical slide-valve is illustrated in Fig. 4 from which it will be observed that, by one member or face sliding over the other, the steam port is exposed. This design offers the advantage of simplicity and ease of maintenance, but its fundamental characteristics sometimes preclude it from use on high-speed engines, although no general dictum can be given in this respect. A piston valve is shown in Fig. 5, which explains itself. The Corliss pattern may take more than one form, and may consist of a cylindrical valve face or a disc type, but its operation is characteristic, in so far as the valves are opened and closed by an eccentric, the closing of the inlet, however, being effected by a trigger mechanism.

Governors

Before discussing engines themselves a brief mention should be made of the governor, which is intended to regulate the speed of the piston. In effect, it is a device that throttles the steam when the engine speed passes a pre-arranged figure, and if the inlet pressure should fall slightly it opens the steam supply valve to compensate. The earliest kind of governor employed the centrifugal principle, in which the engine was linked to a pair of balls arranged as in Fig. 6. The higher the speed the farther out would move the balls, and this would result in the collar being raised. This collar, being attached to a further linkage, would actuate the supply valve. The Watt governor has been modified since its introduction, to make it a sensitive piece of equipment, but the principle remains. Other designs have been adopted in more recent years, but space forbids a description of them.

Some Engine Types

Having discussed some of the essentials of a steam engine, we can now examine the engine itself. As stated above, there are many classes and types and, for convenience, only three will be referred to, including the Uniflow, which embodies original ideas. A simple, single cylinder unit is shown in section in Fig. 7, from which the resemblance to an internal-combustion engine will be quickly apparent. The piston operates a crank, which is coupled to a flywheel. In modern engines of this type, usually high-speed, lubrication is effected by filling the crankcase with oil, and feeding the lubricant to the cylinder by splash. Another method is to inject the lubricant into the inlet steam line, by means of a special lubricator, which atomises the oil, or breaks it up into fine droplets, so that it is swept by the steam into the cylinder. Nowadays the steam fed into a vertical engine is usually superheated, and cylinder jackets, as in the internal-combustion engine, are seldom employed. The idea of the jacket is not to cool the cylinder, as with the petrol unit, but to keep it hot and prevent condensation. This trouble is surmounted by the use of a high degree of superheat and the fitting of steam traps. In some instances the steam is led first of all around the cylinder, so that any condensate may be led away before the steam passes into the cylinder.

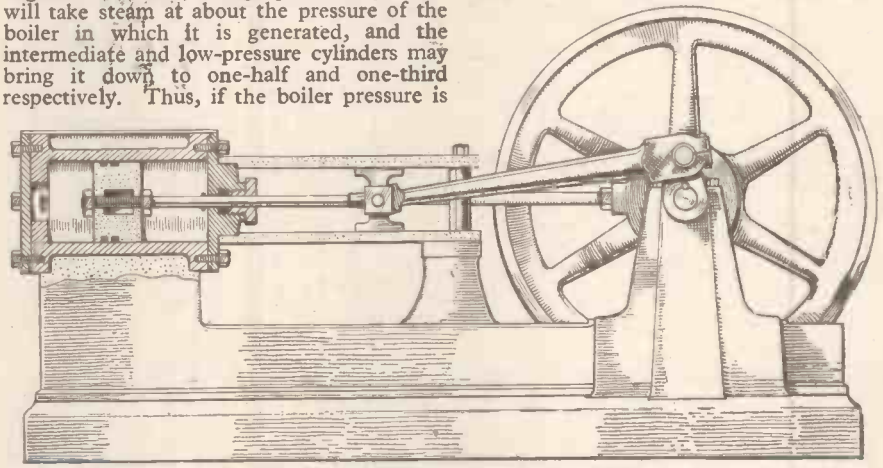


Fig. 8.—Part-sectional elevation of a horizontal steam engine.

Fig. 8 gives an idea of a larger horizontal engine, of the type widely used in the past. The connecting rod is supported, as it were, by a cross head, and slippers run along slides as the piston moves to and fro. The speed is often low, and whereas a vertical engine may run at 2,000 r.p.m., the larger horizontal engine will sometimes have a speed of only 50 r.p.m. Lubrication is carried out as a rule with drip oilers, and a feature of these slow-speed units is their longevity and freedom from maintenance.

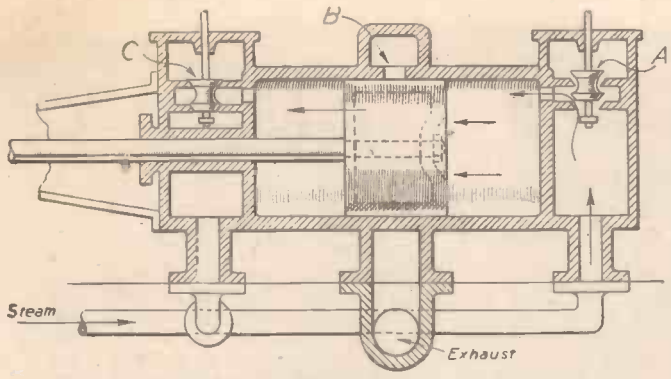


Fig. 9.—Section of the cylinder of a Uniflow engine.

The Uniflow Engine

This represents a new departure in design, and has brought about an appreciable increase in efficiency in steam power generation. In the usual type of engine the steam flows into the cylinder on the power stroke and is then pressed back over the same path and through the exhaust valve, on the exhaust stroke of the piston. In other words, the steam flows over the cylinder walls twice; when it is hot and when it has performed its work and is being exhausted. But in the Uniflow engine the steam flows in one direction only. This is obtained by having an inlet steam port at either end of a two-sided piston, as in Fig. 9. The exhaust ports are arranged around the centre of the cylinder wall circumference. The sequence of operations is then as follows: steam enters at the port or valve A and drives the piston forward, until it uncovers the exhaust ports at B, through which the steam makes its exit. At this position the piston will have completed its stroke, when steam makes its entry at the port C, and drives the piston back, until the exhaust ports at B are again uncovered, making its exit therefrom. It will be seen that the steam always flows in one direction; that is, from inlet to outlet, but never comes back over the same path. Hence, the name Uniflow for this type of engine. This arrangement makes for better exhausting and other features. The engine is characterised by its smooth operation, and a moment's consideration will show that, because the inlet ports or ends of the cylinder are never traversed by exhaust steam, they are always hotter and, likewise, the exhaust ports are constantly cooler. Such factors are reflected in a better thermodynamic efficiency; that is, a higher output of power for a certain input of steam. Another point about the Uniflow engine is that its indicator is not like that for other engines, but more resembling a diesel diagram.

Continued progress is being made in the field of steam power, and just as the Uniflow engine represents a step forward in engine design, so one might expect yet further developments. Coal there is in plenty in Great Britain, while the engineers also are indigenous, so one might reasonably expect that this country will maintain its lead in this field.

Points About Scissors

A Few Interesting Tests

THERE are many points about the construction of scissors which it is well to know if they are to be put to any special uses. A good pair of scissors will, of course, cut better than an inferior pair of the bazaar type.

Simple Tests

One of the first things to look for is whether the cutting edge on each blade is properly "set"; that is, it should "stand up proud," as the cutler calls it. Not only should the two surfaces of the blades that cross each other in the act of cutting be hollowed slightly, as arises from the curvature of the grinding wheel on to which they had been pressed, but in addition the edge can be "set up" by a blow from the setter's hammer, correctly given to increase the rising up of the edge.

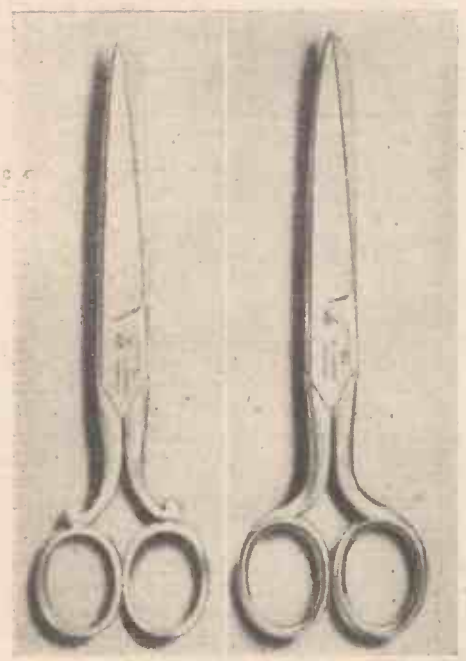


Fig. 1.—Two pairs of ladies' cutting-out scissors.

Hold an ordinary pair of scissors by one handle, vertically; open it by lifting the other handle, which you then release. The scissors will shut of its own accord, but the point of the test is, how far does it shut? A cheap pair of scissors will practically close itself, for the simple reason that the "binding" of the one blade upon the other is so slight, and loose, that the scissors close almost to the tip.

Try the test on a better make of scissors, and it will be found that the edges are in such contact, from the very start near the screw, that the scissors remain open. In other words, the cutting action has no slackness, due to the nature of the workmanship.

Sheffield-made Scissors

Fig. 1 shows two pairs of ladies' cutting-out scissors from a large selection made by an old-established Sheffield house, Christopher Johnson (Cutlers), Ltd. The firm's range includes scissors for all kinds of purposes, including hairdressers' scissors for gents or ladies, made from specially high-grade steel, with smooth, easy-working cutting edges. In the "C.J." mark, the firm have attained a standard in weight, shape, balance and cutting qualities equal to the best imported lines, so proving that Sheffield can produce a hairdressers' scissor of first-class merit.

In ordinary household shears, in the usual sizes from 4½in. upwards, the styles are in heavily plated nickel silver or in steel finish. The heavier type of shears, with cranked or straight japanned handles, runs from 6in. to 12in. overall, the largest size giving a 6½in. cut. Varieties in these shears give the option of nickel-plated blades or nickel-plated bows and shanks.

In Fig. 2 are shown two types of scissors; the Bodkin, distinguished by its round blade, and the Double Bow, used for heavier work where two fingers are needed.

Description of Parts

The following description should be noted with reference to the various parts indicated in the illustration.

Bodkin.—Type of scissors having one blade with rounded point.

Double Bow.—Large enough to allow two fingers instead of one. Chiefly in tailors' scissors for extra leverage.

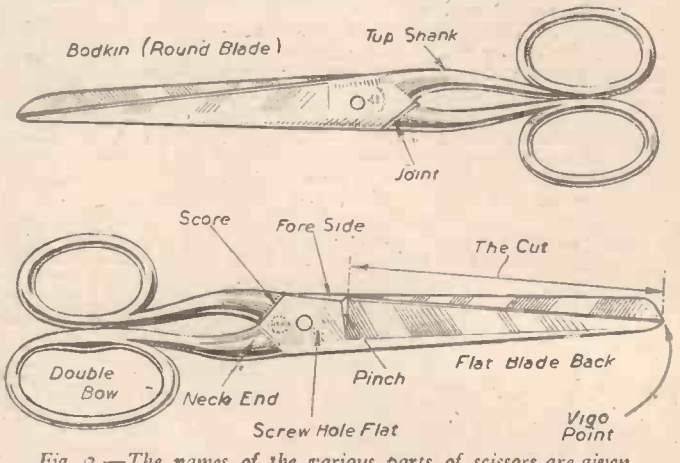


Fig. 2.—The names of the various parts of scissors are given in these illustrations.

Fore Side.—Bevelled edge of screw hole flat.

Neck End.—Where neck of shank joins the blade.

Pinch.—The step down between the screw hole flat and the thin portion of the blade.

Score.—A line or nick scored on scissors, sometimes with a file, to give a little decoration or relief.

Tup Shanks of scissors grow out of the blade to join the bows, like the horns of a tup or ram.

Vigo Point.—Straight or strong point. Probably from Latin: *Vigor*—strong. Chiefly used on tailors' and heavy scissors.

PHOTOGRAPHY

Improving Faulty Negatives

The Process of Reduction Explained

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

HAVING considered some methods whereby "thin" negatives can be improved by intensification, let us now turn our attention to the treatment of those which constitute the opposite class, namely, too "thick." This fault usually arises through over-exposure or over-development, and gives unsatisfactory prints lacking in tone or gradation; it is also advisable to include in this group those negatives strong in contrast which yield prints with a paucity of half-tones, and consequently of very little value for the making of pictorial prints.

Most amateurs will have some negatives which are so dense that they are almost opaque when viewed by transmitted light, and when attempts are made to print them it is found that either a very strong light or much time is required in the exposure to get even the semblance of an image on the paper, yet when the negative is held to a strong light and can be seen through, it is possible to discern an image which gives one the impression that it will or can produce a reasonably good print.

Howard-Farmers' Reducer

The conclusion is that it requires some general reduction; it has got to be made "thinner" so as to give the operator some means of making a print. For this work the most satisfactory formula is that known as the Howard-Farmers' Reducer, sometimes referred to by its chemical contents as the Ferricyanide formula.

There are two solutions required, and these are made as follows:

(1) Soda hypo, 2½ ozs.; water to make 20 ozs.

(2) Potassium ferricyanide, 2 ozs.; water to make 20 ozs.

This reducer is particularly fast in its action, and therefore has to be closely watched to guard against excessive reduction; further, the mixed solution will not keep for more than a few minutes at most, consequently it has to be prepared just when it is required for use. To prevent the action going too far the work should be done near a tap where running water can be used to flood the chemical solution from the surface of the film occasionally, in order to watch the progress. The effect should be noted in the shadow details as the action is slightly quicker on the weak deposits than on the denser parts.

Thorough Soaking Essential

As with all after-treatment methods the negatives to be reduced must be well soaked beforehand to ensure even action over the whole surface.

Take 1 oz. of the hypo solution No. 1 and add to it about 40 drops of the ferricyanide solution, No. 2. The colour of the mixed liquid should be yellow, about the depth of a lemon colour; pour this over the film and rock the dish, and at the end of 1½ minutes make an inspection. If not complete return the film to the dish for a short time and inspect again; when you are satisfied that the negative has been reduced sufficiently, wash for 20 minutes, then dry it by hanging it to a shelf.

Should you desire to speed the action of this bath it is only necessary to add more of the No. 2 solution, up to 60 drops; on the other hand, for slower work, reduce it to 25 drops, but always remember that the mixed solution does not retain its activity more than a few minutes.

It is quite easy to see when the solution is no longer functioning, for it changes its colour to a blue green tint, and at this stage it is useless; a fresh bath must then be made if more negatives are to be treated. Do not use the same bath for more than one negative.

Should you have the misfortune to fog a film, either through light or chemical action, and this fog is over the whole of the negative, then it is possible to make a considerable difference to it by treating it with this Howard-Farmers' Reducer. If the work is done carefully the fog can be so removed as to make the negative quite printable, but do not carry it too far, otherwise the image will also be reduced.

H. W. Bennett's Formula

The second method or formula is that known as the Persulphate Reducer, the most useful for those negatives which are termed "hard," because they give contrasty prints, patches of black and others of almost white, the shadows printing right out, while it is impossible to get anything out of the high-lights; it is these latter which have got to be reduced, so it is necessary to find a reducer with a selective action, and persulphate will be found to respond in this manner. It must be remembered, however, that it will also operate on the shadows if there is any silver image on which it can work. The formula which is given below is one that is known as H. W. Bennett's formula, and is generally accepted as the best. If made up as given it serves as a stock solution, and will keep for a long time, but for use you must dilute one part of this with one part of water, and in this diluted state it will not keep.

Formula: Ammon persulphate, 240 grains; soda sylphite cryst., 45 grains; acid sulphuric 10 per cent. solution, ½ oz.; water to make 10 ozs.

For a film 3½ by 2½ take 1 oz. of this solution, add 1 oz. of water, and having soaked the film for an hour in water pass it to the dish and pour the mixed solution on and watch its action. This can easily be detected, for a slight milkiness will appear, which is the result of the reaction of the persulphate on the silver image; at this stage it is very rapid, so, after a few seconds, remove and examine the film, and if you are satisfied that the reduction is sufficient, place the film in a weak fixing bath made up of hypo ¼ oz. dissolved in 5 ozs. of water. Leave the film in this for one minute only, and then wash it for 15 minutes in running water, and allow it to dry.

Most of you by now will have realised that it is not always easy to judge the density of a wet negative as to how it will appear when it is dry; this is apparently even more difficult when using these after-treatment processes. Therefore, a word of warning: do not be afraid to stop the work before going too far, for with most of the methods, certainly with those I have explained, it is possible to repeat the intensification or reduction if found to be insufficient when the time comes to print from the treated negative. If the reduction has been taken too far it is possible to intensify by the redeveloper process, and, in fact, some workers will, if a negative is too contrasty, use the persulphate reducer, and then intensify in order to put more body into the image.

A pleasing print from a negative after reduction.

Negative Dye

In one of the articles I made mention of a preparation known as Johnson's Negative Dye. I believe that with a bottle of this and one or two good brushes, say a number 00, 0, 1 and 2 sable hair quality, we can add to the work of reduction and intensification, or even at times dispense with those processes. Let me give an example: a negative which is contrasty yet has a fair amount of detail; in the ordinary way such a negative would want a bath of persulphate reducer, but if it was given only a very short time in this it would reduce those high-lights without affecting the shadows. When the film was dry it could be placed in the retouching frame, and with a very weak solution of the negative dye a wash could be placed carefully over the shadows so as to hold back the printing of these parts.

THE MONTH IN THE WORLD OF

Science and Invention

A sound-locator, with its crew of three, at an anti-aircraft station somewhere in England. One man works the course-finding bowl, whilst the other two listen-in on the large sound detectors.

Life-saving Suit

MR. THOMAS METCALFE, who is in charge of life-saving appliances, War Transport Ministry, has invented a bright yellow suit of rubberised material, which is claimed to have saved many lives at sea. The colour makes the wearer easily seen from rescue ships or aircraft.

New Type of Furnace

AN American engineering firm has marketed a new type of furnace for nitriding 10,000 tank track pins at a time. It is gas-fired and measures 38in. diameter by 54in. deep, ammonia gas being admitted through the cover. Losses due to radiation are cut down by circulating air at high pressure and speed. A specially-designed cylinder has the track pins stacked on it in five rows of 2,000 each.

A Flaming Bomb

THE Japanese are now using a new type of bomb. It is one which bursts in the air, and emits huge flames.

Magnetic Oil Filters

A MAGNETIC oil filter has been produced which effectively removes iron particles from lubricating-oil systems of internal combustion engines and reduction gears. The magnets, it is stated, are made of "Nipermag," an alloy of nickel-aluminium-titanum-iron. A series of grids, made from a high-permeability alloy, and between these magnets, are enclosed within a pair of bronze tubes, which are used to direct the flow of oil. Magnetic particles of iron flowing into the filters are held either on the magnets or on the large grid area, which is magnetically energised by the flux of the magnets. Cleaning is rapid and is facilitated by the fact that the grids become non-magnetic when removed from the proximity of the magnets, allowing the iron particles to be removed easily.

Synthetic Rubber

A NUMBER of well-known American rubber manufacturing firms have laid down plants for the production of 120,000 tons of synthetic rubber per year. In order to make this possible U.S. chemists are at present investigating the extraction of rubber from the cactus, which occurs very widely in the Southern States, and which, it is declared, could possibly yield vast quantities. A Mexican cactus plant called *lguayule* is being developed at experimental farms in Arizona, Texas and California.

