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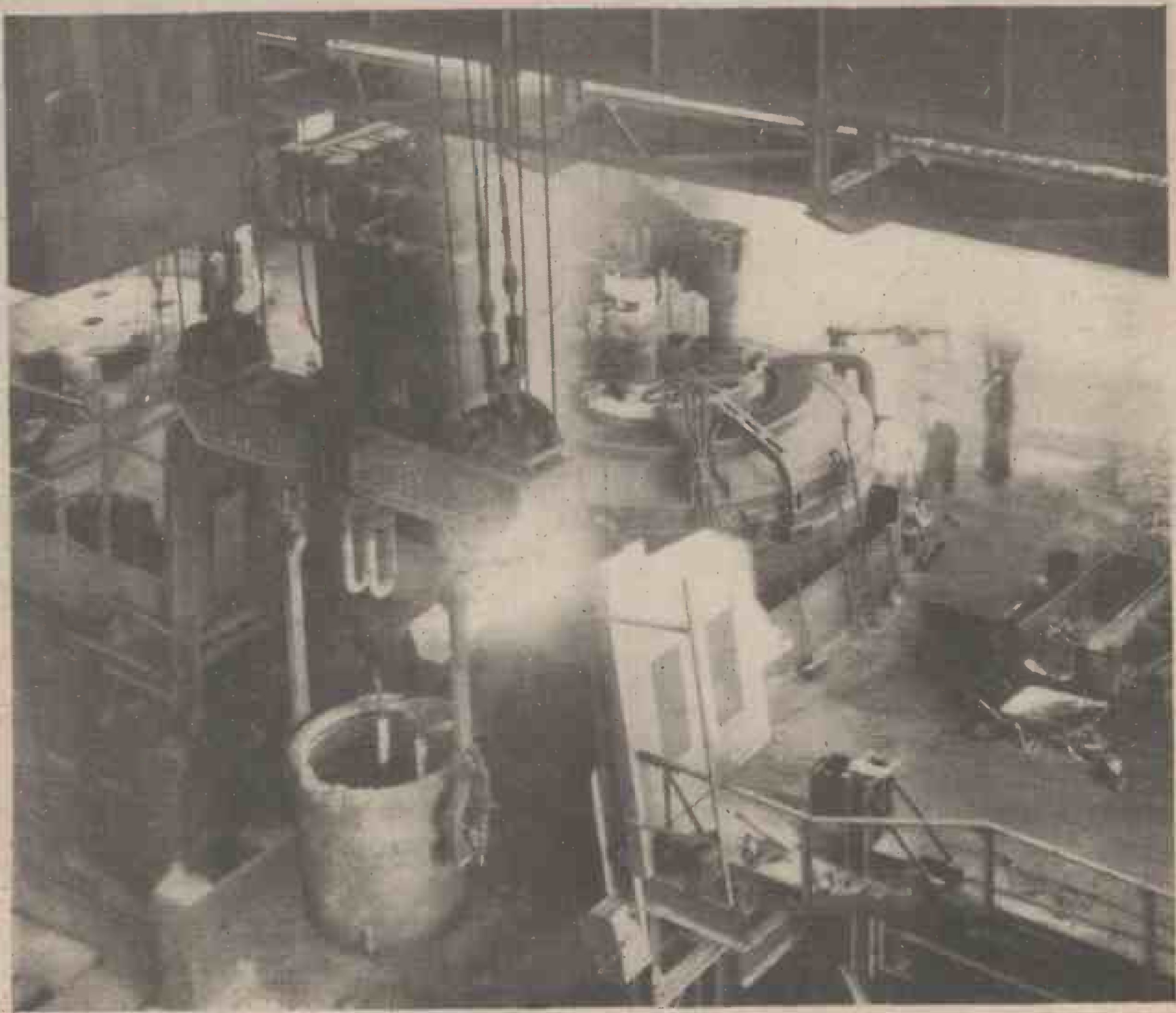
JANUARY 1946



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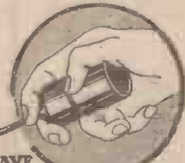

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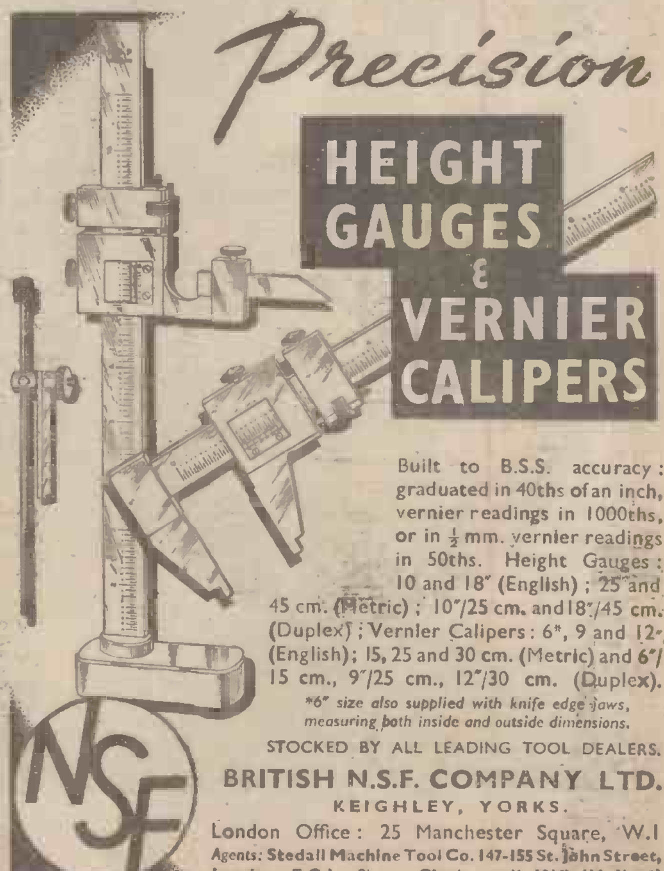

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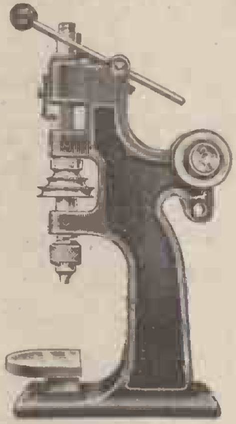

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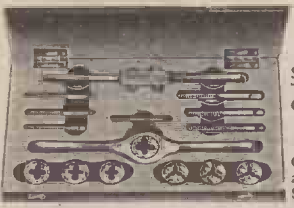

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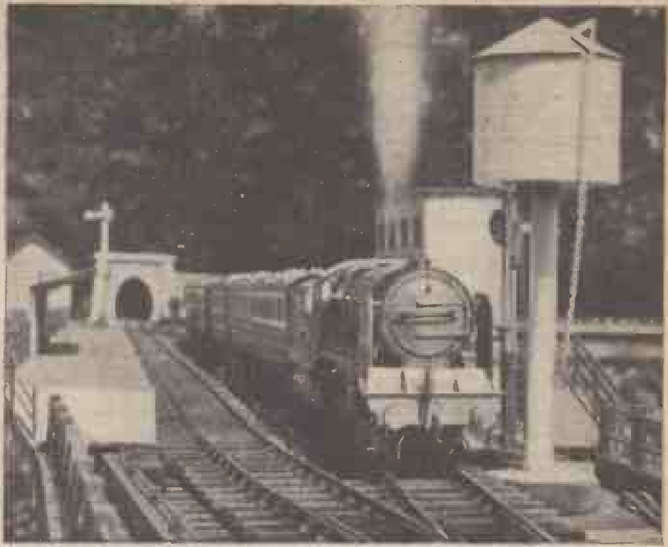

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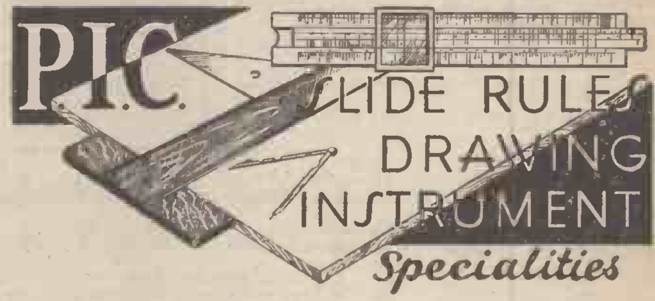

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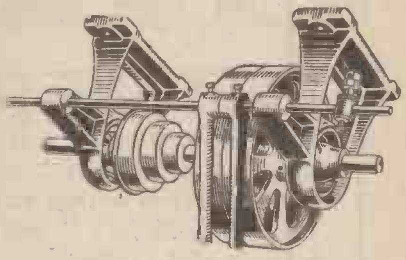

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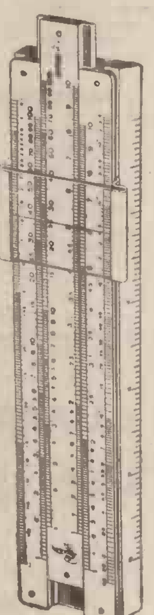

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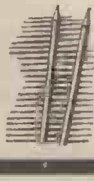

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PRACTICAL MECHANICS

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

Editor : F. J. CAMM

VOL. XIII JANUARY, 1946 No. 148

FAIR COMMENT — BY THE EDITOR

England—the Home of Timepieces

IN a recent broadcast I stated that every important invention and development relating to watches and clocks was due to an Englishman. This remark seems to have caused some astonishment, for I have received a large number of letters from listeners who are under the impression that Switzerland has always been the birthplace of timepieces, with America running close as a serious competitor.

Which only goes to show that there is something lacking in our system of education as far as the teaching of history is concerned. The newspapers have recently published the news that Great Britain intends to *re-establish* as soon as possible our national watchmaking industry. Many have supposed that it never existed. England was once the foremost clock and watch manufacturing country in the world.