Augmenting Petrol

APPARENTLY powdered coal is not of much use in augmenting petrol, according to an American scientist, who has carried out a number of experiments in this field. He found that there is a tendency to detonation with 2 per cent. of coal in the petrol, the particle size ranging from 1-74 microns, and an excessive amount of carbon and tar is formed in the cylinder. The engine tested was a four-cylinder unit running at 1,200 r.p.m.

Aircraft Armour

THE limitations on aircraft weight necessitate the armour plate being made as light as possible, consistent with effective resistance to projectiles. Thus, aeroplane armour, according to an *Air Ministry Abstract*, ranges up to 44in. by 44in. by $\frac{1}{2}$in., most of it being in $\frac{1}{4}$in., $\frac{3}{8}$in. and $\frac{1}{2}$in. thicknesses. Armour plate is essentially a nickel-alloy steel. It must be exceedingly hard on the exposed side; tough but more ductile on the interior side.

The requisite hardness is obtained by carburisation of the exposed surface. As much as 50 hours may be required for a complete heat for $\frac{1}{4}$in. plate. In the new Breeze process, three heats can be carried out in 24 hours. The carburising treatment is accomplished with a liquid salt bath in an electric furnace. This equipment enables the work to be charged and removed quickly, brings the plates up to the desired temperature quickly and makes accurate control of the temperature possible.

"Singing" Propellers

ACCORDING to an article in *Fairplay* it seems certain that the nuisance of the singing propeller—which was practically unknown until bronze propellers of aerofoil section came into general use for ships—is caused through vibration of the propeller blades. A device which is claimed to damp out the vibration which causes singing in the propeller blades consists of small flanges attached to the tips of the blades. It is also claimed to improve the propeller thrust by directing the column of water from the propeller straight astern.

New Type of Extensometer

AN extensometer, to measure the increase of length of small lengths of material subject to strain has recently been perfected. Four wires are fixed to the specimen, which are strained when the latter increases its length. Their electrical resistance alters as a result, and by employing a Wheatstone bridge and using a balancing arrangement in the wires, the extension of the specimen of as low as a millionth of an inch can be measured.

Steel of Tinfoil Thickness

AS aluminium is becoming increasingly short in America, the steel industry over there has produced a paper-thin high-tensile stainless steel for use in aircraft construction. It is similar in appearance to tinfoil, but has a tensile strength of 185,000 lb./sq. in. From official reports it is learned that it is three times as strong as the aluminium alloy now used for making aeroplanes. This paper-thin steel will not rust; is not affected by the degree of heat at which aluminium melts, and is twice as difficult to bend as duralumin. It has one drawback, however, as it is expensive, costing about £200 a ton, which is about twice as much as aluminium.

Automatic Welding

A FIRM of electrode manufacturers have recently taken out a patent for a new method of automatic welding. Plates to be joined have their edges bevelled in the usual way and a long covered electrode is laid in the groove. Over the joint is placed a heavy backing section, the protruding part of the electrode being accommodated in the longitudinal recess. A carbon pencil is used for striking the arc between the electrode and the plates, and the welding process continues automatically until the electrode is finished. It is stated that welds up to 30ft. in length can be made successfully by this method, the welding speed being about 1ft./mm.

Bridge Types

FOLLOWING the destruction by storm of the Tacoma bridge, American engineers are reviewing the designs of several other suspension bridges. From the official report it is evident that the bridge was too light and flexible to withstand aerodynamic effects, and the new bridge is to be wider and heavier, with higher towers and the bridge deck at a lower elevation. Two new types of such bridges have been developed by engineers of experience, and the United States Army engineers have developed plans for portable cableways for military purposes.

New Types of Electrical Gauge

THE General Electrical Company, Schenectady, have developed an electrical gauge for measuring the thickness of non-magnetic metals when only one side of the metal is accessible. Accurate to within 5 per cent., the gauge measures thicknesses up to 1½in., and can be used for measuring thicknesses of non-magnetic metals that are backed by magnetic metals.

Large Hydro-electric Plant

THE Grand Coulee Dam, on the Columbia River, in the State of Washington, has taken eight years to build, and is reputed to be the largest plant of its kind in the world. It is designed to supply power for operating huge water turbines connected to electric generators having a total maximum output of 1,974,000 kilowatts.

This power is furnished by 18 of the world's largest generators, one of which recently commenced to operate; it develops 108,000 kilowatts and will help to supply power for aluminium works and other industries in the north-west area of the United States.

It is significent that the lake formed behind the Grand Coulee Dam extends for 150 miles to the border of Canada; this lake will irrigate over one million acres of land which is now barren and dry.

Australian Tommy Gun

THE Owen gun, invented by an Australian, and being mass produced in Australia from Australian materials, has proved under thorough tests to be the best light sub-machine-gun of the war. With a lower trajectory over 300 yards, it is far more deadly than other sub-machine-guns, and fires with greater velocity, deeper penetration and less recoil. It is mud-proof and sand-proof. In tests it maintained a hail of fire when choked with sand and smothered with mud. Under parallel tests a Thompson gun stopped working and a Sten gun blew up.

The Owen gun can fire 30 rounds in three seconds. A flick of the finger gives either automatic or trigger control. Ingenious but extremely simple catches allow spent magazines and hot barrels to be replaced in an instant. The Owen gun weighs 10½ lb. and costs only a fraction of the price of the Thompson sub-machine-gun. The gun's inventor, 27-year-old Evelyn Owen, a mortar mixer before the war, was on point of sailing with an A.I.F. contingent when the value of his remarkable invention was recognised. Extreme simplicity and unequalled efficiency are the features of this revolutionary Tommy gun, which proves the vast Empire arsenal that is Australia can not only make war weapons equal to the world's finest, but can invent better ones.

Light Buoy

THOSE in peril on or in the sea have adopted many methods to attract the attention of passing ships. We have previously described in these pages a number of marine rescue appliances, yet another has now hove in sight.

The new apparatus is the device of an inventor who points out that he is aware of the existence of a lifebuoy with a self-igniting flare in which calcium carbide is employed as a source of gas which, when lit, provides both light and smoke. Consequently the signal is visible day and night. He mentions the fact that one objection to such a signal is that, owing to its self-igniting character, it is a source of danger to an inflammable cargo on the ship which is fitted with it. For that reason a signal device of this description is not permitted on vessels such as oil tankers.

Smoke Signal

THE inventor also acknowledges the existence of a buoy or float with an automatically operated electric light. While this certainly has the advantage of not being so likely to cause fires, it is practically invisible by day.

His idea is to combine with a float an electric light signal and a device for emitting smoke without producing externally a temperature tending to cause combustion of inflammable liquids and gases.

He mentions that, in order to make the smoke signal appear, various means can be adopted. For example, there may be contained in separate receptacles a strong solution of ammonia and one of hydrochloric acid. An arrangement may be provided to cause these solutions to mix automatically when the float is set adrift from a vessel. This results in heavy, dense white fumes which are easily seen by day. If preferred, there may be emitted nitrogen peroxide—a dark brown gas.

Illuminating the target. R.A.F. flare bombs—one of which is seen going into the chute—enable our heavy bombers to register hits on vital German targets at night.

The Owen gun can be fired either from the shoulder or hip.

Mechanical Tinker

THE travelling tinker is not now a common object in our streets. Nevertheless, we know one of these itinerant craftsmen who has passed the alleged allotted span. His workbench on wheels is refulgent with polished brass, and we have more than once entrusted a penknife to him, and in a few minutes its edge has been delightfully keen. But, as far as one branch of his work is concerned, he now has another rival in the form of an improved mechanical knife-sharpening machine. This is the production of an inventor whose aim has been to devise an effective knife-sharpener which is easy to work and one requiring little skill to manipulate expeditiously.

This knife-sharpener comprises a rotary-driven abrading wheel, the power being derived from an electric motor. There is a guide for receiving the blade of the knife and presenting the edge to one side face of the abrading wheel.

The machine is capable of adjustment by means of which the life of the abrading wheel is prolonged. It has few working parts and knives of different size and character may be sharpened.

The Fourth Dimension!

"Hyper-space" and its Perplexing Problems

A telescopic view of a star cloud far out in the depths of space. Journeying in three-dimensioned space, it would never be possible for us to reach interstellar regions, but by voyaging in the fourth dimension such a feat might one day become possible.

ACCORDING to mathematical conceptions, a *point* is merely a position in space. It has neither length nor breadth nor thickness. A moving point will generate a *line*.

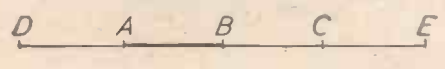
Now, a line has one dimension—that of length. It has no breadth, neither has it depth or thickness.

Surfaces have two dimensions, viz., length and breadth. A straight line moving parallel to itself may be imagined to trace out a surface.

A little reflection, however, will convince the reader that mere points, lines and surfaces are intangible things, for, after all, it is extremely difficult to imagine a point which has no dimensions whatever, or a line which is totally devoid of breadth. The finest pencil line which can be inscribed on paper has both breadth and thickness, for it is composed essentially of a string of heaped-up carbon atoms, each of which can be proved to possess very definite length, breadth and thickness. Points, lines and mere surfaces, therefore, are mathematical abstractions which can be real enough to the theoretical mathematician, but which are nowhere to be come across in our ordinary experience.

Three-dimensional Objects

It is obvious that every material thing must be three-dimensional in nature. That is to say, it must exist in three separate dimensions—length, breadth and thickness. We cannot possibly imagine a material thing which is devoid of any of these dimensions. Further, we cannot even imagine a space which is not possessed of these dimensional attributes.



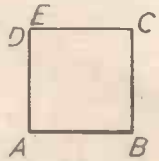


Fig. 1.—Showing how a two-dimensioned square is obtained by folding-up o one-dimensioned line.

The tiniest electron constitutes a definite particle of something. What exactly this something is we are not yet perfectly sure. But if an electron *is* a particle, it must have size, that is to say, size in three dimensions. It must possess length, breadth and thickness. And if, by an effort of the imagination, one conceives an electron rapidly growing in size until eventually it fills the whole of interstellar space (for example, until it becomes of infinite size), even when it attains that incommensurable magnitude our former electron particle will still exist in three dimensions.

It would seem that existence in the three dimensions is in no way connected with a body's actual size. An atom exists in three dimensions. So, too, does the largest star of which we know. Both of them have the property of being material, and it is just this property which signifies their existence in three dimensions. You cannot have a material substance without its existence in three dimensions any more than you can have a solid body without mass or weight.

Hyper Solids

Such facts are, of course, entirely incontrovertible. There are, however, scientific thinkers who have almost instinctively refused to believe that only three dimensions are available or possible for material existence. Such individuals have postulated the existence of a *fourth* dimension, a dimension extra to length, breadth and thickness, which solid, material bodies can exist in. Needless to say, this postulation involves the necessity of imagining a new type of space for four-dimensional bodies to exist in. Such a hypothetical space is nowadays termed (for want of a better word) *hyper-space*, and the material things which are supposed or assumed to be capable of existence in it are referred to as *hyper-solids*.

The supposition that a fourth dimension is possible has, from time to time, given rise to a great deal of scientific controversy, and even to considerable scientific vehemence and bitterness. The existence of the fourth dimension has been attacked and defended with acrimony by the contending factions. Even the psychical research workers and the spiritualists have, at times, affirmed their beliefs in the existence of a fourth dimension, since it has been considered that such a variety of space may well constitute the abode of intelligent spirits and other dynamic entities.

Time as Fourth Dimension

Some people have been apt to imagine that Time constitutes the fourth dimension. They say that all material things must have length, breadth, thickness—and *Time*. That is quite true, because Time appears to be an entirely essential attribute of material things. You cannot, for instance, imagine a *timeless* cube. Any cube, for example, which you care to bring to mind, must have length, breadth, thickness and Time for the simple reason that without these attributes the cube simply cannot exist in our ordinary world.

But Time is no more a dimension of an object than the actual colour or hardness or softness of the latter. The three dimensions, length, breadth and thickness, are all at right angles to one another. But you cannot say that Time is at right angles to thickness or to depth. As a material (or extra-material) dimension, Time has nothing to do with the case in point. Time is simply a non-dimensional attribute of material things, and it might be quite possible for even non-material creations to exist in Time.

Clearly, the fourth dimension (if it exists at all) must bear some definite relationship to length, breadth and thickness. The case for its existence rests mainly upon arguments from analogy. The arguments are these:

Imagine a surface which is populated with intelligent two-dimensional beings, that is to say, with creatures which are possessed of only length and breadth. The name "Flatland" has been given to such an entirely imaginary world. Now, these beings have length and breadth only. They have no thickness whatever. Their bodies may take the form of squares, rectangles, triangles, circles, etc., but they are not solids, for the reason that a solid requires a three-dimensional world in which to exist.

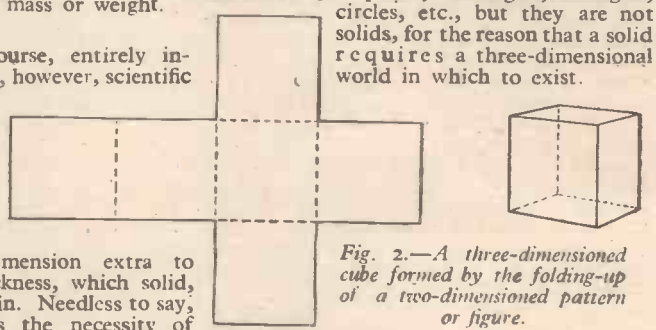


Fig. 2.—A three-dimensioned cube formed by the folding-up of a two-dimensioned pattern or figure.

Well, our race of "Flatlanders" will naturally be utterly unconscious of the existence of any third dimension. They will be inherently unable to comprehend the nature of space as we ourselves know it, for, of their very nature, they are two-dimension dwellers, inhabitants of Flatland, able to move freely enough backwards and forwards, right and left, but *not* up and down, since up and down implies a third dimensional space which simply does not exist for them.

The "houses" of our imaginary race of Flatland creatures will consist of straight or curved lines. Such "houses" might very well be thousands of square miles in area or, alternatively, their areas might be only microscopical in magnitude. But the point to note is that if, for example, a refractory Flatland dweller were confined to a "prison" comprising merely a square, a triangle, or some other figure made by an enclosure of lines he would not be able to get out of it.

If one of us, however, being three-dimensional beings, were to descend upon Flatland we could readily enable the imprisoned Flatlander to break out of his place of confinement simply by lifting him up into our three-dimensional space and by thereby removing him beyond the extent of the enclosing lines which confined him.

To his Flatland gaolers, the prisoner would appear to have been spirited away, for the enclosing "doors" would still remain closed and the "walls" of the prison cell would have been untampered with.

If, by any chance, a human being were seen during a visit to Flatland, he would appear as a sort of ghost, as an apparition, for he would be able to reveal himself within the Flatlander's houses without having actually passed through their walls. Of course, the Flatlanders would not see our human earth-dweller as he actually was. Being restricted to acting and thinking and perceiving things in two dimensions only, the scared Flatlanders would merely see the outlines of successive cross-sections of the human visitant's body. The whole manifestation would, indeed, be one of the highest mystery, and, to the poor Flatlanders, no matter how intelligent they were, it would comprise a wellnigh insoluble problem.

Now, arguing from analogy, it has been suggested that if there exists a fourth dimension, we must inherently be almost as incapable of clearly apprehending its real nature as our hypothetical race of Flatland dwellers would be of appreciating the realities and the spacial arrangement of three dimensions.

Certainly, it would seem that if a three-dimensional prisoner in his cell knew how to move about in the fourth dimension he would at once be able to make an unimpeded escape from his place of confinement without actually passing through its walls. For movement in the fourth dimension does not imply motion in either length, breadth or thickness. The fourth dimension does not (if it exists) lie, as it were, alongside ordinary or three-dimensional space. It transcends such space, and it must surely be able to exist within and without the three-dimensional world of ordinary solid bodies in which we ourselves live.

A Formidable Problem

How are we to get at fourth dimensional space? How are we even to attain to some partial comprehension of the character of this supposed "hyper-space"? The problem is, indeed, a highly formidable one, yet its almost unassailable perplexities have engrossed and fascinated many clever minds, with the result that some highly ingenious methods of attaining a knowledge of "hyper-space" (or four-dimensional space) have, from time to time, been put forward.

Imagine a line (which is a one-dimensional unit), AB (Fig. 1). If to this line we add at each end of it another line of equal length (BC and AD) and then one more line beyond it (CE), we obtain the figure DABCE. Now, this figure or line (which, theoretically, exists in one dimension, having length only) can, by folding, be converted into a clearly two-dimensional figure, to wit, a square, having length and breadth.

Take, now, a square, which is two-dimensional in nature. If this square is "developed" in the same way as the line was, that is to say, if the square has one additional square developed on each of its sides, and if, then, one more square beyond is added to one of the developed figures, we obtain the figure illustrated at Fig. 2. This figure is clearly two-dimensional, and, by a race of Flatlanders, it could never be conceived as being anything else. Our own experience, however, indicates that it is readily possible for us to fold this two-dimensional figure up into a three-dimensional pattern and so to form a cube. By so doing, we convert a two-dimensional object into one of three dimensions.

Now, by exact analogy, the fourth-dimension enthusiasts contend that just as it is possible to "develop" from a two-dimensional square a figure or pattern which, when correctly folded up, will produce a three-dimensional figure (a cube) so, also, is it possible to "develop" from a cube the three-dimensional figure or pattern of a fourth-dimensional entity.

The "Hyper-cube"

Thus, by "developing" an additional cube on every face of an existing cube, and then by adding *one more cube beyond*, we obtain the figure shown in Fig. 3. To this mysterious geometrical figure the names "tesseract" or "hyper-cube" have been given, and it is considered to be an exact

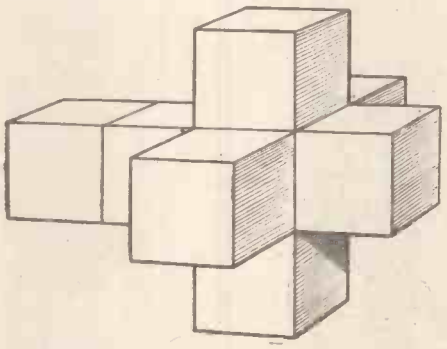


Fig. 3.—The "Tesseract" or hyper-cube, which is considered to be a three-dimensional plan of a fourth-dimensional object, correctly folded up, this figure should produce a fourth dimensional solid. Can you do it?

counterpart of the two-dimensional plan of the three-dimensional cube shown at Fig. 2.

The analogy, of course, is a perfect one. But, unfortunately, the difficulty arises in that we do not know how to fold up the tesseract correctly in order to form the required four-dimensional figure. In this respect, we are like the imaginary race of Flatland dwellers confronted with the "plan" cube shown at Fig. 2. If such a race of beings had any clear notions of the "up and down" nature of three-dimensional space, their difficulties with regard to the correct folding of the "plan" cube (Fig. 2) would vanish. So, too, in regard to ourselves. It is considered that if we could attain to some perception of the intrinsic character of four-dimensional space, the correct folding up of the "hyper-cube" or "tesseract" would at once become child's play to us.

And here, from a practical standpoint, at any rate, is where our present knowledge of the fourth dimension ends. Many serious scientists assail the whole question of such a dimension on the grounds that the analogies drawn from hypothetical two dimensional beings and "Flatlanders" are false ones. They say that existence in two dimensions alone is not merely impossible, but, also, unthinkable. Such conclusions, however, are by no means wholly satisfactory.

Again, if one concedes the existence of a fourth dimension, contend these opponents, why stop there? If there *does* actually exist a fourth dimension in some way connected with our well-known three dimensions, why, then, should there not exist a fifth dimension—and a sixth and a seventh and even an eighth dimension? In fact, why should there not exist an *n*th dimension, which means, of course, why should there not be an infinitude of dimensions all capable of existing within the others and each successively higher dimension transcending its previous ones?

To all such queries that answer echoes—mockingly, perhaps—*why not?* Questions such as these seem to transcend the borderland of our human reasoning powers. Seemingly, *if* a fourth dimension exists (it is certainly a possibility) there is really no reason why an *n*th dimension should also not exist.

An Exciting Possibility

The world nowadays is far too busily engaged in severely practical concerns to admit of much time for speculative and apparently highly impracticable thinking. Yet, sooner or later, the entire subject will be resurrected and re-examined once again, for, in regard to this fourth-dimension speculation there is at least this one almost exciting possibility: that with the proof of the existence of fourth dimension and some knowledge of its manipulation and essential characteristics, we might, once and for all, become able to master the long-dreamt-of problem of space-voyaging. To travel from the earth to the stars out in space, even at the speed of light (186,000 miles per second), would take, in many instances, hundreds and even hundreds of hundreds of centuries. If, however, by some means or other, we could step into the fourth dimension (assuming that it exists) we might conceivably be able to perform that journey in an instant. We might even be able to travel in Time, and perhaps, indeed, even to *overtake* Time!

But all such ideas are only wildly imaginative ones. The intellect of mankind will necessarily have to advance considerably before any such problems can be attacked. Yet, instinctively, one is inclined to believe in the presence of actual possibility behind all such imaginings.

New South African Stamp

THE tremendous part arc welding is playing in the war effort of the Union of South Africa has been recognised by the issue of a special postage stamp. This indicates that the Union is not lagging behind other countries in the use of this new industrial giant in the construction of her ships, tanks, aircraft and similar equipment.

Afrikaans and English

The photographs, supplied by The Lincoln Company Ltd., of Welwyn Garden City, Herts, show two of the stamps which are of 6d. value. Each stamp is printed both in English, as shown on the right, or Afrikaans, as on the left. This is the case with all stamps issued in South Africa. The stamp depicts a welder using modern shielded electric arc equipment, and dressed in protective head shield, gloves and other special clothing.

Lincoln Electric officials say that, as far as they know, this is the first time that such a stamp has been issued in the history of either stamps or welding.

The new South African stamp printed in Afrikaans and English.

The Story of Chemical Discovery

No. 14—Madame Curie and the Discovery of Radium

A FRAIL-LOOKING, somewhat diminutive woman was Madame Curie, a personage who not unfrequently gave the impression of having been permanently saddened in her life. Yet, within a few short years, her towering scientific ability took her to the front ranks of the world's scientists and resulted in her name becoming almost a "household word" among the everyday rank-and-file of scientific workers. Madame Curie was one of the very first of female scientists. Others, nowadays, follow in her footsteps, but none of them has ever approached her pinnacle of fame.

Madame Curie, although she brought the revolutionary knowledge of radium and of radioactivity generally to the world, despite, indeed, the benefactions which her pioneering and indisputably brilliant work conferred upon science in general, and upon chemical and physical science in particular, lived a hard and at times a drear life.

Madame Curie was a Pole. She was born in Warsaw in 1867, her unmarried name being Marie Sklodowska. Her father was a poor, underpaid, hard-working teacher, and after receiving a high-school education in her native town, she immediately began to give lessons herself as a means of eking out the scanty exchequer of her family.

Arrival in Paris

In 1891, after having displayed a rather dangerous interest in Polish political affairs, she decided to join her sister and her brother-in-law in Paris. In that city she began to study mathematics, physics and chemistry in real earnest. Her life at that period was nothing if not frugal. Listen to what Marie Sklodowska herself has to say about it:

> "The room in which I lived was a garret, very cold in winter, for it was insufficiently heated by a small stove which lacked coal. During a particularly rigorous winter it was not unusual for the water to freeze in the basin at night. To be able to sleep I was obliged to pile all my clothes on the bed-covers. In the same room I prepared my meals with a spirit lamp and a few kitchen utensils. These meals were frequently reduced to bread with a cup of chocolate. I had no help in housekeeping, and I myself carried the little coal I used up the six flights of stairs to my room."

Yet Marie Sklodowska somehow managed to keep cheerful throughout this drab existence. In 1893 she obtained her degree in physical science, and, in the following year, in mathematical science.

It was in 1894 that Pierre Curie first came into the picture. He was a poor scientist, a teacher, yet, like Marie, he had a brain which he had kept well out of the scientific rut of the day. The acquaintance between the two deepened. Each admired the other's ability. In the July of 1894, Pierre and Marie married, the latter thereby becoming the now world-famous Madame Curie.

Fame, however, had not come to the Curies at that stage of their existence. Pierre Curie was a teacher of physics in the City of Paris School, and Marie assisted him in his laboratory. In this occupation she received ample discouragement. The presence of women in the colleges and universities was, if anything, definitely frowned upon by the academic authorities of the period.

Madame Marie Curie.

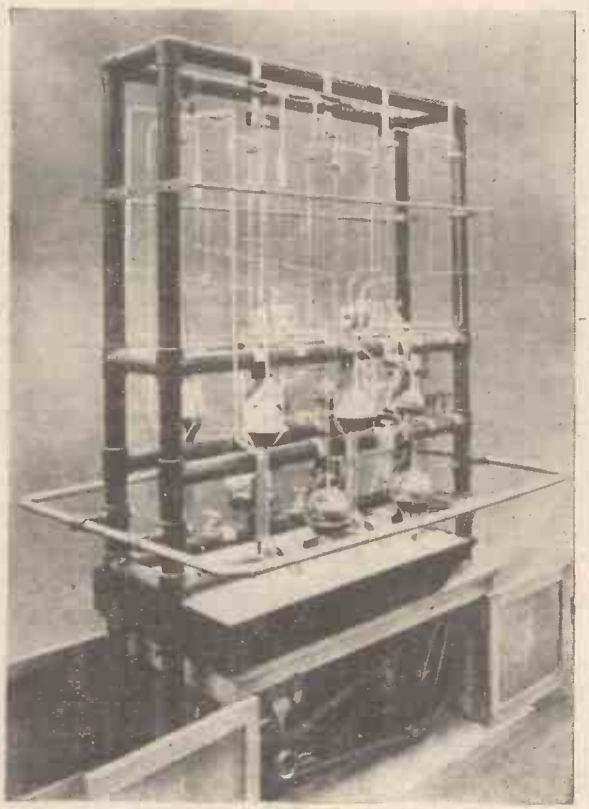
Radioactivity

Fortunately Pierre Curie lived to change his views, for, although his name is coupled with that of his wife in their subsequent investigation of the mysteries of radium and radioactivity, it was undoubtedly Madame Curie herself who displayed the greater genius in the discovery of radium, and the greater insight and perception in her subsequent investigations of the many strange and remarkable properties of this new element.

Radium constitutes one of the landmarks of chemical science. Its discovery introduced a new epoch into chemistry and into physics alike, for, by investigating radium and the extraordinary phenomena of radioactivity, it became possible to penetrate still deeper into that fundamental mystery, that of the exact constitution or make-up of the atoms of matter.

The history of radium begins in 1895, the year following the marriage of Pierre Curie and Marie Sklodowska. A French chemist, Henri Becquerel by name, fired to a pitch of enthusiasm by Professor Rontgen's then recent announcement of his strangely penetrating ray (which, for the want of a better term, and to signify their unknown constitution, he dubbed "X-rays"), drew attention to the fact that the compounds of uranium also evolved mysterious rays which were capable of affecting a photographic plate. The Curies were particularly interested in the matter, and they decided to take up Becquerel's line of investigation, and to search for other ray-evolving compounds. Madame Curie herself performed most of the work, for her husband was more absorbed in his own researches in physics.

Madame Curie took advantage of the facts that the "Becquerel rays" evolved by uranium compounds have the property of ionising or rendering electrically conductible the air in their vicinity. She therefore devised a special type of gold-leaf electroscope with which she was able to obtain an approximate estimate of the actual intensity of the rays. She proved that heat and light had no effect whatever on these rays and that their intensity was solely dependent upon the quantity of metallic uranium present in the compound under review.



Typical apparatus for the extraction of "emanation" from radium salts and compounds.

Thorium Rays

She next examined other elements to see whether they exhibited this strange phenomenon. Only one other element, however, was found to evolve similar rays, and that element was thorium. Here again, Madame Curie found that the thorium rays were dependent for their intensity solely upon the actual quantity of metallic thorium present in the compounds.

The emission of tangible "rays" by uranium and thorium compounds was an entirely new phenomenon. Madame Curie searched around for a suitable term to describe the new effect. She coined the word "radio-activity" for this purpose, a term which, of course, has, for many years, become universally recognised and used. It should be noted, however, that the expression "radioactivity" was invented by Madame Curie *before* she had any real conception of the existence and nature of the element radium.

The next step which Madame Curie took in her search for more intense sources of the mysterious Becquerel rays was to investigate certain minerals containing uranium and thorium. She discovered that all such minerals evinced a greater ray-emitting power than did pure thorium or uranium compounds themselves.

"I then made the hypothesis," wrote

Madame Curie, in after years, "that the ores of uranium and thorium contain in small quantity a substance more strongly radio-active than either uranium or thorium. This substance could not be one of the known elements, because these had already been examined; it must, therefore, be a new chemical element. I had a passionate desire to verify this hypothesis as rapidly as possible. And Pierre Curie, keenly interested in the question, abandoned his work on crystals to join me in the search for this unknown substance."

Pitchblende

The Curies selected pitchblende as the mineral most likely to contain appreciable amounts of the new element, since this ore was at least four times more radioactive than uranium itself.

Then followed a programme of intensive chemical extractive work by the two Curies, husband and wife.

"We passed our days in the laboratory," records Madame Curie, "often eating a simple student's lunch there. A great tranquillity reigned in our poor, shabby apartment. Occasionally, while observing an operation, we would walk up and down, talking of our work, present and future. When we were cold, a cup of hot tea, drunk beside the stove, cheered us. We lived in a preoccupation as complete as that of a dream."

Discovery of "Polonium" and "Radium"

The chemical process of decomposing the uranium ore (pitchblende) and of separating it into various portions or "fractions," each one of which was separately tested for its ray-emitting powers by means of the Curie electroscope, was a tedious one in the extreme. Thousands of separate operations were required. Eventually, however, the Curies were able to show that there actually did exist in pitchblende an unknown element which was many times more powerful as a ray-producer than either uranium or thorium. This element Madame Curie discovered in July, 1898. She called it "polonium" in honour of her native country.

In the December of the same year, Madame Curie announced the existence of another element in pitchblende. This she happily named "radium" (from the Latin, *radius*, "a ray") in view of its extraordinary ray-emitting power.

At this stage, the work of the two Curies seemed likely to finish prematurely, for their scanty stock of pitchblende ran out, and they did not possess the financial means to acquire more of the valuable ore. The whole of the supplies of pitchblende of that period came from a mine at Joachimsthal, in Bohemia, which was owned by the Austrian Government, which worked it for the extraction of uranium. Through the good offices of the Vienna Academy of Sciences, the Austrian Government sold a few tons of their pitchblende ore to the Curies, who provided a proportion of the purchase price of the material themselves—the remainder of the amount being subscribed by several interested bodies in Paris.

For two whole years, the Curies worked incessantly upon their stock of Austrian pitchblende, concentrating it and gradually extracting from it the precious elements, polonium and radium. The apartment in which all this work was carried out was a disused storeroom in one of the Paris colleges, the scientific equipment of which was practically non-existent.

Success, however—and, frequently, brilliant success—has a habit of supervening upon work carried out under great difficulties. The case of the Curies proved to be no exception to this well-recognised rule. Eventually, their long months of tedious and super-exacting labour resulted in their gathering together a few grains of a radium salt in a chemically pure state. This they began to study without delay.

Radium Salts

There was no doubt that Madame Curie's new element, "radium," constituted a most remarkable entity. Even its salts were more

A quantity of radium bromide contained in a silica basin. This photograph was taken by means of the luminescence emitted by the radium salt.

than a million times more radioactive than the salts of uranium. One ton of pitchblende was shown to contain substantially less than half a gram of radium (about 0.37 gram, to be exact). From this figure, the amount of chemical processing and extracting carried out by the two Curies during their pioneer work on their few tons of Austrian pitchblende can be imagined. Superhuman efforts were, indeed, required of them, endeavours which only scientific ardour and enthusiasm of the very highest and keenest order could ever hope to bring to a successful conclusion.

After the sensational discovery of radium by the Curies, the whole of the scientific world became, as it were, "radium crazy." Radium salts and their properties were minutely examined by the Curies and by numerous other investigators. It was shown that, uninfluenced by any external influences, a fragment of radium salt steadily evolved three types of rays: the *alpha* rays, which were found to comprise positively charged helium ions; the *beta* rays, which are electron streams shot out from the radium atoms, and the *gamma* rays, which are very much akin to X-rays.

Furthermore, it was quickly noticed that radium salts and compounds, besides being perpetually luminous, spontaneously evolve heat, so much so that a quantity of radium salt is always a little warmer than its immediate surroundings. Measuring this evolved heat, it was found that a quantity of radium salt evolves during half an hour sufficient heat to melt its own weight of ice.

One by one the many mysteries of radium and of radioactivity were mastered. It became obvious that, in radium, we are confronted with an element which is actually undergoing violent decomposition under our own eyes. A radium atom is virtually an exploding atom. The *alpha*, *beta* and *gamma* rays which it hurls out from itself are the atomic "flak" of its explosive disintegration.

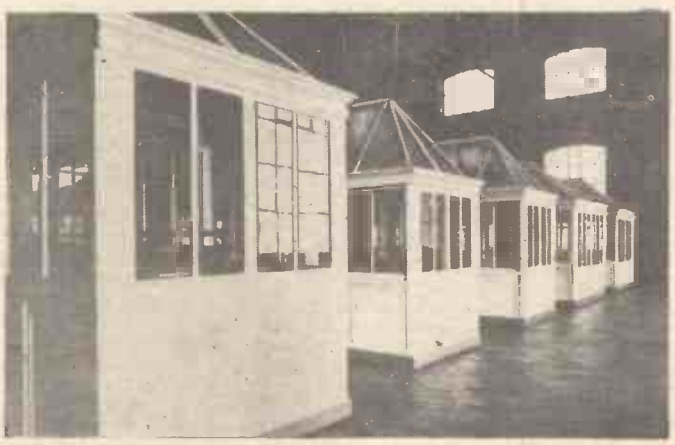
Pierre Curie happened to spill a little of the precious radium salt on to his hand. It produced a burn which took many months to heal. And Henri Becquerel, parent of the "Becquerel rays" emitted from uranium salts, carried about in his waistcoat pocket a tiny tube of radium bromide which had been given to him by Madame Curie. The radium rays burned a hole clean into his skin, and it was a long time before the wound healed completely. Looking at this fragment of radium salt in after years, Becquerel was wont to exclaim: "I love it, but I owe it a grudge!"

Honours now began to fly fast to Madame Curie and her husband. The scientific institutions of the world competed with one another in showering their most coveted awards upon the Curies. Even the parsimonious French Government asked the Curies what official decorations they would like to have. To which Madame Curie replied: "I pray to thank the Minister and to inform him that I do not in the least feel the need of a decoration, but I do feel the greatest need for a laboratory!"

Personal Sorrow

At the height of her scientific triumphs a great personal sorrow suddenly descended upon Madame Curie. On April 19th, 1906, her husband, Pierre Curie, was knocked down by a motor vehicle and killed instantly.

Courageously, his widow refused to abandon her scientific work. Despite the fact that she was left with two small children to bring up and to educate, she struggled bravely on, attending to both her family and her scientific duties. But she was not alone in her efforts. A special laboratory (known as the Curie Institute) was built and equipped for her in Paris, and here she continued to work almost daily until her death in 1934. Her



Heavily lead-lined processing booths in a radium factory. In these isolated apartments radium salts are progressively concentrated by chemical means.

scientific work she gave freely to the world, and, in return, the world, or, rather, the scientific world of Paris, just managed to maintain her in frugal comfort to the end of her days.

As she grew older, Madame Curie, still harbouring the sadness consequent upon the early death of her husband, became embittered. Radium, for her, brought little material rewards, although others prospered exceedingly out of it.

Marie Curie died a disappointed woman, despite the fact that through her discovery a new era of chemical and of physical science was entered into.

Filtration

Metafilters—Their Uses in Various Industries

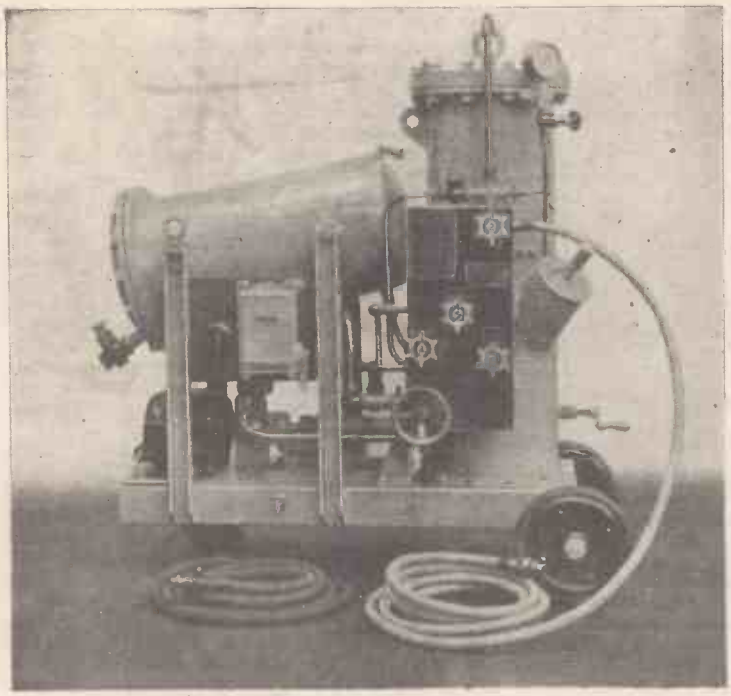


Fig. 3. T.8 Portable Metafilter Unit. Can deal with 80/100 g.p.h. of transformer or carbonised switch oil. Oil is completely clarified and maximum B.D.V. obtained with one passage through the filter.