In 1657, in London alone, the art of clock- and watchmaking was practised by 20,000 persons, whilst in Coventry, Bristol, Leicester, Preston, Newcastle-on-Tyne, Derby and Liverpool at least another 30,000 people were so employed.

It is also beyond all question that British watches and clocks were exported to all countries, except France, and particularly to Holland, Flanders, Germany, Sweden, Denmark, Norway, Russia, Spain, Italy, Portugal, Turkey, East and West Indies, China and Japan. These exports totalled £400,000 a year, which represented a very large sum of money indeed in those days.

We should also have exported watches and clocks to France, and France was indeed anxious to purchase the English product, but she was barred from so doing because her laws prohibited their importation. In 1709 the English Government asked the reasons from the French Government for the French king imposing such prohibition, and put up a strong case to him for its removal.

There can be no doubt at all that British clock- and watchmakers were the supreme masters of their craft, for their services were sought by countries such as Switzerland and the now effete France.

The records of the Patents Office show that every important invention relating to clocks and watches, no matter whether concerned with the escapement, the cases, or other details of the mechanism, was due to an Englishman. Thomas Mudge, an Englishman, invented the gravity escapement, George Graham, an Englishman, invented the finely compensated pendulums, Thomas Tompion (the father of English clockmaking) produced the most marvellous watches and clocks, and Harrison received the British Admiralty prize of £20,000 for making an instrument from which could be determined longitude at sea within 1 deg.

This inventive genius, however, was insufficient to sustain the industry in this country, and there was a natural apathy at that time to the introduction of machinery. The old craftsmen believed in hand methods—the watchmaker's bow turns the flycutter for gear cutting, and so on—and this at a time when the foreigner was planning to mass-produce English inventions. I use the term English advisedly, because none of the inventions of any moment was due to a Scotsman, a Welshman, or an Irishman. Our craftsmen thought that good clocks and watches could not be mass-produced.

Emigration of British Craftsmen

IN 1813 the following words were written: "The progressive decline of the manufacturing and the consequent impoverishment and misery of the manufacturers, being destitute of employment and dependent upon parochial relief, can, unfortunately, be attested." Then followed a report, which indicated that there was taking place the emigration in great numbers of the most ingenious English artisans to America, France and other places. No less than 30 manufacturers, collected by public advertisement, embarked in one vessel to America.

Next there came the tragic report:

"The demand of foreign manufacturers has consequently and incalculably increased. Not only do the establishments in France, Switzerland and Geneva exist, but our ablest artificers in jewelled work, having been driven from England by necessity, and seduced to those countries by hopeful advantage, they prosper and improve. But also, new establishments are formed in America, Sweden, Denmark, at Berlin, Nuremberg, and Neuchatel, which will annihilate even our domestic trade, as they imitate completely British manufacturers. Thousands of watches are annually smuggled, not only formed after the British patent, but with the names of British manufacturers, and the hall-marks of the Goldsmith's Company forged thereon; and not only are these countries impairing this manufacture, but availing themselves of the ingenuity of the watchmakers, whose imigration they have encouraged, and whom they liberally support."

There have been many attempts since this time to revive the industry in England, and especially between the years of 1830 and 1930.

In the latter year it dawned on certain manufacturers in this country that about 5,000,000 clocks per year were imported into this country. Hitherto, only one firm in this country produced domestic clocks, although there were a number producing chronometers and clock systems, and a few were manufacturing clocks for motor-cars.

Accordingly, clock and watch factories were started at Swindon, Cricklewood, and Enfield, and several others followed in other parts of the country. Thus started the recommencement of English clock- and watchmaking, and it must be said for private enterprise that this was due to large firms with capital, vision and foresight, who, by means of private enterprise and lacking any Government support sought to recapture for Great Britain the trade and the industry which the narrow-mindedness of previous Governments had lost for us in allowing our skilled craftsmen to emigrate.

Foreign Competition

THEY had to meet severe foreign competition. German clocks, for example, were reduced in price by 50 per cent. It is valuable to record the results. In 1931 English manufacturers sold 65,000 clocks. In 1932, 200,000, and in 1933, 500,000. In 1938 the production of British factories had increased to 1,500,000 pieces, and these were all clocks of good quality. In point of fact, the total value of English production exceeded in cash value that of all the imports of clocks and watches.

This, in spite of the battle which Germany embarked upon. It must be remembered that German manufacturers were granted for many years subsidies on exports to the United Kingdom by the German Government, amounting to between 25 and 40 per cent., and this more than counteracted the small tariff-protection which British manufacturers enjoyed.

The short period of England's attempt to stage a come-back did not enable it to establish itself on a firmly competitive basis, but it has been continuing to train the personnel to enable it to compete with Switzerland, where most of the work is performed by outworkers under conditions of labour which would not be permitted here.