FILTRATION is of interest, in varying degrees, to every trade. Chemical manufacturers, engineers, oil companies, laboratories, electric supply companies, brewers, and hospitals are a few of the concerns which have their filtration problems. Water filtration is another example of wide application, as clean and pure water is a necessity in many and diverse circumstances. Mineral-water makers, chemists, dairies, hotels, domestic users—all these immediately come to mind as requiring pure water. Varnish, insulating and lubricating oil must be filtered before it is ready for use.

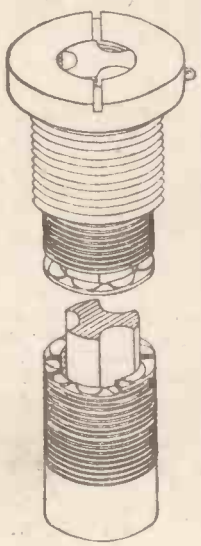


Fig. 1. A filter unit consisting of a pack of rings built up on a central drainage rod.

Various forms of filters have been in use for centuries, but the simple and efficient filters manufactured by The Metafiltration Company, of Hounslow, Middlesex, are the product of many years of chemical research.

Renewable Bed Filters

One of the earlier models of the Metafilter is known as the Ring Type, in which the filter-bed is held on an immovable foundation, but is easily thrown off for reforming. The rings (Fig. 1) are not more than 1in. diameter, and are of great mechanical strength. There are about 30 rings to each inch of length, each ring having an internal and external diameter of $\frac{5}{8}$ in. and $\frac{7}{8}$ in. respectively. It is necessary that there should be a regular channel between each ring, and these channels are obtained by forming a number of embossings on each side of alternate rings. A column or pack of rings built up in this manner on a central drainage rod or tube may be a filter when covered with filter-bed and fitted in a suitable container; or may be one of a number, each of a predetermined length, mounted on a drainage manifold, and contained in the filter body (Fig. 2), forming a larger filter.

Filter Beds

The materials forming the filter-beds in a Metafilter are selected with great care to ensure that the best results are obtained. A large variety of materials is available, including powdered charcoal, Kieselguhr, decolorising carbon, magnesium carbonate and silica. There is also a specially selected filter-bed known as Metasil, of which there is a grade for every class of filtration undertaken.

Filter-bed Formation

The formation of a filter-bed on the Metafilter strip frame or ring packs is simple and foolproof. A suitable material is mixed with the liquid to be filtered, the already filtered liquid, or other liquid, such as water, oil, or solvent, as circumstances permit. It is necessary to keep the filter-bed in suspension and pass it through the Metafilter units by pressure or under vacuum. As the liquid and suspended filter-bed endeavour to pass through the accurate spacings between the rings or strips, the suspension is evenly strained out, and leaves a perfectly even bed over the surface of the strong retaining structure. If the liquid used is different from the prefilt, it may be drained from the filter body, leaving the filter-bed securely held in position and intact, and it is only necessary to commence forcing the liquid to be filtered through the bed. Where the bed has been formed with the prefilt the operation of filtering is straightforward and the run need not be stopped until the bed is completely choked.

The filter-bed will withstand very high pressure, but normally it is economical to form a new bed when the pressure required to pass liquid through reaches 100-150 lb./sq. in., but this may be modified in special circumstances.

Filtration of Oils

The regular periodic filtration of transformer and switch oils is necessary in order to eliminate water, and to maintain their correct acid value.

Transformer oil contaminated with moisture, dust, sludge, and microscopic fibres is common. The oil must be relieved of these impurities to retain its high electric strength. Moisture alone has little effect on the breakdown voltage of an oil, but in conjunction with other impurities—especially if hygroscopic—it reduces the electric strength of the oil to a low and unsafe figure.

Switch oils may have the same characteristics as transformer oils and the impurities collected in them may be practically the same as in transformer oils, except for one important factor—the effect of continuous circuit breaking and the opening of switches on heavy overloads. In this case, and particularly with overload operation, some portion of the oil is cracked—leaving the oil in the chamber contaminated with carbon and metal particles. The carbon is very finely divided and part of it is in the colloidal state. This impurity is of such a character that it is difficult to remove by ordinary methods, but it is essential to maintain the oil entirely free from suspended impurities. Centrifuges, filter presses, paper filters, and chemical methods all have disadvantages, but the Metafilter can restore the oil to its original condition in a single, simple filtration.

Metafilters are built having a wide range of output—from 10 gallons per hour to 1,000 gallons per hour. The smaller sizes, which can be portable, are very suitable for factories or sub-stations; the larger units are designed specially for power stations or sub-stations

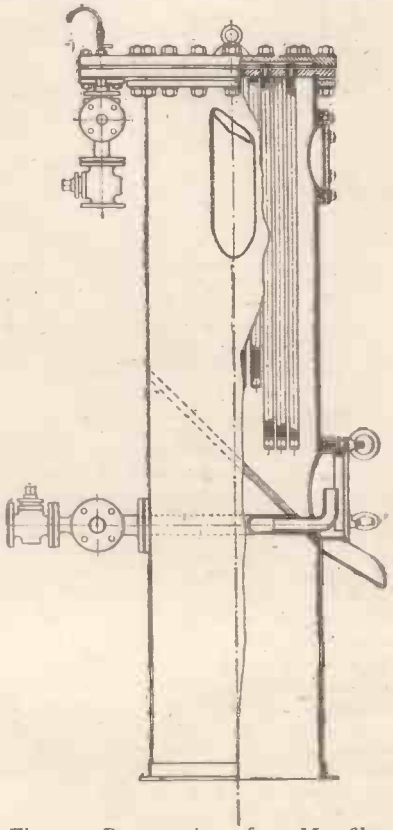


Fig. 2. Part section of a Metafilter showing internal construction. Note the long filter packs in the top chamber.

with heavy transformer and switch gear requiring filtration plant capable of dealing with large quantities of oil.

Constructional Details

In Fig. 3 is shown a portable unit for dealing with transformer, or carbonised switch oil. The general construction of the unit is as follows :—

A cylindrical upright mild steel container is divided, by a sloping plate, into the filter chamber above, and the mixing chamber below. The filter chamber is provided with a quick-opening sludge door for filter-bed and sludge removal. In the filter body is mounted the requisite area of filter pack to give the desired output. The filter packs are constructed in brass and the filtered oil is delivered through a mild steel division plate at the top of the filter into a mild steel header which is equipped with a sight glass and delivery pipe with sampling tap. The mixing chamber is provided with a Metasil introduction port and measuring scoop and has hand-operated mixing gear. A silent pump is supplied driven by an electric motor.

A water separator is also fitted, and this is seen on the left, in Fig. 3. This separator is arranged to be on the suction side of the pump to prevent emulsification of water with oil and thus facilitate settling in the separator. Final dehydration of the oil is ensured by the absorptive qualities of the special filter-bed. As filtration proceeds, and removed impurities accumulate on the filter-bed, the pressure will rise; when this has reached a desirable maximum (100 lb./sq. in.) the filter-bed should be discarded, the filter cleaned, and a new bed deposited, if necessary. The removal of a filter-bed and extracted impurities takes a few minutes only. The filter is simply backflushed with a small quantity of clean oil, the filter-bed with collected impurities falling to the sloping base of the filter chamber and being discharged from the sludge door.

Low Running Costs

The cost of filtration is very low. The only power required is the small motor for driving the pressure pump, which forces the oil through the filter. The cost of the filtering material Metasil is only a fraction of a penny per gallon, even when dealing with heavily carbonised oil.

NEW SERIES

Odd Jobs in House and Garden

2.—Adjusting Ball Valves, Renewing Tap Washers, and Cleaning Sink Traps

By "HANDYMAN"

IN most small houses there are several simple plumbing jobs which can easily be carried out by the householder, such as remedying faults in cisterns, renewing tap washers, repairing ball valves, and clearing sink traps.

Adjusting a Ball Valve

When water persistently drips from the overflow pipe of a flushing tank or water cistern (Fig. 1) it indicates that the ball valve has failed to cut off the water when it reaches the correct high level. This may be due to a faulty washer, or the arm of the ball valve may require bending down so that the water supply will be cut off earlier.

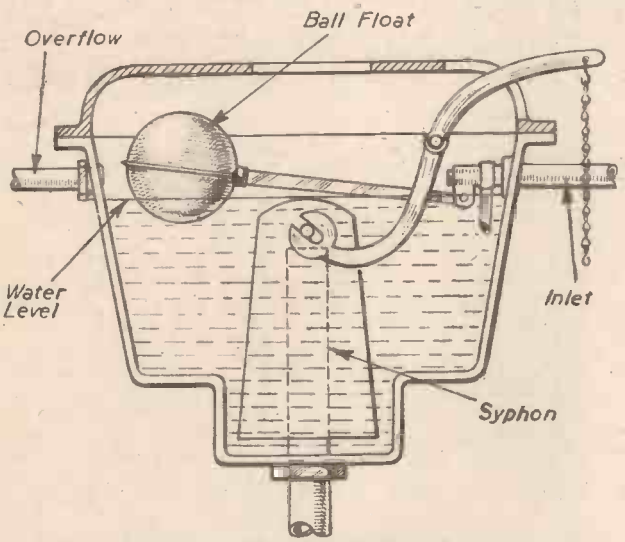


Fig. 1.—Sectional view of a flushing cistern showing ball-float and syphon.

The first thing to do is to turn off the water supply to the tank, and remove the cover. Take out the split pin at the hinge end of the ball arm, which can then be lifted out. A simple method of bending the arm is to put one end in a dresser drawer, opened about 3in., as shown in Fig. 2. Do not press on the ball, but hold the arm as shown in the diagram, and carefully press downwards. After slightly bending the arm, replace it in the tank and turn the water on. If it still does not shut off the water soon enough, take it out again and repeat the bending operation.

Insufficient flush of water indicates that the ball valve is shutting off the water too soon, and preventing the tank from filling to its correct capacity. In this case it is necessary to slightly bend the ball lever upwards.

Leaky Ball Float

The ball float is made of thin spun copper and a small pin-hole is sufficient to allow water to enter which has the effect of counteracting the buoyancy of the float and rendering it useless. This fault is usually indicated when the ball is noticed very low in the water, as when in good condition it floats well above the water level. To make good the leak, remove the ball and arm, and slightly enlarge the hole with the tang of a small file to drain all the water out. Place the ball arm in a vice, as in Fig. 3, and after cleaning with fine emery cloth, apply a little flux and run a spot of solder on the hole to seal it.

If the repair is watertight, the ball when replaced in the tank should float in its correct position *above* the water level, and not *below* it.

Fitting a New Washer

When a valve in a flushing tank or water cistern fails to shut off the water properly when the ball float is in its highest position, a faulty washer is indicated. The replacing of this is a very simple matter. Turn off the water supply, as before, remove the ball arm, and withdraw the plunger. Fig. 4 shows a section of a cistern valve with the plunger A in position. Remove the old washer from the socket in one end of the plunger, and press in a new one. These small washers are of hard red rubber, and are obtainable at any ironmonger's shop. After replacing the ball arm and pushing in the split pin which holds it in position, the water should shut off properly when it reaches the correct level. When finally inserted in place, the ends of the split pin should be slightly opened out with a screw-driver to prevent the pin working out. All the moving parts should be well greased before being replaced.

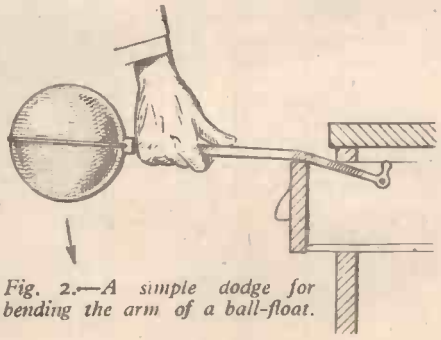


Fig. 2.—A simple dodge for bending the arm of a ball-float.

Renewing Tap Washers

Replacing a faulty tap washer only takes a few minutes, provided that a spanner of the correct size, or an adjustable one, is at hand.

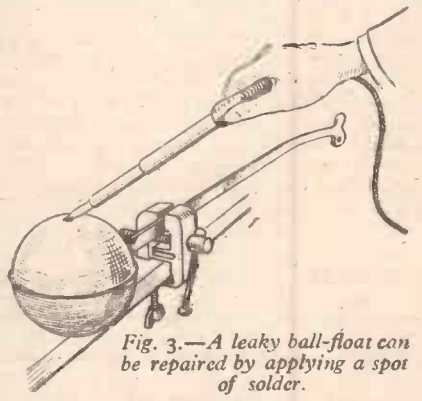


Fig. 3.—A leaky ball-float can be repaired by applying a spot of solder.

In the case of a tap with a domed top, a pair of pipe grips will be necessary.

After turning off the water, unscrew the nut A (Fig. 5) with a spanner, and remove the top half of the tap with the handle and screwed spindle B. Pull out the "jumper" C, and remove the worn washer by unscrewing the small nut which holds it in place. Slip on a new washer, tighten up the small nut, and after replacing the "jumper," turn the tap handle to full open position, and screw on the top part of the tap again, fairly tightly. Turn on the water supply, and then turn the tap "off" slowly. After the tap is completely shut down there should then be no sign of leakage. The washers are obtainable with a central hole ready for fixing. Brass "jumpers" complete with a thick hard rubber washer, as shown at D, are also obtainable.

Sink Traps

The purpose of sink traps is to prevent bad-smelling gases from coming up the waste

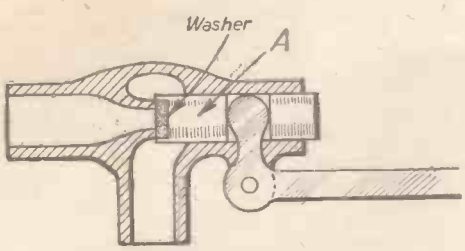


Fig. 4.—Details of a cistern valve with plunger and washer in position.

pipes into the house. There are many forms of trap, but the principle of all of them is the same. A small part of the waste water remains in the trap, as shown in Fig. 6, thus sealing the waste-pipe and preventing any bad odours from entering the house. It is important that these traps should be periodically cleaned, as they are liable to become coated with grease and other substances. A good method of cleaning the trap is to dissolve 1 lb. of washing soda in a quart of boiling water, and pour the hot solution down the waste pipe. Allow the solution to remain in the trap all night, and flush out with water the next morning. Unscrew the plug which is just below the bend, and scour the inside of the trap with a small wire brush. Replace the plug, and fill the trap again by turning on the water tap.

Rainwater Gullies

In addition to the traps connected with the ordinary sanitary fittings of a house, the rainwater pipes outside the house discharge over gullies which are also connected to the drainage system. Gullies are also provided to carry off the waste water from baths, and these gullies are trapped in the usual way, and are liable to become unsealed, owing to evaporation, during long spells of dry weather, especially in the summer months. To remedy this, water should be poured down the gullies occasionally. The grids covering the gullies should periodically be cleared of dead leaves and other refuse which collects on them. If they are left too long without attention the rainwater cannot drain away quickly enough, and will overflow,

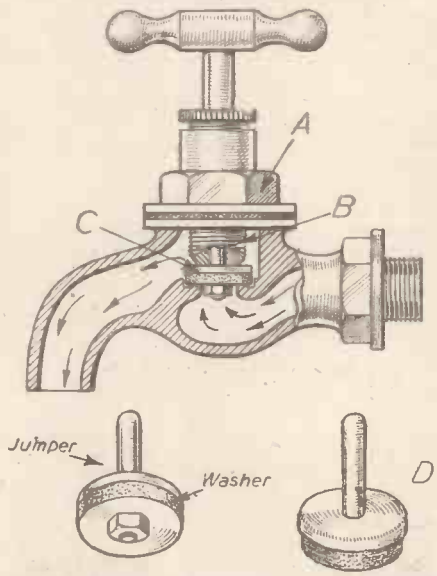


Fig. 5.—Sketch of a domestic water tap showing working parts.

thus causing the brickwork of the house at that particular spot to become damp.

Cleaning Cisterns

Water from a cistern in the loft of a house is sometimes used for filling saucepans or kettles, as the subsequent boiling sterilises the water. It should always be borne in mind, however, that dirty sediment forms in the bottom of such cisterns unless they are cleaned out at regular intervals.

It is a good plan to clean out a roof cistern at least once a year. Turn off the water at the main, then open one or two taps and empty the cistern in the usual way. Before disturbing the sediment plug the pipe-holes with tight-fitting corks, and then remove the sediment and any remaining water in a pail. After this use a heavy cloth and a pail of clean water for swabbing down the inside of the cistern. Finally, remove the corks, and give the cistern a good flushing down with a couple of pails of clean water, before turning on the water supply again. Another important point to remember is that a loft cistern should always be fitted with a cover of wood, or other material.

Noisy Filling

Some cisterns fed direct from the water main are often under such pressure that the rushing water can be heard all over the house when the cistern is filling. A simple remedy is to always keep the supply tap in the kitchen only half turned on. Failing this, another good plan is to fit a length of pipe on to the outlet of the cistern valve. The pipe should be sufficiently long to reach to within a couple of inches of the bottom of the tank, where the end is soon covered with water, and the rushing sound consequently reduced.

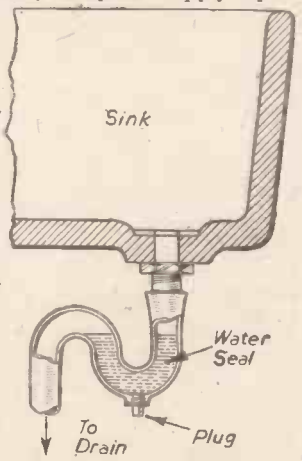


Fig. 6.—Section of a sink trap showing the water seal.

Items of Interest

Fast Piston Buffing

A NEW automatic polishing machine for buffing an aluminium aero engine piston in 15 seconds, instead of the usual 10 minutes taken by hand, is announced by the Udylite Corporation, Detroit. It consists essentially of a circular index table fitted with twelve chucks for holding the pistons. The table revolves and a piston is brought opposite the appropriate buff, which is fitted at such an angle as to buff either the top of the piston or the side, the latter being revolved slowly as the table turns. There are six buffing pedestals, the wheels being operated from V-belt drives.

To Fortify Footballs

IN one respect a football resembles a bicycle tyre ; it has an inner rubber ball and an outer case. The victim of innumerable kicks, the cover requires to be sufficiently strong to resist the rough treatment it receives. We have seen a football kicked over a fence on to the road, where a brewer's dray has passed over it. There occurred a report resembling a feeble imitation of an exploding bomb. It is therefore essential that the outer cover should be fortified against perpetually "getting the boot."

To attain this end there has recently been designed a football casing specially qualified to resist rough usage, and it is the subject of an application for a patent in this country. The casing consists of at least 13 sections, the majority of which are tee-shaped. When sewn together they are arranged to form zig-zag seams.

Hay Lifter

FOR many centuries the pitchfork, with its twin prongs and long ash handle polished by the toil of the farm labourer, was the sole implement for lifting hay on to the farmer's cart and rick. In times of rebellion it was occasionally diverted from its peaceful avocation to be commandeered as a weapon in civil war. Eventually it was superseded by the mechanical elevator, which facilitated and expedited the lifting of the hay. An inventor now contends that he has improved upon this contrivance.

The new invention combines a framework with ground wheels, an endless conveyor furnished with tines and carried to pulleys, and an inclined trough along which hay can be moved by the tines from the ground to a discharge position. There is a blower which delivers a blast of air under the hay for engaging it with the tines. And means are provided for driving the blower and conveyor.

A.T.S. girls, training for radio work in the West of England, are here seen starting up a Diesel generating plant which supplies current for the radio apparatus.

MASTERS OF MECHANICS

No. 74.—The Brothers Montgolfier and the Beginnings of Ballooning

THERE lived in Italy towards the end of the 17th century a Jesuit missionary, Francis de Lana by name, who was keenly interested in the possibilities of human flight.

A stone drops to the ground, reasoned de Lana, because it is decidedly heavier than air. Obviously, therefore, anything which is lighter than air must tend to rise in the air. Hence, if you could contrive a number of vessels containing something lighter than air and attach these to a light structure, it ought to be possible to get the latter to ascend into the atmosphere.

De Lana's "Flying Machine"

What, however, would be lighter than air? De Lana considered that a vacuum (since it was devoid of air) would necessarily be lighter than anything else obtainable. Consequently, he drew up a plan for making a vessel to sail in the air. The projected aircraft was to comprise a sort of light sailing-boat having three or four thin copper globes exhausted of air. This, in the main, was de Lana's flying machine.

But de Lana himself was aware that his airship proposition was full of snags, and eventually he indulged in some remarkable predictive philosophy concerning artificial flight in general.

After his death few, if any, serious projects were put forward for the construction of flying machines for at least a century.

We now come to another clergyman, the Rev. Joseph Priestley, an Englishman this time, who in the 18th century made a name for himself as a chemical pioneer. He was a sort of reactionary, in that he sided with the French Revolutionists, which in those days was about as bad as siding with Hitler. Consequently, for such opinions Priestley had eventually to emigrate to America and to end his days there.

Among the several brilliant discoveries which Priestley made was that of oxygen, the vital gas of life. This energetic clergyman and experimenter wrote several scientific treatises, one of which was entitled "On the Various Kinds of Air." This became a famous book and was translated widely, one of its translations being into French.

It was this French translation of Priestley's treatise on Air and Gases which happened, about 1782, to fall into the hands of Joseph and Etienne Montgolfier, sons of Pierre Montgolfier, a rich paper manufacturer of Vidalon-lez-Annonay, in the French Department of Ardèche. The brothers were actively engaged in the paper-making business. Joseph was the elder of the two, having been born in 1740, five years before the birth of Etienne.

Both the Montgolfier brothers were vitally interested in physics and mechanics, for both these branches of science were constantly cropping up in their family trade of paper-making. Joseph, in particular, was impressed by the Rev. Joseph Priestley's book on the different kinds of "air." He was especially interested in Priestley's observation that it was possible to make a gas (afterwards called "hydrogen") which was the lightest thing known, being only 1/14th as heavy as air.

The Montgolfiers' Experiments

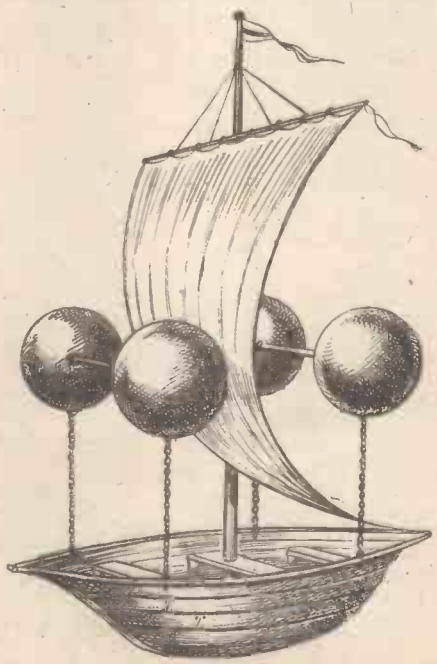
A year or two previously, the two Montgolfiers had amused themselves by various conjectures concerning the practical possibility of flying. They had tried to make clouds—by means of steam—and to enclose these in large paper bags, but naturally, owing to the condensation of the steam, such endeavours were hopeless failures.

Then Joseph Montgolfier conceived the idea of generating some hydrogen and of sealing it up in a bag. The brothers generated the hydrogen by the action of vitriol (sulphuric acid) on iron filings, but somehow or other the experiment was not successful. The hydrogen-filled balloon failed to rise in the air. In all probability the little paper balloon was only half filled with very impure

Portrait of the brothers Montgolfier reproduced from a contemporary medallion-plaque.

hydrogen gas, the experiment being done in a very rough and haphazard manner, which was really a pity, for it robbed the ingenious brothers of the chance of making themselves the joint inventors of the gas balloon, which even to-day has its many important and, indeed, vital uses.

The Montgolfier brothers, however, were not the people to lament over small failures. Joseph—who was always the more active of the two—had another brain-wave shortly after. It occurred to him that smoke rises and that if he could seal smoke within a canvas bag, the bag itself might be caused to rise. The brothers, therefore, acting at once, constructed a spherical balloon out of taffeta, and when it was finished to their satisfaction they filled it with smoke generated by the slow burning of sheep's wool and damp straw.



The "flying machine" suggested by Francis de Lana about 1670. It was to be supported in the air by means of four vacuous copper spheres.

This time, the experiment was quite successful. The balloon (and other subsequent ones which they made) rose gracefully to the ceiling of their room and remained there for some time.

The Montgolfiers were at a loss to account for the rise of their balloons. Electricity was coming into scientific fashion at that period, and for this reason the enterprising brothers may, perhaps, be excused for alluding to the "electric smoke" which held up their balloons. For a long time, however, they failed to realise the fact that it was not any "electricity" of smoke which was the cause of their balloons' ascents, but simply the relative lightness of heated air.

The initial Montgolfier balloons succeeded just as well in the open air as they did indoors. They even got a balloon to rise to a height of about 300ft.

First Public Display

The Montgolfier brothers then decided that they must have a public display of their balloons. Their first "entertainment" was held in the Montgolfiers' native village of Annonay, on June 5th, 1783. A large, paper-lined sack was, in the presence of a considerable number of people, held, by means of a frame, over a fire in which wool and straw were allowed to smoulder.

Gradually, the sack was filled with heated air and as it became distended it slowly swelled into the shape of a globe. As the proceedings progressed it took more and more men to hold the balloon down, and when, eventually, the smoke-filled sphere was released, it shot up instantly in the air to a height of several thousand metres, so that it eventually appeared little more than a tiny floating speck in the sky. After a short career in the clouds, the balloon gracefully descended and landed a mile or two away from the place of its ascent.

So far as history records, this "entertainment" of June 5th, 1783, is the first authenticated instance of a balloon ascent. The activities of the two Montgolfiers rapidly became noised about, and the news concerning them quickly reached Paris. That city became agog with excitement and the Parisians demanded a balloon exhibition of their own. Before long, they were treated to such a demonstration by Professor Cesar Alexandre Charles, of the French Academy of Sciences, who used a hydrogen-filled balloon which ascended successfully and spectacularly in the presence of many interested and enthusiastic spectators.

Charles, being a professional scientific man, had succeeded in filling a balloon with hydrogen, whereas the Montgolfier brothers, mere amateurs in science and mechanics, had strangely failed in that task.

The fame of the Montgolfiers, however, quickly spread, despite the progress of the competing Professor Charles. Etienne was summoned to Paris to give lectures before the French Academy of Sciences, whilst Joseph stayed at home and built a larger hot-air balloon, which was 72ft. high, 41ft.

in diameter and weighed about 1,000 lb. The exterior of this balloon (as afterwards became the general rule) was very finely decorated with brilliantly-coloured designs and emblems.

Balloon Ascent with Load

It was taken to Paris and, on September 12th, 1783, it was exhibited before the members of the French Academy of Sciences. Loaded to the extent of between 400 and 500 lb., the balloon ascended easily, although in its descent it was damaged.

The ascent of the balloon with a considerable load attached to it was indicative of the fact that balloons of this type were capable of taking human cargo with them into the air.

The Montgolfier brothers, however, held back from being the first human beings to ascend into the air. Perhaps the possibility of some unexpected failure in their "aerostatic machine," as they termed it, was the reason for their lack of daring in this respect. Instead, therefore, of going up into the air themselves, they decided, first of all, to adopt the principle of "trying it on the dog."

The balloon ascents in Paris had interested the French Royalty in this new branch of science. The Montgolfier brothers were summoned to Versailles to give a demonstration before the King and Queen of France and the members of their Court. This time the brothers placed "on board" a duck, a cock and a sheep. The balloon ascent was perfectly satisfactory and all the animals landed safely and unharmed in a country field about two miles away.

It was now obvious to all that if any progress was going to be made in the technique of ballooning, somebody must volunteer to risk their lives in an ascent in a balloon.

It was not long before volunteers for a balloon ascent presented themselves, and the first human being to ascend into the air by means of a balloon was a young Frenchman, François Pilâtre de Rozier by name. This individual made several 300ft. ascents in captive balloons in order to satisfy himself as to the general buoyancy of the balloon.

First Balloon Passengers

In his first "free" flight, de Rozier took with him another enthusiast, the Marquis d'Arlandes. For this purpose the Montgolfiers built a special balloon. It was 74ft. high and 48ft. in diameter. The bottom opening of the balloon (through which the heated air from the fire rose into it) was 15ft. across, and this opening was surrounded by a gallery, made of light wickerwork. A brazier was suspended below the balloon by means of wrought-iron chains. Into this it was the duty of the balloonist to throw fuel from time to time, for the Montgolfiers had now realised that, in order to keep their balloon in the air for any length of time, the supply of hot air must be maintained.

It was on November 21st, 1783, that the historic balloon ascent took place. The brothers Montgolfier had found ways and means of dissolving rubber and of impregnating their balloon fabric with it, thereby imparting a greater degree of impermeability to the fabric. The balloon ascent was perfectly successful, and even, it would seem, enjoyable, to the world's first airmen, the Marquis d'Arlandes and Pilâtre de Rozier. Afterwards the Marquis d'Arlandes gave a brief account of this aerial trip :

"Our departure was at fifty-four minutes past one, and occasioned little stir among the spectators. Thinking that they might be frightened and stand in need of encouragement, I waved my arm. M. de Rozier cried, 'You are doing nothing, and we are not rising.' I stirred the fire and then began to scan the river, but Pilâtre cried again, 'See the river. We are dropping into it!' We again urged the fire, but we still clung to the river. Presently I hear a noise in the upper part of the balloon, which gave a shock as though it had burst. The balloon by now had many holes burnt in it, and I cried out that we must descend. My companion, however, explained that we were over Paris and must now cross it. Therefore,

The Montgolfier fire-balloon used by the Marquis d'Arlandes in 1784. (From a contemporary print.)

raising the fire once more, we turned south till we passed the Luxembourg, when, raking out the flame, the balloon came down spent and empty."

A Giant Balloon

The prosperous silk town of Lyons was the next to catch the ballooning craze. The town authorities collected funds for the acquisition of a large Montgolfier balloon. Even Montgolfier senior, parent of Joseph and Etienne, was called into the project, and eventually the Montgolfiers produced an enormous balloon having a capacity of about half a million cubic feet. On January 19th, 1784, this balloon ascended with seven passengers on board. Actually the monster was capable of lifting about 18 tons dead weight. It ascended to about 3,000ft., and at that height the fabric developed a large rent. Fortunately, the envelope managed to hold together, but the occupants of the balloon were given an ultra-rapid descent.

The ascent of Joseph Montgolfier in a fire balloon from Lyons, on January 19th, 1784. (From a contemporary print.)

As the science of ballooning extended, there evolved a technique of balloon construction and also one of balloon manipulation. The brothers Montgolfier concentrated all their attention on the construction and improving of their fire-balloons, leaving others to attend to the actual technique of aerial voyaging.

That the Montgolfier brothers were eminently successful there is little doubt. They were granted free Letters Patent by the French king. Honours were showered upon them from all over the world. Even Napoleon appointed them to various official offices. They wrote a few technical works on the theory and construction of balloons. "Les Voyageurs Aeriens," published in 1784, was the best known of these.

Despite the greater convenience, to say nothing of the greater safety, of the hydrogen balloon, initiated by Professor Charles, the vogue of the fire-balloon—dubbed for many years the "Montgolfier"—persisted.

Record Flights

Many record flights were made with "Montgolfiers" of varying types, and it was, indeed, for the most part these crude fire-balloons which performed the pioneer work of exploring the earth's atmosphere.

Ultimately, of course, the Montgolfier fire-balloons became completely obsolete, but such a state of affairs did not set in before the fire-balloons had, despite their almost alarming insecurity and hazards, done much to initiate "air-mindedness" among many nations of the world.

The younger Montgolfier—Etienne—died in 1799, just before the close of the 18th century. His elder brother, Joseph, lived on until 1810.

Books Received

Aero-engine Theory Simply Explained: Aero-engine Practice Simply Explained. By Group Captain Coats. Published by Sir Isaac Pitman and Sons, Ltd. 38 pages. Price 6d. each.

THESE two small handbooks are written especially for those who have inclinations towards flying, and the author assumes that the reader has no previous knowledge of the subject. The first book covers in simple language what may be termed the A B C of aero-engine theory, and deals with such subjects as: What an Engine Is; Elementary Heat Engine; the "Four-stroke Cycle"; the Crankshaft; Compression Ratio; Brake Horse Power; Supercharging; and Ignition.

In the second book practical points in the design and working of the modern aero engine are explained, and an interesting insight is given into its component parts, testing, maintenance, and overhaul.

Aerobatics Simply Explained. By Wing-Commander R. Cravell. Published by Sir Isaac Pitman and Sons, Ltd. 40 pages. Price 6d.

THIS useful little book tells you all about aerobatic flying which, to-day, is acknowledged to be an essential part of every pilot's training. The author explains the various manoeuvres in an interesting manner and explains the precautions which have to be taken to bring the aircraft again on its normal course. The book is illustrated with several diagrams.

Our Busy Inventors

By "Dynamo"

Easier Shaving

THE fashion of the clean shave imposes upon mankind a daily self-performed minor operation, and since the morning scrape cannot be avoided, it is important to have an effective razor.

To keep the safety razor blade in condition is the object of an improved strop, which has been submitted to the British Patent Office. It consists of a curved sheet of leather or other appropriate flexible material, mounted on a similarly curved backing sheet of cardboard or like substance, covered with any suitable material such as leather cloth or paper.

The inner face of the leather sheet constitutes the operative surface. One part of this is grooved, scored or roughened and treated with abrasive paste to produce a sharpening surface. The other part presents a smooth, velvet-finished strop. If desired, the grooving may be dispensed with and the whole of the inner face be used as a stropping medium.

Bandied Bird

A SURVEY of inventions recently submitted to the British Patent Office does not reveal anything of a striking, original character, but there is a steady attempt to improve existing devices. These inventions are by no means restricted to the subject of the war. I note that players of games have been catered for. That oscillating member of the feathered world, the shuttlecock, has been considered capable of improvement. In the course of its aerial career to and fro, the shuttlecock should be qualified to put up with many hard knocks. Occasionally it endures the indignity of being trodden upon. At the same time it must be as light as Ariel.

In order to fit the shuttlecock for its exacting experiences, an inventor has so formed the body of the "bird"—as it is sometimes termed—that it will immediately return to its normal condition when distorted by undue pressure. He has further provided an improved arrangement for anchoring the feathers in the elastic body of the "bird."

The shuttlecock, as is well known, plays an important rôle in the game of badminton, and it has, for many generations, been associated with the battledore.

De-icing Device

AN improved method of preventing ice-formation on aeroplane propellers is the subject of an application for a patent in this country.

The inventor remarks that the formation of ice on the spinners of aeroplane propellers interferes in a marked degree with the movement of propellers, particularly those of the variable pitch blade type. This, he states, is owing to the fact that, when flying under ice-forming conditions, liquid particles in the air-stream congeal on the spinner. They also tend to collect and solidify around the roots of the propeller blades, preventing proper functioning of the pitch-changing mechanism. Moreover, ice on the spinner and nose of the fuselage materially augments head resistance. And, as a result, the speed of the aeroplane is definitely retarded.

To obviate this obstruction, the inventor provides for surfaces exposed to ice-forming conditions a flexible shield mounted for rotation.

Darning Needle Threader

A HANDY appliance, which is very welcome at the present time, is a darning wool needle threader for which a patent in this country has been applied. The gadget is a simple device consisting of a thin strip of steel having a narrow hooked end capable of being thrust through the eye of a needle. The hook is double clawed, and the operation is completed by engaging the hook with the wool, which is then drawn through the eye without any difficulty. Preferably the hook should be made of rustless steel.

Anti-blast Bricks

THE sandbag, a common object in our streets during the present war, is not impregnable against the relentless attrition of the weather. To obviate this drawback is one of the aims of an inventor who has devised a protective brick. It is made by loosely packing together in a mould a number of laminations of plastic clay, e.g., strips shaved from a block of clay or clay rods, bars or strips formed by extrusion or other method. This formation is afterwards fired or baked.

It is maintained that a structure erected with these bricks will be unaffected by weather conditions, and will indefinitely retain its original shape. The structure will remain dry and, as a consequence, will be far more hygienic than one built with sandbags.

A further advantage claimed is that a missile striking the erection will be deflected in many different directions. This is due to the loosely packed and irregular disposition of the laminations. The effect will be that the missile will lose its impetus and, as a result, there will be greater protection than is the case with a barricade of sandbags.

Land and Water Vehicle

A RECENT invention is an improved amphibious vehicle which can be used on land or water for war purposes, but is also suitable for commerce.

This vehicle combines a buoyant body having a power unit and propelling wheels, an endless track arrangement, and means to propel the vehicle through the water, all designed to be operated by the power means, and the propelling wheels are qualified to move the vehicle over soft ground.

Landing Gears for 'Planes

AMONG recent applications for patents in this country concerning aircraft is one relating to landing gear. It particularly has reference to a ski apparatus.

The inventor has aimed to construct a ski unit which may be easily and rapidly attached to the ordinary undercarriage without necessitating the removal of the wheels. He asserts that hitherto an objectionable characteristic of this type of ski is that, although the principle applied has usually been correct, the involved nature of the construction has inevitably produced structural weakness, excessive weight, and similar handicaps. It is one of the objects of the design to overcome these undesirable features.

A further object is to retain the shock-absorbing qualities of the undercarriage and pneumatic tyres.

The inventor has also had in view facility in the replacement of parts, low manufacturing cost, and a maximum of streamlining in conjunction with a maximum of strength.