Imported Rubbish

ENGLISH manufacturers have decided that they will not endeavour to compete with Switzerland or any other country for the rubbish market—the clocks and watches which sold for two or three shillings, and of which millions were imported before the war. They hope that some measure of protection will be afforded to them by the Government in the banning of the importation of such rubbish. At the present time, English manufacturers are producing high-quality eight-day timepieces, boudoir and travelling clocks, synchronous electric clocks, and certain types of high-grade watches. Let us dispose of the myth that no one can make watches but Switzerland, Germany and America.

The de Havilland Dove

Details of one of the Latest Aircraft Designed for Civil Aviation

A front view of the new de Havilland Dove.

THE Dove is a highly modern aircraft for branch line duty, private charter, executive and family travel. It will operate economically at a low utilisation, but its maintenance features have been engineered to suit intensive operation equally well.

It is designed primarily to serve developed or developing tributary airways which for reasons of frequency, stage length or traffic volume have need of small aircraft seating from 8 to 11 passengers, and can count upon 800 to 1,000 hours of duty in the year with loadings averaging at least one-half to two-thirds of capacity. On services which have that minimum of traffic and do not need a larger vehicle the Dove should be the most economical aircraft available for some years to come.

The full-tank range in still air is about 1,000 miles, 1,609km., so that for journeys appropriate to an aircraft of its size and purpose the Dove may be expected to fly most frequently with tanks about half full. Thus with fuel for 500 miles, 805km., in still air (enough for a stage of 250 to 300 miles, 402 to 483km.), the Dove, fully equipped for eight passengers, with toilet room and two crew with dual control, will carry about 1,700lb., 772kg., of payload. Cruising at 160 m.p.h., 257 km/hr., at 5,000ft., 1,525m., on 0.47 of take-off power, it will achieve 7.6 air miles per gallon, 2.7 km/litre, 121 ton miles, 197 tonne-km., of payload per hour and 5.8 per gallon, 2.08 per litre, of fuel, reckoned on the cruising speed. Full-tank range (1,000 miles, 1,609km.) reduces the payload to about 1,200lb., 545kg., and the ton-mileage figures accordingly.

Main Features

The size of the Dove aircraft and the power employed have been balanced to suit the purpose which it will most commonly serve. It is of a size which will prove especially useful for charter, executive travel and private ownership, as well as airline operation. Quickly detachable internal bulkheads and seats aid versatility; thus by eliminating the toilet compartment 10 passengers can be accommodated, or 11 by removing also the luggage compartment partition. There still remains a forward luggage hold of 22 cu. ft. With all seats removed, a cabin volume of 348 cu. ft. is available for freighting. Door width and position are convenient for ambulance duty. A spare power unit, with propeller dismantled, can be carried. The aircraft is well suited to air survey work. It is convertible for float or ski chassis.

All-metal construction minimises the day-to-day attentions and shortens the annual overhaul period. Low-wing layout is necessary in a small aeroplane to give the pilot a good view and to minimise spar intrusion into the cabin. It also ensures less risk to the passengers in the event of accidents. A nose-wheel chassis gives airfield safety, taxi-ing facility and a level loading floor: the tendency to swing or ground loop on take-off or landing is completely eliminated.

The fuselage sides are parallel throughout the length of the cabin with an internal width of 4ft. 6in., and the cabin is 5ft. 2.5in. high throughout. The windows are particularly large, separated only by narrow pillars and provided with sun blinds. There is hot and cold ventilation under the pilot's control.

Power Plant

Power-unit development has played as important a part as aircraft design in the advance which to-day's formula shows over pre-war aircraft. For several years a slightly larger engine than the pre-war Gipsy Six, based directly upon it and embodying several important refinements in design, has been under development. With supercharging and gearing this new unit gives a take-off output of 330 h.p., with adequate cooling for tropical summer conditions. The recommended cruising power is 0.47 of the take-off power.

Single-engine Safety

Great importance has been attached to safety in single-engine performance, and the latest requirements of the British Air Registration Board are complied with. On full load the aircraft will climb to 7,000ft. at 120ft. per minute on one engine working at *normal* climb power, and its absolute ceiling in that condition with full load is 10,000ft.

Furthermore, at the take-off (assuming still-air sea-level conditions and a hard runway) if one engine should fail at the moment of commencing to climb, the Dove will nevertheless continue climbing and will attain a height of 50ft. within 1,230yd. of the start of its take-off run, or the aircraft can alternatively be landed and brought to rest in less than that distance.

Braking by Propellers

The Gipsy Queen engines drive de Havilland constant speed three-blade propellers equipped for feathering and for reverse-pitch braking. The still-air landing distance (from 50ft. height), using the wheel brakes, but without

Interior of the passenger compartment.

Another view of the de Havilland Dove—being jockeyed into position by the ground staff preparatory to a trial flight.

using the propellers for braking, is 500yd. Using the propellers for braking in conjunction with the wheel brakes is valuable in emergency, or on very short airfields.