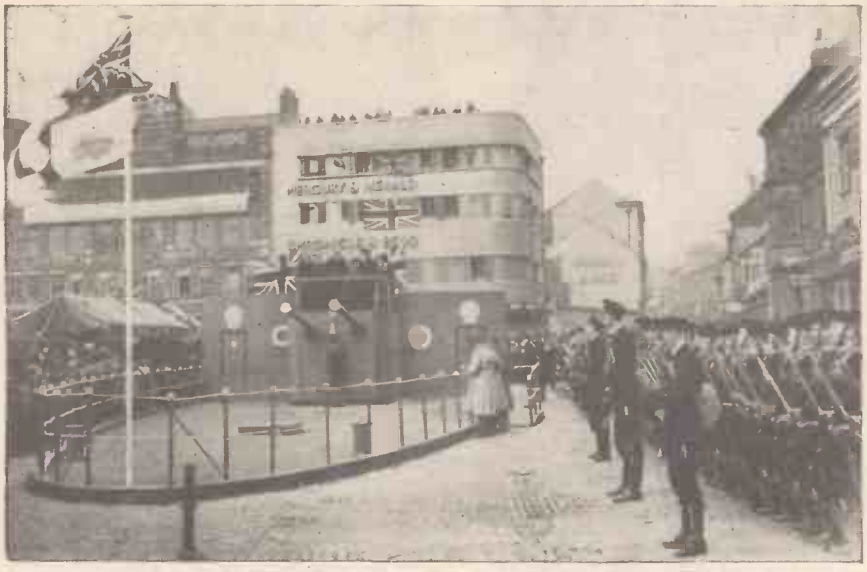
The ski mechanism includes a yoke hinged to the wheel axle of an aircraft undercarriage at one end and hinged to a ski at the opposite end. There is a cable practically plumb between the wheel axle and the ski. And fore and aft of the ski are cheek cables.

A sectional model of the giant 200-inch telescope observatory erected on Mount Palomar, in Southern California. In the illustration Sam Orkin, the creator of the observatory, is seen pointing out the workings to Charles Correl.

THE WORLD OF MODELS

By "MOTILUS"

A Display of Ship Models for Warships Week



The Mayor of Northampton introducing the First Lord of the Admiralty, the Rt. Hon. A. V. Alexander, on the occasion of Northampton's Warships Week.

WAR Savings Weeks and War Weapons Weeks are the feature of every city, town and village in the United Kingdom to-day, and I suppose there never was such a demand for the loan of models of warships to stimulate the efforts.

Unfortunately, commercial model making, except on work of national importance, is now at a standstill, and most goods that were stock have long since been disposed of, so the only models available are those privately owned.

Some towns, as, for instance, Northampton, featured a full-size model of the deck of a warship. Our illustration shows the quarter deck of *H.M.S. Laforey*, which was built up on the Market Square at Northampton. The Warships Week was opened by a visit from the First Lord of the Admiralty, the the Rt. Hon. A. V. Alexander, who addressed the huge crowd assembled, from the bridge.

Another idea that has quite recently been developed is the promotion of competitions among schools in the district for the making of model warships, aircraft and other war weapons which lend themselves to modelling.

A Fine Model Display

At Rushden—a small town in Northamptonshire—a really fine display was made. Entries came from four Rushden schools and three others in the district, with the result that for the Warships Week there were over 150 ship models—all made by scholars from 11 to 14 years of age—and including all manner of warships, aircraft-carriers, sloops, corvettes, destroyers, mine-layers, cruisers, submarines and other small craft. The drawings for this competition were supplied by the National Savings Committee of London, and have been issued specially for use in competitions of this sort. The drawings I have seen are of the *Ark Royal*, a naval sloop, a motor torpedo-boat, and a trawler. They are very carefully laid out, and the instructions on the back of the drawing contain useful information.

Two of the illustrations on this page give a fair idea of the Rushden display, which was judged by Mr. W. J. Bassett-Lowke and Mr. H. W. Franklin, of Bassett-Lowke, Ltd. Mr. A. Woodhead, H.M. Inspector of Schools, and Alderman C. W. Horrell were present at the judging, and the six pounds prize money was the gift of Mr. Horrell and Mr. A. Miles.

The prize-winners were: Over 14—Kenneth Sugars, of Higham Ferrers; 13 years—Gordon Wilby, of Rushden Alfred Street School; 12 years—Frank Tandy, of Rushden Intermediate School; 11 years—A. Lomas and W. Baegan, of Raunds; and under 11—Brian Tarry and Margaret Spencer, of Rushden Alfred Street School.

Some of the prize-winning models at Rushden's Warship Week.

The display was on for a week only—with copper for admission—and raised over ten pounds. It was evidently a very popular feature, and it appears that scores of small children *compelled* their parents to attend!

The organiser of the exhibition was Mr. S. A. Lawrence, headmaster of the Alfred Street School; and the total amount raised during the week was over £200,000, and the destroyer *H.M.S. Quorn* was adopted.

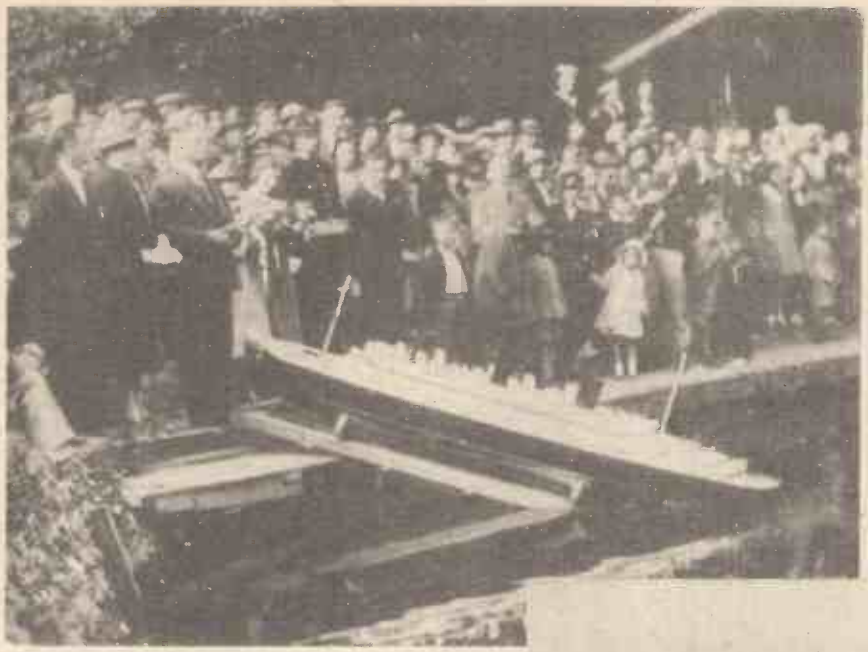
In addition to models in wood and metal, there were also book-ends and titles from the Alfred Street School pottery class, featuring ships or parts of them. There were also models of aircraft loaned by the R.A.F., and ship models loaned by the Rev. Macklin, of Iver, Bucks.

Now, here is a splendid idea by which the education authorities can help the Warships Weeks in providing exhibitions, and also at the same time instruct boys at school in the useful hobby of model making.

A general view of the fine model display at Rushden.

War-time Offer

Some of my friends who are not "OO" gauge enthusiasts, but still cling to gauges 1 and 2 (which certainly have "points" where space is available), complain that it is time they had a war-time offer of goods rolling stock. So I thought it rather opportune when I was in Bassett-Lowke's Holborn shop the other week that they were offering some pre-grouping 2-inch scale model goods brake vans



Launching of a model "Queen Mary" by the Mayoress of High Wycombe. This is one of the models built by Mr. J. R. L. Aldridge, of High Wycombe.

at the very attractive price of 14s. for three vehicles—their 10-ton G.W.R., L.N.W.R. and M.R. goods brakes—plus postage. Certain of the vehicles they are offering separately at 5s. each, plus postage. Although these are gauge 2 scale, they can also be supplied with the wheels altered to gauge 1 without extra charge. They are the standard pre-war lithographed tinplate vehicles fitted with cast wheels, and are excellent value.

Two Fine Model Liners

This war has seen the loss of many large and beautiful ships, the most recent being the French super-liner *Normandie*. At the time of writing it is not certain whether she will become a total wreck or whether America's workmen will be able to salvage and re-condition her for war purposes.

There are two ships we hope will survive the war, and these are the Cunard-White Star liners *Queen Mary* and *Queen Elizabeth*, and here are models of them made by Mr. Joseph R. L. Aldridge, of High Wycombe, to a scale of $\frac{1}{8}$ in. to the foot.

Mr. Aldridge tells me his *Queen Mary* model was begun on Whit Monday in 1937. He says: "I first made a large wood mould—semi-solid—of old timber taken from a house that was pulled down in the village. I then cut some stout tin ribs, about $\frac{1}{2}$ in. wide, and fixed them on to the mould, starting on the stern and spacing them 2 ins. apart. When I had worked on these to the extent of about 3 ft. I obtained some tins from a friend, cut them into strips and shaped them to fit, soldering them on to the ribs, each plate overlapping the other. When I came to the stern I cut a kerf with my hand-saw right down the centre line, and this had a piece of steel $\frac{3}{4}$ in. x $\frac{1}{8}$ in. thick shaped to the correct curve, and all plates were soldered to this, making a very strong job. For a distance of 18 ins. from the stem a double bottom was plated and made water-tight—a fine job taking months to do."

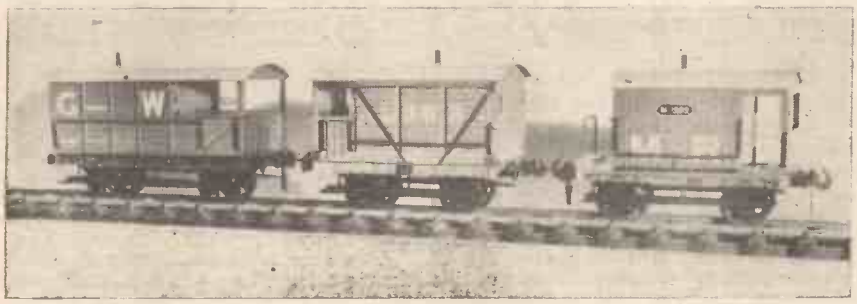
When taken from the mould this hull was given two coats of good lead paint inside and out. A transom was fixed inside the bottom of the hull to save "breaking its back." Bulkheads were fitted, and also stringers alongside the hull, held in position by girders and columns. These were spaced to allow the batteries and motor to come into position. Everything on these models has been made from scrap, using all manner of material; the decks were made from piano sound-boxes and lined out with indian ink. The funnels were made on a former. They are banded, and have eyes for stays in quite the correct way. All lifeboats have blocks and tackle, each one has a $\frac{3}{16}$ in. propeller and removable rudder; each winch has seven pieces, and to put these together is quite an enjoyable job. The ventilators are built up with grid fronts, and the fairleads and bollards are also built up; the model took nearly two years to complete. The only things bought were the hand rail wire and stanchions from Bassett-Lowke's at Northampton. The model was launched by the Mayoress of High Wycombe on July 1st, 1939—some 4,000 people being present.

The model "Queen Elizabeth," built by Mr. J. R. L. Aldridge.

"Queen Elizabeth" Model

When Mr. Aldridge decided to make a *Queen Elizabeth* model there wasn't a drawing available, but he saw in the papers that Bassett-Lowke, Ltd., had made a large model for the British Pavilion at the World's Fair in New York. He wrote to them immediately for assistance, and they sent him six photographs of their model during its various stages of progress. With these he set to work on his model, and the result shown on this page is a splendid effort—11 ft. long and 19½ ins. in the beam. Her Majesty Queen Elizabeth has accepted a similar picture of this model.

Mr. Aldridge is 58 years old, and served in the last war in the R.F.C. His latest effort is a 10 ft. 6 in. destroyer, which his wife presented to the naval cadets at High Wycombe recently. His *Queen Mary* and *Queen Elizabeth* models have been on exhibition many times for war charities.

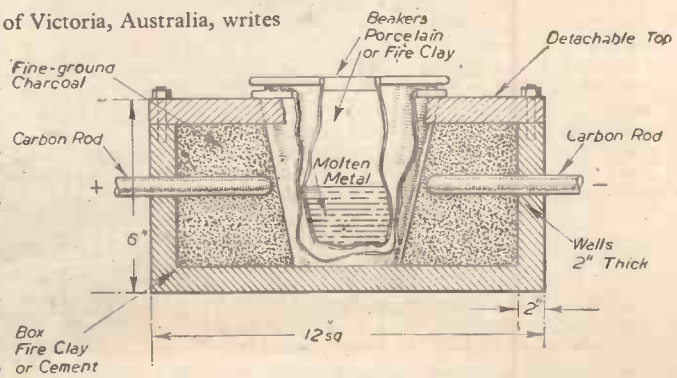


The three 2-inch gauge wagons which were being offered at a bargain price.

Melting Aluminium

A READER, D. Cook, of Victoria, Australia, writes as follows:

"I noticed in a recent issue, in the Queries and Enquiries columns, that a reader wanted to know how to melt aluminium, and also brass. I have not yet tried to melt any other metal. The accompanying sketch gives details of the electric furnace I used. Trusting this information will help many other readers."



Section through a simple electric furnace for melting aluminium.

QUERIES and ENQUIRIES

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

Ballasting a Model Ship

I AM making a model of an old-time sailing ship and I want advice on how to ballast it. Should I fix a weight, equal to the weight of the spars, sails and rigging on to the lower "top" of the main mast and get the ship to float on an even keel like that, or should the weight be placed higher up? If it should be higher up, please tell me where to put it.

The weight of the masts, spars and sails is about 6oz., and as I want the ship to float correctly, I intend to put a temporary weight on the main mast, and then put some permanent ballast in the hold. The weight would then be removed and when the ship is fully rigged it would float correctly. I would not put on the sails until I had ballasted it, as they would get in the way. What I want to know is exactly where the temporary weight should be put.—J. D. Wild (Mill Hill).

IT would appear to be the obvious thing to do to make the yards and sails—as they will have to be made eventually—and to hang them on the masts in a temporary manner. In any case you will need to know the approximate weights of them. The total weight of them will be the amount to place on the masts and the approximate positions, distributed over the three masts, will, in a ship of the *Great Michael* type, be just about where you suggest, viz., in the "tops."

Actually there is no need to go to this trouble at all, unless you are going to make sails and yards which are excessively heavy.

You must bear in mind that wind pressure on the beam is by far the greatest capsizing factor, and it is this which the hold ballast is required to counterbalance.

Inter-geared Shafts at Right Angles

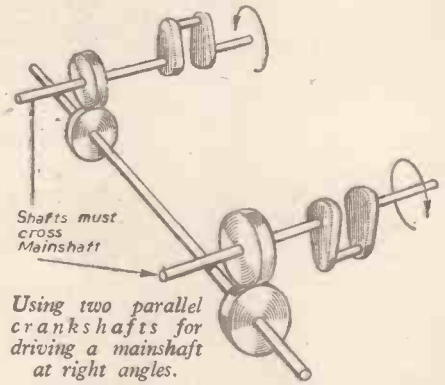
I HAVE to lay out a sound job, using two crankshafts parallel to one another, driving a mainshaft at right angles, as shown in the sketch. Another job would have an extra pair of crankshafts arranged below the mainshaft in the same relative positions as the crankshafts shown.

The gearing would have to be as silent as possible at 3,000-4,000 r.p.m., and reversible, and about 50 h.p. is contemplated for the smaller size job; a reduction of about 2-1 is desirable from crankshaft to mainshaft.

Freedom from backlash and consequent "getting out of phase" of the two crankshafts presents the biggest problem to me. On what lines would you recommend this problem to be tackled?—A. G. Fenn (Bristol).

WE recommend that the drive be taken from one crankshaft to the other through spur gears. So far as can be judged from your sketch the simple procedure of mounting one spur gear on each crankshaft and allowing them to mesh directly would probably demand undesirably large diameters. The alternative in that case is to provide two intermediate idler gears so that the crankshafts have opposite directions of rotation.

This same general scheme could also be adopted in the case of the larger machine which has four crankshafts. There would be two idler gears arranged with their centre lines on a horizontal plane half-way between the two horizontal planes containing the centre lines of the crankshafts.



Using two parallel crankshafts for driving a mainshaft at right angles.

In order to ensure quiet running, profile grinding of the teeth would probably be necessary, and if arrangements could be made to provide the necessary thrust bearings, a further improvement would be effected by the use of single helical teeth.

Circle of Confusion

WILL you please tell me what is the circle of confusion of my camera? I have a dolly taking 27 film, of 2in. focal length, Xenon f2, Compur shutter to 1/300th, focusing down to 3ft.—R. Woodward (Eltham).

A POINT of light when projected by a lens will on the image show as a dot of small diameter, and it is the diameter of this dot that is referred to as the circle of confusion. It should, of course, be as small as possible. If a point appears as a dot less than 1/100in. diameter, the picture will appear reasonably sharp on a contact print. If the negative is for enlargement, a sharper image would be required, say 1/200in. Modern miniature cameras produce much sharper images than this, the circle of confusion being smaller than the silver grains in the plate, unless special fine grain film is used. Negatives made with such cameras and film will stand great enlargement.

Bottled Gas for Cars!

CAN you tell me if town gas can be stored in calor gas cylinders for use in a car, and, if so, how many cubic feet of gas could be introduced into one container? What mileage could be expected from a thousand cubic feet of gas?—J. W. Boot (Sutton).

IT is not practical to use bottled gas cylinders for town gas. The cylinders are of light construction for pressures of the order of 30 to 35lb. per square inch, and they are usually tested to 200 lbs. per square inch. At 35lb. per square inch a bottled gas cylinder would hold about 6 cubic feet of town gas, equivalent to 1/50 gallon of petrol. For transport purposes town gas is usually stored at 3,000lb. per square inch, a pressure which requires cylinders of very much heavier construction.

Practical tests show that 250 to 300 cubic feet of town gas of 500 B.Th.U. per cubic foot calorific value are equal to one gallon of petrol. A thousand cubic feet of town gas will, therefore, be equivalent to between 3.3 and 4 gallons of petrol. On a ten horse-power car this would be roughly equivalent to 100 to 120 miles per 1,000 cubic feet of gas.

Making Liquid Glue

FOR some time I have been attempting to make a liquid glue.

I had in mind something like the glues sold in tubes for universal repairs, etc. Any help you could give me, or any recipe would be much appreciated.—G. Cropper (Greenock).

MANY of the published formulæ for making liquid glue are woefully wrong. In the main, gelatine glues are liquefied by means of formic acid.

Take a quantity of ordinary fish glue and soak it in water for 24 hours to allow it to swell up to a maximum. After this time, heat the glue in the usual way, aiming at making a very strong, thick solution. Whilst this is still hot, add from 1 to 2 per cent. of its weight of strong formic acid (commercial strength). Stir well and allow the glue to cool. It will remain liquid, its degree of fluidity depending upon the amount of formic acid incorporated.

You may have a difficulty in obtaining formic acid. If so, you can obtain this acid from Messrs. A. Boake, Roberts & Co., Ltd. (emergency address), "Ellerslie," Buckhurst Hill, Essex. If for any reason you cannot obtain formic acid, acetic acid may be used in its place.