Crew Convenience

The crew compartment is planned in recognition of the fact that although an aeroplane of this size can be flown and navigated by one pilot, a second pilot or radio-operator may sometimes be carried. Dual control is therefore provided, and the starboard control column can be quickly detached and stowed so that a radio-operator occupying the starboard seat has easy access to the comprehensive wireless equipment which is housed in the dashboard. In an aircraft of moderate size this arrangement is possible with a clear view of all instruments from both seats, and a particular feature of the detail design has been the development of a uniform, matched set of instruments especially for the Dove aircraft. The radio set is in view and reach of the first pilot. Instruments have the Royal Air Force type of ultra-violet and red lighting. External air temperature gauge and cylinder-head temperature gauges are fitted. The pitot head is electrically heated. Control locking is foolproof. There is stowage for maps and crew's equipment.

The Mosquito-type cockpit canopy and rather high seating give the crew an excellent view at all times. Both seats are adjustable for height and tilt, and the rudder pedals are adjustable fore and aft. There is a direct-vision window for bad-weather landings. The roof embodies a signal pistol fitting.

The standard wireless set provides for receiving and transmitting by W.T. on H.F. and M.F., and has a D.F. loop. Two types of blind-approach apparatus are incorporated, S.B.A. and S.C.S.51, also a four-channel V.H.F.

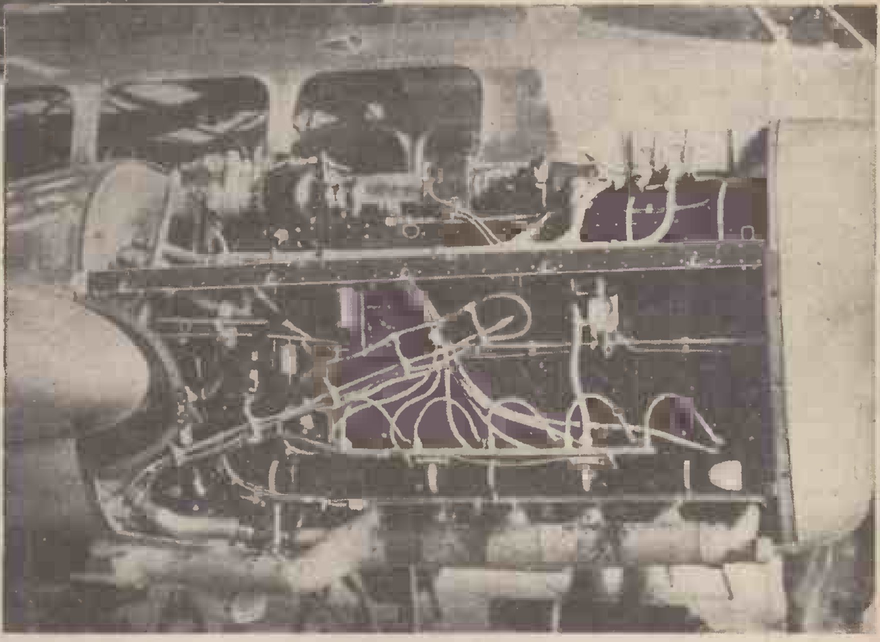
Maintenance

A principle in the design of this small aircraft has been that its maintenance and operating features should conform to main-line standards for large aircraft. Thus, the engine units are completely interchangeable port and starboard, and are quickly removed or fitted complete with oil tank, oil-cooler, air-cleaner, and other accessories, and cowling. The wings are detachable at the fuselage side because it is realised that serious mishaps may involve transportation by road or rail. Fuel tanks are interchangeable port and starboard, also elevators.

The three single undercarriage legs are of the extremely simple compression-rubber type with casings made from single-piece forgings. The main undercarriage units are interchangeable port and starboard, and the jacks and radius rods are interchangeable on all three legs. To simplify services, pneumatic actuation which is commonly employed for wheel brakes is, in this aircraft, also adopted for the undercarriage retraction and for operating the flaps, while to eliminate vacuum pumps the gyroscopic blind-flying instruments are electrically driven. Undercarriage retraction takes 4.5 sec. and lowering 3.5 sec. There are no hydraulics.

All instruments—radio, battery, pneumatic and electrical power control—are accessible from outside by large doors in the fuselage nose, and the nose-wheel feature keeps these doors and the luggage doors conveniently low. Any instrument or the whole panel can be easily removed.

Control runs pass under the cabin floor and are accessible by doors from the outside, so as to avoid the disturbance of cabin furnishings and the falling of dirt on to the control runs.



Side view of one of the Gipsy Queen engines.

The structure is of clad aluminium-alloy sheet, with a considerable use of aluminium alloy forgings and some magnesium-alloy fittings.

Mid-ocean Airstrips!

BRITISH scientists have found a way of increasing the natural surface tension of water, making it technically possible to build a mid-Atlantic aerodrome or a floating cross-Channel bridge.