THE Cyclist

Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

Cycles Only

THE National Association of Cycle Traders has decided by a majority to drop the motor-cycle side of the Association, and to concentrate entirely on the cycle side of the industry. It has, therefore, dropped the motor-cycle portion of its title, and now becomes the N.A.C.T. This move, in conjunction with the new Institute which will grade dealers according to their ability, is a move which has been long overdue. How far it will overlap the work of the Manufacturers' Union we do not know. The Manufacturers' Union has for many years worked for the improvement of the cycle industry, and traders generally have benefited by that work, which thereby also benefits the public.

But retail cycling has been in need of a cleansing of the Augean stables for many years, for almost anyone could sell bicycles and accessories, and there was little thought for public service. Few dealers dealt entirely in bicycles, for the sale of motor-cycles was found to be more profitable. In the early days of bicycles, before the motor-cycle and the motor-car were anything more than practical possibilities, a dealer perforce dealt only in bicycles and accessories, with perhaps petrol as a sideline at 10d. a gallon. Even in those days, however, cycle repair was anybody's job. Usually it was the work of a local blacksmith, who hammered the cranks straight, or replaced a spoke. For some reason cycle repair has never been regarded as a profession, or even as a trade. A bicycle is a simple device, the mechanism of which can be mastered in a few weeks. Such repairs as can be undertaken more cheaply than replacement can certainly be mastered in a year. These consist chiefly of brazing and soldering, and the replacing of bearings. There is no great skill required, and there is little wonder in an industry which for the past quarter of a century has developed on price lines—producing bicycles more cheaply each year—that few, if any, have considered the bicycle trade as one which provides prospects for a living.

Sidelines

NO one wishes to be apprenticed as a cycle mechanic, and there are many dealers who could not exist on the cycle trade alone; therefore they have sidelines such as motor-cycles, gramophones, wireless sets and similar articles in ready demand.

Whilst the new institute of cycle repairers is a good move, it must be many years before it makes its presence felt. The present generation of cycle repairers are not likely to go out of business because they are not able to pass an examination. If they become members of the institute by virtue of their long association with the trade, and hence without examination, even though they may be incompetent as cycle mechanics, the position is as before the institute was formed. The institute, in other words, will not put out of business those which it feels ought not to be in business. The institute is rather aiming to improve matters for posterity, and even then it will only succeed if bicycles are made to some extent irrespective of price where service fees can extend beyond the few pence at present charged, so that adequate wages can be paid.

Some blame attaches to manufacturers for this state of affairs. They have presumed that bicycles have reached finality in design when there are many portions of a bicycle which need to be improved. We have drawn attention to many in past issues of this journal. There is reason to believe that post-war bicycles will be a different mechanism to what we now know. Many firms will leave the cut-price market, and enter the quality market, and, we think, wisely. Bicycles have been too cheap, and quite often they have been nasty.

Defects in Bicycle Design

IT may be that many of the defects in bicycle design and in the selling of bicycles is due to the fact that those responsible hang on to office too long. They may presume that what was good enough 50 years ago is good enough to-day. Perhaps their ideas have not been kept up to date. A little fresh blood here and there might do good. There has been talk of a formation of an institute of cycle repairers for 30 years or so. Now it is an accomplished fact time alone can prove the justification for its existence. There was such an institute, but it went out of existence, having, as it was then thought, outlived its period of usefulness.

It will only attain its ideals if it works in close co-operation with and not antagonistic to the Manufacturers' Union. The interests of the manufacturer and the dealer are as one, and if in the past the dealer has regarded the manufacturer as his natural enemy we cannot blame the manufacturer too much for that. If the present institute, and the decision of the National Association to concentrate entirely on the sale of bicycles and to ensure that those who sell them are really qualified, is an earnest of a new order at a time when all countries are thinking of new orders, then it must operate for the good of the cycling public. We believe that that is the intention, and therefore we advise the National Association, which has also sponsored the new institute, to forget the old traditions and the old personalities, and to introduce some new blood into the body into which they desire to infuse new life. We wish the N.A. and its efforts well.

The Problem of Helpers

THE new restrictions on the use of petrol which will come into force a few weeks hence will provide problems for promoters of Opens. In past years it has been the custom to enlist the use of cars for transporting the various helpers round the course. The feeding, the sponges, and the drinks are weighty items in a field of 100 or so. Before motor-cars were used it was the custom for the helpers to arrive the night before, and to sleep in the open if necessary to await the riders in the morning. Lack of cars will not hamper road sport. We shall revert to the old system even though it be at some inconvenience to those who during the war are working long hours and have not the necessary leisure to spare to make a Saturday and Sunday event of it. The help has always been forthcoming in spite of the difficulties. The R.T.T.C. might usefully consider forming a panel of helpers through their District Councils so that any club experiencing difficulty in the matter of help can appeal to the secretary for it. That in itself might create a difficulty during particular week-ends when a number of important events is being run at the same time.

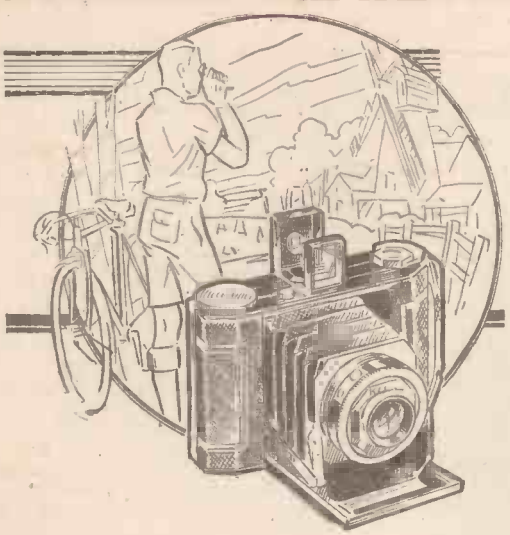
Perhaps during the war feeding could be dropped, or the riders themselves make their own arrangements for feeding. In the earlier days of road trials that is what the riders did, and those were days when trials were harder, if slower, than they are to-day.

Trade Discipline

THE National Association has set up a Trade Disciplinary Committee upon which we adversely commented in the previous issue. The National Association, according to its announcement, intended to haul before its Committee any dealer guilty of a breach of trade ethics or unprofessional conduct, and we pointed out that it had no authority to do this; especially is this so in the case of a man who is not a member of the N.A. We pointed out that the existing Cycle Trade Union already had powers to deal with the matter. This Union was founded to encourage, promote and protect the cycle and motor-cycle and cycle car industry, and to safeguard the general interest of users of cycle and motor-cycle goods, and of firms and persons engaged in the wholesale and retail sides of those industries, against the operations of scrupulous traders. The Union still carries on this work, but has had no occasion to exercise its disciplinary powers in recent times. No one wishes to support an unscrupulous trader and we are all in favour of bringing him to book. At the same time we are equally opposed by any attempt of any body to arrogate to itself the powers of a dictatorship, and to attempt to exercise control over people where they have no right of control. An unscrupulous trader can be brought to book through the process of the courts, as well as by placing him on the Stop List.

Dissension in a New Club

IN our issue dated January, 1942, we referred to the formation of a club for cyclists, and adversely commented upon the fact that the election could only be by a unanimous vote. After but a very short period of existence a circular letter has been sent to every member of the club, in which the chairman, secretary and committee tender their resignations. Apparently the committee are objecting to the interpretation of the rules. Many important members of the cycling industry and pastime who have applied for membership have been blackballed, and quite naturally the secretary objects to writing frequent letters to rebuffed applicants. It is difficult to understand the position, since the committee must have had a large hand in framing the rules. We shall deal with this matter more fully next month.



Paragrams

Club Members Back
NELSON WHEELERS have welcomed back to membership T. Crowther, who has been riding for the Derbyshire Road Club, and W. O. Jackson, holder of Lancashire Road Club 50-mile competition record.

Well-known Tourer's Death
ABRAHAM WREN RUMNEY, one of the most notable figures in the history of cycle touring, has died. He had toured in various parts of Europe and the Middle East.

A Promising Youngster
C. F. VALENTINE, Southgate C.C., is a youngster to be watched. Already he has figured prominently in time trials in the London area.

Clarion Meet
THE annual Clarion Meet was held at Leicester at Easter. It was the 47th of the series.

Diamond Jubilee
TO mark its diamond jubilee, University C.C. is staging three open events this season.

Crack Riders Join Up
SEVEN of the crack riders who made up the formidable array of hill-climbers in the Barnet C.C. have joined up.

Anfield B.C.
THE president of the Anfield B.C., H. Green, attended each of the club's 1941 fixtures. Over 150 Anfielders are now serving with H.M. forces.

Club Members in R.A.F.
HARRY HIGH, former hon. treasurer of the Steelopolis C.C., and G. F. Clark, North Worcester Road Club, are both in the same R.A.F. squadron in the Near East.

Cyclists in Middle East
GEORGE NIGHTINGALE, Charlotteville C.C., winner of many open events and one of the country's fastest 25-milers, is with the Middle East Forces, and has met other cyclists, including a club-mate (H. Burdock) and N. Heathcote and W. Carvey (Swindon Wheelers).

Jimmy Purves Missing
JIMMY PURVES, well-known Vegetarian C.C. member, previously reported missing in the Middle East, is again starred as missing. Six months ago he was "captured" by Vichy French in Syria and subsequently released.

Manchester N.C.U.
H. S. ANDERSON has been elected chairman of the N.C.U. Manchester Centre for the 16th consecutive year.

Essex N.C.U. Secretary
D. W. BRUNWIN, Brentwood Wheelers, has taken over the secretaryship of the N.C.U. Essex Centre.

South London Road Club
THE old-standing 13th Wheelers C.C., has changed its name to the South London Road Club.

Committeeman for 25 Years
PERCY BRAZENDALE has served on the committee of the C.T.C. Liverpool District Association for 25 years

Prisoner of War
HARRY WILKINSON, Oldham Century Road Club, is a prisoner of war in Germany.

Bradford Club Carries On
PENNINE C.C. (Bradford) is still carrying on although 40 of its members are serving with H.M. Forces.

Scottish Open Events
WEST of Scotland T.T.A. and the Mid-Scotland T.T.A. plan 27 open events this year.

Lanark R.C. Disbands
THE famous Lanarkshire Roads Club has disbanded for duration.

Cyclists Safe in Far East
NEWS has been received that H. Burgess, Bronte Wheelers, and B. Williamson, Pennine C.C., are safe after troublesome times in the Far East.

Clarion Member Missing
J. DENHAM, Southampton centre of the Clarion, an observer in the R.A.F., has been posted as "missing" in the Near East.

Liverpool Association Time Trials
RUMOURS that the Liverpool Association will not be staging time trials this year can now be disregarded.

Comforts for the Forces
ANFIELD B.C. members have spent £42 on parcels of comforts for serving members.

Southgate C.C. Club Events
SOUTHGATE Cycling Club have reduced entry fees to club events from 2s. 6d. to 1s. and abolished medals and prizes for duration. All winning rides will be certified.

Ilford R.C. Carrying On
ALTHOUGH their active membership has been greatly decreased, Ilford Road Club are determined to carry on.

C.C. Attached to Fleet Air Arm
DUNDEE and District T.T.A. have been notified of a new club in their area. It is attached to the Fleet Air Arm!

Prisoner of War
DAVE BREWSTER, Lochee member of the C.T.C., is known to be a prisoner of war in Italy. He was "missing" for months.

Vice-President of Priory Wheelers
CAPT. L. D. GAMMANS, M.P., has accepted vice-presidency of the Priory Wheelers.

Cyclist Boxer
GEORGE LEM, Steelopolis C.C., who is with the Royal Artillery in Scotland, won the Highland Division light-heavy-weight boxing championship.

Clubman in B.D.S.
ENTHUSIASTIC member of the Glamorgan Road Club, Lt. G. A. Gwilliam now serves in the Royal Engineer Bomb Disposal Squad.

Cyclist Has a Memorial
A GLASGOW A.R.P. cyclist messenger, Neil Leitch, who lost his life during a blitz on Clydeside, recently had a memorial erected to his memory. Sir Patrick Dollan unveiled the memorial.

Still a Shilling
REPRESENTATIVES of the 21,000 cyclists and hikers in the Scottish Y.H.A., meeting in Edinburgh, decided to keep the one shilling per night fee. E. St. John Catchpool, secretary of the Y.H.A. of England and Wales, was present.

Films for Publicity
THE youth hostels movements are using films for publicity to a greater extent than formerly. Two colour films of Scots hostels events in 1941, and of tours in the Lake District and the Trossachs, have just been released.

Police Watching Norwich Cyclists
SPECIALLY detailed police have been set to watch for cycling offenders at Norwich. This has resulted in the number of accidents being reduced by 50 per cent., according to a report given by the Chief Constable.

Hostels Hunts
CYCLISTS in Lanarkshire are holding organised "Hostels Hunts" to add to the number of youth hostels in Scotland. They scour the countryside in search of empty buildings which might make good hostels.

American Soldiers Buy British
MEMBERS of the American Forces at present in the British Isles are buying British bicycles. They are attracted by the speedy lines and easy running of machines made in Britain.

No Lights in Moonlight
AT a Home Counties court recently, two cyclists told the magistrates that they rode their machines without lights early one morning because the moon was shining.

Touring in the North
TOURING in the North of Scotland is now possible again. The Government has lifted the ban on travelling in much of the area north and north-west of Inverness.

Bicycle Tyres in Black Market
EIRE has a black market in bicycle tyres. According to a Dublin report, £5 has been charged for a 9s. cover.

New Hostel Opened
A NEW youth hostel was opened in time for Easter at Tun House, Whitwell, Hertfordshire.

Awkward Corner on End-to-End
AN awkward corner at Dunblane, on the End-to-End route, has been removed by the making of a new bridge and approach roads.

Cycling Poachers
EAST Anglian magistrates have warned cycling poachers that they are being watched, and will be severely dealt with in future.

Devon Inn Damaged
THE Old Ship Tavern, at Bideford, Devon, which figured in "Westward Ho," has been damaged by fire. The inn is well known to tourists.

Highland Hostels Available!
EVERY effort is being made to reopen the youth hostels at Ullapool, Achiltibuie, and Badbea, in the North-west Highlands, in time for summer.

Society of Cycling Antiquarians
THE suggestion has been made that a Society of Cycling Antiquarians, to cater for people interested in old bicycles, should be founded.

Sussex Acres for State
ABOUT a thousand acres of woodland at Goodwood, in Sussex, have been left to the nation by Sir Francis D'Arcy Cooper, chairman of Lever Bros.

Cyclists Run "Brains Trust"
EARLY in April Scottish cyclists ran the first session of a "Brains Trust" in Glasgow, in which a team representing various cycling interests answered questions by an audience of wheelmen.

By-passes Only Partial Solution
SPEAKING at Edinburgh last month, Mr. W. A. Macartney, Burgh Engineer, said that by-passes were useful, but only a partial solution of the congestion problem, although cheaper in effect than the widening of roadways in densely-populated areas.

Cumnock Rally News
THERE is to be one speaker only at this year's Cumnock Rally. Other arrangements, including camping fees, are to stand as in past years. Already national and local trade interests have donated prizes.

Soviet Soldier Cyclists
THE bicycle is playing a great part in the war on the Eastern Front. All Russian machine-gunners, tank busters, automatic riflemen and nurses, must know how to ride a bicycle, according to a recent order. In Moscow, the Committee for Physical Culture has begun to train special cyclist groups. For summer campaigning, cyclists are to replace the mobile ski units.

New Hostels Handbook
THE 1942 edition of the handbook of the Youth Hostels Association of England and Wales contains full details of some 170 youth hostels at present open. There are also special items dealing with war-time travel, while the cover is in itself an invitation to cycle.

Copies are obtainable from the Y.H.A., 16, Meadow Way, Welwyn Garden City, Hertfordshire.

Scots Girl Weds
NAN MUIR, the leading Scots time trialist in pre-war days, was married recently to Bob Charles, who is serving in the Royal Navy. The new Mrs. Charles clocked the fastest 25 ever done on the road by a Scots girl just before the war. Both Mr. and Mrs. Charles are members of Thornliebank (Glasgow) Clarion C.C.

A quaint corner of Dartmouth, South Devon.

Around the Wheelworld

By ICARUS

In Honour of the Editor

A LUNCHEON was given by a number of the older members of the Bath Road Club at a West End restaurant recently in honour of the services of the Editor of this journal, Mr. F. J. Camm. Those present included the founder member, W. G. James, Percy Beardwood, J. Dudley Daymond, S. M. Vanheems, J. Callway, E. Coles-Webb, J. Westaway, T. E. Osborne, W. Hinds, A. H. Bentley, C. A. (Bath Road) Smith, Reggie West, J. E. Rawlinson, Frank Smith and H. Frost. Of these, no fewer than four were ex-editors of the *Bath Road News*, the old-established journal of the Bath Road Club, which in recent months has been made even more famous by its past editor, who was the guest of honour on this occasion. W. G. James is the only living founder member of the club who was present at that historic meeting at the New Inn, Ham Common, in 1886. Daymond, Vanheems, W. G. James and Beardwood are vice-presidents; while the famous C. A. (Bath Road) Smith, who did so much for the Bath Road Club, and founded and edited the *Bath Road News*, is the first and only hon. life member of the club, whose rules were specially changed in order that the honour might be conferred upon him. He was President for many years. Past editors present were: S. M. Vanheems, T. E. Osborne, C. A. Smith and Frank Smith. No fewer than 14 speakers paid tribute to the guest of honour.

Arising out of this luncheon was an interesting suggestion, of which more later.

The Charlotteville "50"

ONE of the most attractive and representative entries for many years rewarded the promoters of the classic Charlotteville "50" which was run off on the Bath Road course on Easter Sunday. Of the starters no fewer than 10 had accomplished 2 hrs. 10 min. over the course, and 22 clubs had teams riding. The conditions were not ideal and the going was hard. This is apparent from the fact that only 14 of the 85 starters beat evens to the turn. The event was noteworthy for the number of punctures. Crowther and Palmer, for example, had three each, and last year's winner, L. Thorpe, also had three. Pope had one, Pape had one, and Roberts two. Fleming was afflicted with a slow puncture, but changed machines.

The win at 2 hrs. 14 min. 33 sec. by E. Gale, of the Leamington C. and A.C., provided a surprise for all. At the turn he was in fifth place, but on the return journey he was almost a minute faster than any other rider, while Doody, his club mate, went up from 11th place at the turn to sixth at the finish. The Leamington club had a lead of 5 min. over Ealing Manor in the team race. Fastest to the turn was Fleming, at 1 hr. 10 min. 5 sec., Pape being second at 1 hr. 11 min. 24 sec. Each of these punctured on the return journey. Gorman was third at the turn at 1 hr. 11 min. 41 sec., while Roberts was fourth at 1 hr. 12 min. Gorman picked up three minutes on Fleming on the way home and thus ran into second place at 2 hr. 15 min. 44 sec., with Fleming third at 2 hr. 16 min. 51 sec. Vic. Jenner, of the Charlotteville, did not start owing to a cold. Unfortunately, Paul's entry was received too late. Twenty-seven did not finish, and there were 15 non-starters. The Leamington C. and A.C. (Gale, Doody, Sargisson) won the team race at 6 hr. 54 min. 50 sec.; Ealing Manor was second at 6 hr. 59 min. 44 sec., and Addiscombe third at 7 hr. 6 min. 48 sec.

Herne Hill Track

WE understand that Herne Hill Track has been leased by the N.C.U. for a period of 21 years from the owners, Dulwich College.

New N.C.U. Judge

JACK SIBBET has been appointed as N.C.U. judge. This old member of the Manchester Wheelers, so closely associated with the Fallowfield meetings and now a veteran, still maintains his keen interest in the pastime. Fifteen or so years ago Sibbet was famous as a competitor on the track, and he has raced all over the world. With Ernie Chambers he competed in tandem events, and the pair were national champions on six occasions between 1928 and 1937. He was N.C.U. five-miles champion in 1922, sprint champion in 1925, and also in 1931 and 1932.

The Cycle Engineers' Institute

IT is not generally known that a trade association known as the Cycle Engineers' Institute existed many years ago and it did a vast amount of research work in connection with the bicycle. It later became the Institution of Automobile Engineers.

In spite of the investigation into bicycle design, which had been made not only by trade associations but by such authorities as the late Paul Renouf, and particularly by Prof. Sharpe, who wrote the standard book on the subject, it is surprising that there are still many defects in bicycle design. No one has yet foiled the cycle thief by means of a device incorporated in the bicycle itself. We are still using antiquated cone bearings, which are screwed on to a spindle, and cannot possibly be accurate. My colleague, C. A. Smith, has already drawn attention to defects in chain-wheel design. After the war, however, I am quite certain that there will be some really high-grade bicycles made irrespective of price, which will break away from the traditional assembly of standard parts which comprises many of our modern machines; especially should annular bearings be used. I know that experimental work is proceeding along these lines. The bicycle in later years has always made its appeal on the question of price, but I believe there is a large potential market for a machine which is not made down to a price, but made up to a standard of quality. I am not decrying the mass-produced bicycle as distinct from the bash-produced bicycle, or the cash-produced bicycle. They are all good value for the money. I think it is wrong, however, to presume that everyone who wants to ride a bicycle wants to spend the smallest possible sum in purchasing it. This cannot be true, otherwise expensive watches would not be made, nor expensive motor-cars, nor expensive clothes or furniture.

I hope the trade are thinking along these lines, too, because it is absurd to presume that bicycles have reached finality in design and that there is no room for further improvement.

Oil

A MINISTRY OF SUPPLY Order will soon make it impossible for cyclists to obtain oil in tins, and the County Chemical Company point out that this Order will affect the supply of their well-known tins of Nonclog Oil with spout. Oil will be supplied in future in one of two ways, either from the agents in bulk, or in bottles, so that every cyclist should preserve his present oil tin, and have it refilled from time to time.

Dynamo Lighting

ONE of my readers, Mr. P. Colborne, of Swindon, in a letter, replies to Frank Urry's criticism of dynamo lighting. This reader says that the weight of dynamo at present in use is about 1½ lb., which compares with 1¼ lb. of a good quality long-life battery lamp. Permanent fixture gets rid of rattles; with a battery lamp, rattles and vibration are fatal both to lamp and battery. The battery lamp incorporates at least three contacts or more if a dimming switch is used. The pressure is 3 volts, which is insufficient to overcome a high resistance caused by bad contact, corrosion or rust. The dynamo of 6 or 8 volts has all contacts of the terminal type if the two-wire system is used. Dynamo drag can be reduced by fitting a large size pulley or a ring on the existing pulley. Such a ring riveted to the pulley and carrying a small section of rubber tyre has been found quite satisfactory, and the light emitted is only slightly reduced at 10 miles per hour for half the drag. It is suggested that a dimming switch fitted to the handlebar should be useful to fast night riders.

WAYSIDE THOUGHTS

By F. J. URRY

The Disinterested Attitude

THERE seems to be a tendency at home to consider that the utility cyclist does not need what is called a high-class machine for his daily peregrinations. The standard pattern will do the job for him, and that's that, and there is no reason to consider the matter further. Probably this notion has arisen to some extent because the war output of bicycles is likely to be confined to the utility type of machine, with most of the specialities like speed-gears, light tyres, the best saddles, the best brakes—that go to equip the high-class bicycle—withdrawn from the market. But that reason is not wholly true, because it has been recently said that the standard bicycle is "the survival of the fittest" for the daily journey, as no man would dream of going to work in a factory attired, say, in holiday costume. But I think such an analogy is false, because the bicycle does not go to work: it merely performs the office of helping to transport the rider more swiftly than walking, more cheaply than any other form of travel. One might just as readily say of the motorist who drives to work that he would be wise to do so in the cheapest type of car he could buy. It is further said by the retail trader that the utility cyclist is the easiest customer to serve; and I've no doubt that is true, for the simple reason that, unfortunately, many dealers take the line of least resistance in selling the article, and do not realise they are or should be—selling something of far greater importance—cycling. Many retailers do not like the racing man, with his numerous fads and fancies, his untutored criticisms, and his ever-changing interest in changing fashions; and I admit he is frequently a nuisance to the busy man, for often he has invested himself with an importance which only a mirror can reflect. Yet I think most traders know how to deal with this type; and, in any case, he is not numerous.

The Ideal Combination

I RAISE this question of the standard bicycle for the utility rider now because I do not want the facts as recited above lost sight of when peace returns, and we can once more buy the best, and so give ourselves the fullest sense of comfort in cycling. I am a utility rider as well as a pleasure cyclist, and have daily ridden to work and home again for more than 45 years. My daily mileage is just over 15, and my annual total, including pleasure cycling, between eight and nine thousand, of which over three thousand is city travel. I ride the best bicycle I can buy and thoroughly enjoy my daily journeys, because they give me the freshest airs blowing and keep me fit. I enjoy these daily journeys because I do them so easily aboard bicycles that represent the very best the factories can make, and the fitness they acquire in me makes pleasure riding a still greater joy. My roadside troubles are wholly concerned with punctures, and in 1941 amounted to a couple of delays, which was higher than the average over many years, due to the abnormal amount of broken glass on the roads. Now, this combination of utility and pleasure riding has never been, in my opinion, fully exploited, nor is it likely to be so long as the trade and the rider is content to say, in effect, "that bicycle is good enough for the workman." If we want cycling to prosper then we must aim at selling the best a man can afford, and so give him a chance to enjoy this mode of travel. There will always be utilitarians whose interest in cycling will be confined to convenience; the folk who, having used their machines for six days a week, do not want to see them again until Monday morning. I have no quarrel with them; they are good customers to the trade within their limits, but lack the "wanderlust" that is in the make-up of most people, but too often lies dormant for lack of opportunity, or advice, to indulge it. Give this type the right bicycle, fitting snugly to the needs of the buyer, point the way to make fuller use of it than the limitations of the home and work journey, and you have done a good deal for cycling.

Glancing Backward

SUCH is the idea I have on the question of cycle expansion after the war, when for a certainty we shall all be poorer, and the need for cheap transport will be greater than ever. When cycling started to attract the public we sold the pastime with the machine. No one bought a bicycle or tricycle unless they wanted to ride and tour. Slowly, as we came closer to manufacturing perfection, the bicycle became cheaper and the number of riders increased. Then Dunlop with his tyre invention brought comfort and ease to the game, the free-wheel made attraction greater and brought the rim brake, then speed gears, and the end of cycle design advance almost seemed in sight with the rise of the motor-car and motor-cycle. For a few years the bicycle was neglected; everyone in the trade thought its day had passed. A few folk still retained faith that so simple and healthy a means of travel could not die. But the use of the bicycle for both utility and pleasure was definitely switched over to the working classes, and we owe it to the forensic ability of Sir Edmund Crane (Hercules) that he realised this soon after the close of the last war and built accordingly. To him more than any other single man we owe the increase in the number of riders from a trifle over three millions in 1921 to well over ten millions in 1939. He taught a fifth of the population of these islands the convenience and economy of cycling; now we ought to go a step farther and teach the cycling and non-cycling populace the pleasure and economy of cycling, and I think it can be done if the pleasure part—without detriment to convenience, indeed with the addition of comfort and ease—is wedded to the propagation of a desire to buy the very best one can afford.

Make the Best of It

AND now let us remember that April is here and all the long days are ahead. They will be busily occupied by most of us and our leisure hours will be few and far between; but there will be some, when we can perch ourselves on a saddle and go and look at the ever-changing countryside, as the beneficent hand of the seasons soothes the rolling shires. Some of us may get a few days' release, when a cruising journey on a bicycle is not only a perfection of freedom in itself, but gives a vision of the glorious land for which we are fighting and working. These short retreats from the noise and grind of the daily task provide a refreshment far more beneficial, in my opinion, than the unsatisfying restfulness of inertia with its boring tendency to grumble at the last meal and speculate on the next. Take your luck in your hands and, if you can persuade one, a friend of like mind, the small adventures of food and accommodation can be overcome. Carry iron rations in case of need, but I do not think you will need them, for my experience on winter rides has been one of pleasant surprise that so many of the old houses of call are doing so excellently for the casual wanderer. You may not be able to travel far, or leave your trail over new country, but every one of us lives within easy distance of open country where the winds blow freely and the great waves of sunshine paint a gigantic landscape. The very thought of these chances to come make me keen to taste once more the freedom of the road that for ever calls the wanderer over the next hill to a harbourage for the night, when the sunset is playing a colour symphony to end a glorious day.

Take Care of Tyres

AGAIN let me issue a note of warning in reference to the supply of tyres. They will be short, and possibly of one type only. There may still be time for you to obtain replacements of your favourite cover, and I advise you to act accordingly. I do not think there is any risk of cycle tyres going out of manufacture, but those of us who have known the comfortable value of the best and lightest makes do not want to be standardised in this matter of equipment if we can avoid it. The other obvious thing is to care for the tyres now in use. Frankly, I admit tyres have never troubled me. When a cover has shown signs of wear or a cut has developed into a slight bulge, then a new one replaced it; but now I am looking for the weak spots and attending to their early repair before they get into the wreckage stage, not as a matter of economy, but for the reasons already given.

My Point of View

BY "WAYFARER"

ON my way home from a little jaunt the other Saturday evening, I was stopped by a fellow cyclist wearing long trousers and a bowler hat, and nonchalantly wheeling his machine, and the question he put to me was: "Is this the way to the north?" While I was figuratively scratching my head—for the enquiry temporarily nonplussed me—he murmured the name Middlesbrough, nearly 200 miles from where we stood. Then—without going into too much detail!—I assured him that he was travelling in the right direction. It is to be hoped that he has reached his destination by now. Had time permitted, I would have liked to ask why he was off to Middlesbrough, and in that garb, and at that time of night.

Ageing Rapidly

ON a recent half-day jaunt, when I paused for tea at a familiar house of call in Shropshire, the caterer's small daughter admitted me, and then went through to the kitchen department to announce my presence, which was done in these terms: "Mummie! It's that very old man!" I seem to be ageing rapidly, it being only six months since I was referred to, at a Berkshire guest-house, as "the old gentleman." Well, V.O.M. or O.G.—you can pick where you like!—I am still able to cycle my century, or walk my 20 miles, in a day.

"Heavy Weather"

WHAT "heavy weather" many cyclists make of the greatest of road games, to be sure! They seem to me to do everything in the hardest possible way. I make bold to assert that a *majority* of bicycle-owners are still using over-large and unduly heavy mounts, accompanied by excessive gears—despite the gallons of ink which have been ladled out on these topics within the last few years. I also make bold to say that the same majority have never bothered in the least to find and adopt the most effective position, nor have they tried to get fit. It may further be said that thousands of bicycle-owners—again perhaps a majority—are not interested in "dressing for the part."

I speak from intimate experience of these things, because I have been "through the mill." In my time I have used over-large and unduly heavy bicycles: I have pushed excessive gears: I have sat awkwardly on bicycles: I have clothed myself unsuitably. Thank heaven, I have "turned from the error of my ways." I have lived up to the gospel of "as little bicycle as possible," which I adopted many years ago, my frame-height now being some 6ins. shorter than in the days of long ago, while at least a third of the weight has been cut out. About 20 years ago I adopted, as standard (and as "the only wear"), a gear of 63½, and I remain faithful to it; and I have an idea that I *do* know how to sit on a bicycle. In the matter of clothing the greatest possible advance has been made. At one time I could not stand hot weather for cycling, but now I revel in it, and this is mainly because I am "dressed for the part." Shorts are a tremendous advance on plus-fours: an open-neck shirt is a delight: a very light jacket aids and abets the process of standing up to blazing sunshine. It is partly because of the sane clothing policy now followed that the last few years have seen me at my best in such hot weather as has been vouchsafed to us. Discomfort has vanished, and I get through the longest day's journey with complete enjoyment.

When you see so many cyclists making "heavy weather" of our romantic pastime, it is hardly to be wondered at that this amazing and magical game can claim as "real cyclists" only a minority of the millions of people who rank as bicycle-owners. One speaks of there being from 10 to 12 million cyclists in these island—a good talking-point based (no doubt) on something that approximates to the fact. But, alas, how many millions of the people who own bicycles are doomed, by their own chilled-steel lack of interest, and by their process of making "heavy weather" of cycling, to live on the verge of the Promised Land! The quotation "the little more, how much it is" seems apt in this connection, for within reaching distance will be found the infinite joys and advantages which accrue from proper cycling—all those things which combine to make our pastime what it is. Cyclists of the "heavy weather" brand! You have but to reach out for the gifts which the pastime has in store for you—for the "glittering prizes" which have enriched the lives of so many of us. If you value physical (and mental) fitness, it awaits you: if you want inexpensive travel, it awaits you: if you want to see the land in which you live, the path is clearly defined: if you want to be weather-proofed, there is no surer way than through cycling: if you want the freest and most delightful of all forms of holiday, push on towards the Promised Land. Get the right sort of bicycle, and "as little bicycle as possible": gear moderately: learn how to sit on your bicycle, and how to ride it: "dress for the part": get fit. Then you will be on the way towards becoming the right sort of cyclist!

Snare and Delusion

HENCEFORTH I am going to be extremely suspicious of people who prate about the quietude of the countryside. I have been kept awake at night by the "musical" performances of the gentle corncrake: I have been disturbed in the early morning by the vociferousness of poultry and cows, and by the crashing together of milk-churns: and now this happened: I cycled away to a farm at the back of beyond, achieving a delightful 83 miles in the process of getting there. The farm lies at the end of a *cul de sac* (pudding-bag lane, they call it in the city where I dwell), in a village remote from what we term "civilization." Hitherto, I have gone to bed there in a deadly but most acceptable silence, but on the occasion of which I write I stayed awake for half the night—quite unintentionally, of course—listening to the passage of aircraft overhead. How I longed for the relative peace and quietness of the vast industrial centre in which I live!

So people who now talk to me about the peaceful charm of the countryside had better beware!

That "Travel" Talk

AT last a common-sense word has been spoken in connection with all the loose talk which has been going on in high places in discouragement of "travel," and it was Mr. Noel Baker, Parliamentary Secretary, Ministry of War Transport, who said it. After dwelling on the difficulties confronting public transport, owing to war conditions, he expressed the hope that people would avoid long railway journeys, and spend their holidays "either in the neighbourhood of their homes or in walking or cycling," a view which we feel bound to commend. Meanwhile, Mr. Baker's parliamentary master, Lord Leathers, has spoken in the usual vague terms against "travel," particularly at Easter, and one of our contributors, who admits that he has little respect for people in elevated positions, wrote the Minister a frank letter on the subject, pointing out that he, himself, "travelled" to the extent of thousands of miles every year, that he intended to "travel" as much as possible at Easter, that he had not been in a railway train for months, that he kept out of trams and buses as much as possible, and that, as far as he could, he went everywhere per bicycle. Lord Leathers sent back the "soft answer which turneth away wrath," saying that he hoped his exhortation to people not to travel at Easter would not be interpreted as a request to cyclists to refrain from using their machines, as he "would certainly not wish to discourage this form of healthy exercise." Further, he "appreciated that people who used bicycles rather than buses and trams were acting in the public interest." So now, perhaps, folks in authority will say exactly what they mean when speaking of "travel."

No Need for Alarm

SOME cyclists still show a great deal of concern because, on waking up in the morning after a day's ride, they are liable to feel stiff and sluggish. We do not believe that there is the slightest need for alarm, and we happen to number among our acquaintances cyclists of very long and intense experience who always "suffer" in this way, and they are quite unconcerned about it. No doubt the stiffness which follows a strenuous day in the saddle can be neutralised to some extent by indulgence in a sharp walk before going to bed, a change of exercise being notoriously as good as, if not better than, a rest; and a before-breakfast tramp in the morning is also a good investment. When this stiffness occurs during a tour, the real cure is "a hair of the dog which bit you"; in other words, the stiffness which follows cycling can be disposed of by more cycling! It will be found that, soon after the journey has been resumed, the aches and pains have disappeared and one is conscious of a growing feeling of fitness. So that, as we have said, there is no need for alarm because of morning lassitude. Enquiry of sportsmen of other types will reveal that they, too, have their aches and pains after a strenuous game—but nobody apparently suggests (as is done with cyclists) that they are "overdoing it"!

Notes of a Highwayman

By LEONARD ELLIS

Hoax and History

IN these days of devastated buildings it is queer to realise that in the past one or two misguided people have spent much money and even more effort in manufacturing "ruins." On the very summit of Mow Cop, in Cheshire, and visible for miles around, is an imposing ruin that stands to-day substantially as it was built by one Randle Wilbraham, of Rode Hall, in the eighteenth century. To be charitable he may have had a good reason for his freakish action—perhaps altruistically he was providing a shelter for those who followed him to admire the views he must have loved so well. And it is certainly true that there are times when a shelter on the summit of Mow Cop is highly desirable. It must be admitted that sightseers make good use of his ruin and the unglazed windows are in great demand.

History is also here, as on this spot Primitive Methodism was born. Here in 1807 the first English Camp meeting, convened by Hugh Bourne, a Stoke wheelwright, was held. The Methodists remember the birthplace of their religion and in 1937 ten thousand of them congregated on Mow Cop and held a service to mark the acquisition of the height by the National Trust. Scattered around are numerous freaks in stone, one looking very much like a map of Scotland in profile.

Cheshire's Glories

ONLY two miles away as the crow flies, but longer and more arduous as the cyclist usually travels, is Little Moreton Hall, or Moreton Old Hall as it is popularly called, one of the chief glories of Cheshire. This is said to be one of the most beautiful examples of Elizabethan black and white architecture in the country. It is complete with moat and bridge and is open to the public on set days. I have not seen the old place since the war began and often wonder how much survived a disastrous fire that occurred some little time ago. Cheshire is, of course, famous for its "magpie" architecture and Moreton is by no means an isolated example. Not many miles distant is Gawsworth, where there is a splendid fifteenth-century vicarage and fine old Hall. At Lower Peover, in the same county, there is a church built partly in the black and white style. The county town of Chester provides many fine examples among which God's Providence House is world-famous. This dates back from the seventeenth century and is elaborately carved all over its black oak beams. Two other houses in Chester are Bishop Lloyd's House, and the Bear and Billet Inn.

A curious rock on Mow Cop

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