This latest discovery in engineering-on-water began when an inventor's brainwave sent him motor-cycling at 50 m.p.h. along a tarpaulin stretched over a river ford. The new discovery has been sponsored and developed by the Royal Navy.

Ordinary tension will support a needle on the water's surface. By putting a flexible synthetic surface on the sea, and by increasing the tension about 400,000 times, it has been found possible to support heavy lorries and aircraft in mid-ocean.

One practical result of the discovery is the production of man-made " islands "—composed of hundreds of hexagonal buoyancy cans—" islands " which can be built to any shape or length required, and which can be easily dismantled, transported and reassembled.

Another, which has already stood up to the severe practical tests of war, is the " Swiss Roll," a floating pier that can be rolled up, carried on board ship and later rolled out again from ship to shore.

This pier is nearly twenty times as light as a " Bailey " bridge of equal length, yet it will carry a nine-ton lorry.

Inventor of these new devices is Mr. R. M. Hamilton, of Victoria Street, London, S.W., who served at the beginning of the war as a Petty Officer in the Royal Naval Patrol Service. He is an inventor by profession.

Co-operating on the involved mathematical calculations required was Mr. J. S. Herbert, Housemaster at Eton College.

It was in 1941 that Mr. Hamilton was turning over in his mind the general problem of floating airports—when he had his " brainwave."

" I realised the simple truth that if you could increase the natural tension of water you could support weights," Mr. Hamilton said.

That was where Mr. Hamilton's motor-cycle came in. He borrowed a length of farm paling and some tarpaulin from a local farmer at Farnham, Surrey, where he was then staying. He bridged a local ford with them and crossed on his motor-cycle.

As he crossed, the inventor found, as he had expected, that he was being supported on the surface of the water.

That was the beginning, but it was not until 1944 that the first practical result was employed—the " Swiss Roll " pier, used in the Normandy invasion.

In " Swiss Roll "—a flexible canvas-and-wood jetty—a tension of 18 to 30 tons is applied to any length stretching from ship to beach and the result is that a laden lorry can be driven ashore in safety over the sea.

The Story of Radar—3

Identification of Friend and Foe : Centimetre Waves and Valves

(Continued from page 101, December issue)

This early type of A.A. fire control equipment had to be sited on a specially prepared flat site, and was relatively immobile. The wire netting screen was used to overcome the undesirable effects caused by irregularities in the ground. The need for these screens disappeared with the development of modern radar sets.

THERE are few more discouraging thoughts in the mind of the pursuing fighter pilot and crew than the fears the pursued may be an unidentified friend; few more discomforting thoughts in the mind of the potentially pursued than fears that he may be mistaken for a foe. Clearly many of the benefits of radiolocation would be thrown away if there were no safeguards against a wild goose chase after an unannounced and unrecognised friend. The first memorandum proposing radiolocation offered a part solution in these words: "There will also be, for consideration, the problem whether the interval between detection and engagement may not be best reduced to a minimum by having interceptor craft fitted with a keyed resonating aerial so that they are readily located by the same methods as those used on enemy bombers, but discriminated and identified by the intermissions in their "reflected field." This project, too, had to await the moment when staff could be diverted from the drive for a primary defence line in the coastal chain to experiments involving much flying, always difficult to arrange in those days. The early months of 1936 sufficed to show that the use of tuned aerials with no associated equipment other than a key to open or close the aerial circuit (and so to vary the reflecting power of the aircraft as a whole) was cumbrous and aerodynamically troublesome. It was therefore proposed—and after discussions and drafting delays the proposal was embodied in a secret patent application dated September 15, 1936—that each friendly aircraft and ship should carry a small set which picked up the radiolocation signal, amplified it, and re-radiated it at increased strength and with a superposed code change which would increase enemy difficulties in simulating the friendly response. The proposals extended to the sending back of the amplified reply on a wavelength the same as or different from the "interrogating" radiolocation signal, and it was noted that if the delay in the process of retransmission (which would appear at the interrogating station as an increase in the apparent distance from which the magnified echo came back) was not negligible it could be made small and nearly constant, and could, if necessary, be allowed for.

It was in I.F.F. experimental flying that the first loss of life in the Bawdsey team took place, although the cause of the flying accident had no relation to radio.

Identification System

The greatly extended use of radiolocation devices in the Services of Britain and her Allies during the years 1941 and 1942 made the use of a common identification system essential.

It was, for example, necessary to enable Army A.A. gunners to recognise by radiolocation homecoming bombers of the R.A.F. Now each Service had developed specialised equipment using a wavelength or band of wavelengths operationally most suited to the function of the equipment and with due regard to radio "interference" with others.

The chain stations were using 10-metre waves and longer, the mobile equipments 5 to 7 metres, the G.L. rather shorter waves; then came a series of devices using wavelengths of about $1\frac{1}{2}$ metres and another group just below 1 metre.

The technique of I.F.F. at this time was to cause the indication of the received echo periodically to increase in intensity or size, but the response was usually (but not necessarily) on the same wavelength as the initial questioning and locating pulse. It is true that, with some ingenuity, a band of wavelengths was swept through by the responder, so that, for example, the multiple wavelengths of the several chain stations were each in turn given a response. It was clearly necessary that a British bomber, returning from a sortie, should be able to identify itself automatically, no matter what part of the coast it might have to approach.

Nevertheless, the multiplicity of Service uses for radiolocation enforced the decision to allocate a common waveband for interrogating the I.F.F. apparatus, no matter what wavelength might be used by the radiolocation equipment itself.

Thus, for example, a mobile radiolocation transmitter might be sending out pulses of $5\frac{1}{2}$ metres wavelength and receiving the $5\frac{1}{2}$-metre echoes from several aircraft, some friendly, some hostile. *Simultaneously* with the emission of the $5\frac{1}{2}$-metre pulses there would be a series of interrogation pulses somewhere in the waveband allocated to I.F.F. (for example, on 2-metre wavelengths). These interrogating pulses would evoke responses when the I.F.F. Mark III apparatus in the friendly aircraft swept through the 2-metre tuning point, in the course of its automatic and continuous search throughout the I.F.F. waveband. As a result of this, intermittent responses would appear in the 2-metre receiver associated with the

The "Skiatron," used in the Navy for tactical plotting by radar. The instrument is attached to long range warning set, and used in aircraft carriers by the fighter direction officer to control fighters.

interrogator, and would be connected by visual indication with one of the aircraft echoes shown by the $5\frac{1}{2}$-metre locator. If this same friendly aircraft then flew near one of our naval vessels, the ship's aircraft locating gear would detect the aircraft on its own naval wavelength, far removed from the $5\frac{1}{2}$ metres of the mobile transmitter first postulated on land in our example. But the ship would interrogate the aircraft in the same I.F.F. waveband as before and the responses would be shown in association with the particular echo on the ship's locator.

The introduction of U.S. equipment and the eagerly awaited Allied Combined Operations in the European, Mediterranean and Pacific theatres of war made necessary the extension of this identification system throughout the Allied Forces, and I.F.F. Mark III and subsequent developments are now in use both by U.S.A. and ourselves. It must be made clear that although the earliest use of I.F.F. was in the air, all three Services now have this means of identifying themselves to Allied radiolocation stations.

Early in the development of I.F.F. devices it was realised that should one of them fall into the hands of the enemy we might be faced by air raids in which the attacking aircraft "wore the uniform," as it were, of our Forces. Therefore, not only was a coded response introduced, but each I.F.F. equipment was provided with an explosive charge which could be detonated by the pilot in emergency or which would be automatically exploded when subjected to an acceleration of several "g," as in a "crash."

Centimetre Waves and Valves

The foundations of the radio technique given by Heinrich Hertz to the world in the 1880's rested upon experiments with electric waves about 15 or 20 centimetres long. Hertz generated these waves by spark-excitation of simple resonant circuits, and because loops of copper rod a few inches in diameter were easy to handle in a laboratory, and reflectors of metal sheet and prisms of pitch could not conveniently be much larger, the wavelengths used in his reproduction of optical phenomena were of this order of size. But when Marconi and others came to use electric waves for telegraphy through space they found that they could not generate more than minute amounts of high-frequency power at these very short wavelengths; moreover, their transmission was limited to an "optical" path between sending and receiving stations. Therefore for many years, almost half a century, the practical business of wireless telegraphy and telephony was carried on with wavelengths usually longer than 20 metres and only very rarely shorter than 5 metres.

Radiolocation was born, as has been indicated, at a time when proposals for working on 5-metre wavelengths were a little daring and when centimetre waves in the strict sense were little more than a dream.

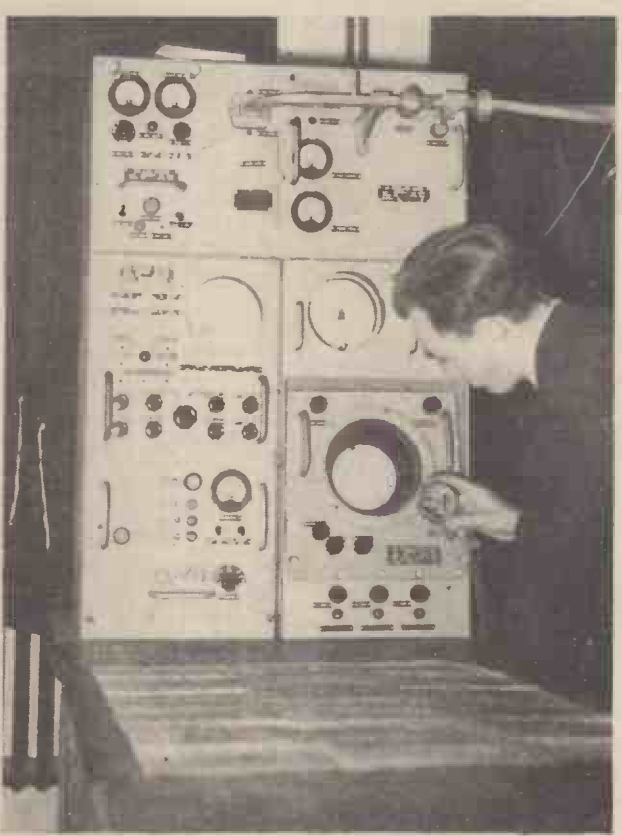
Nevertheless, in the dreams of the early experimenters at Orford and still more clearly in the vision of later years, a frequently recurring thought was that a beam of centimetre waves would have vast possibilities, if sufficiently great power could be reliably generated in pulses of a millionth of a second duration.

If larger transmitter powers were needed, where was the valve to deliver this power? If it was thought that a problem could only be solved by the use of shorter wavelengths, where were the valves which would transmit and receive on this wavelength? And the cry has always been for more power and for shorter wavelengths. In fact, the valve is, and always must be, the real kernel of the equipment, and upon its proper functioning depends the whole value of the equipment.

The first sets were designed round valves which were already in existence; valves designed for continuous wave working and not necessarily the best that could be made for use in radiolocation, which requires the transmission of a very large power for a short time. Therefore in 1938 it was decided to increase the strength of the group at the Admiralty Signal School, which had been working on the development of valves since the last war, and also to use the skill and knowledge of a great British industrial laboratory in helping to solve the new problems. One of the types of valves commonly used as the transmitter in the first chain stations was the silica valve, designed by the Signal School for use in naval communication transmitters, and in the crisis of September, 1938, there were not enough silica valves being produced to keep the stations working day and night. The small group at Signal School, therefore, stopped their research for the time being and made sufficient valves to keep the watch going. A great effort at a time of great emergency.

Pulse Transmitter

The next step was to provide the chain stations with a transmitter of as high a power as possible so that in conjunction with the higher towers, which were then being planned, a great increase of range could be obtained and so make the early warning system doubly effective. This increase of power was obtained by using continuously evacuated demountable valves. These were introduced into the chain stations in 1939. But the first type of valve specifically designed as a pulse transmitter was a small metal-glass valve, the so-called "Micro-pup." This used a copper anode, which was also part of the envelope, and copper glass seals. These were much smaller than the previous valves and could be used at shorter wavelengths, so making possible the design of the A.I. set for night fighters where small size was essential. A number of modifications of this type followed, suitable for different purposes, culminating in the valves suitable for use on "decimetre" wavelengths; these were used in the ship sets where it was essential to use the shortest wavelength possible in order to keep the aerial size small. The great achievement of this development was not only that valves had been designed to meet the requirements, but that the very new techniques employed had been worked out in such a way that they could be made in large scale production, and these valves were soon required in very large numbers.



Lightweight radar centimetric warning set as used in the Royal Navy for tactical and navigating purposes.

So far, although a number of new techniques had been introduced and great ingenuity had been used in overcoming difficulties, the new valves were triodes or multi-electrode valves based on well-established principles, and it was becoming apparent that the shortest wavelength to which this sort of valve could be pushed was not much less than a metre. But the operational need for shorter wavelengths was very great. In the first place the maximum range of the A.I. set was no greater than the height of the aircraft, and this very severe limitation could only be overcome by producing a really narrow beam with an aerial sufficiently small to go in the aircraft. Secondly, the detection of small ships, such as submarines and E-boats, at good ranges depends on the use of as large a ratio of height of aerial to wavelength as possible, and when the aerial is on a ship this means as short a wavelength as possible. Thirdly, the problems of accurate measurement of direction and height for gunnery and other purposes become capable of fairly ready solution if wavelengths of the order of 10 cm. can be used. These tremendous advantages had not been pursued partly because of the great pressure of work on the other applications, but also because there were no valves available which could possibly generate sufficient power to be of any use.

The few watts already continuously generated at some 17 cm. wavelength for cross-channel telephony were quite useless for radiolocation purposes employing pulse technique, and other means of generation and detection had to be developed if any worthwhile results were to be achieved with "centimetre" technique.

Radiolocation had grown, in the most stringent secrecy, in the hands of a team of workers whose numbers were severely restricted by the need for preserving that secrecy. Extensions and applications of the technique had been recognised as attainable and valuable, but had been put in suspense through sheer inability to construct equipment fast enough to secure the proffered gain.

In the autumn of 1939 it was decided to increase the effort available for work on valves, and a research team at Birmingham and a team at the Clarendon started work on what appeared then to be the faraway goal of designing valves for centimetric radiolocation. Later the research laboratories of more British commercial organisations were brought in.

This work has been co-ordinated and controlled by an inter-Service committee known as the Co-ordination of Valve Development Committee (C.V.D.), and since this has proved to be a most successful example not only of inter-Service collaboration, but also of collaboration between the Services and industry, it is appropriate to give some account of its activities.

Until 1938 the only research team working on valves specifically for Service use was that at the Admiralty Signal School, who served not only the Navy, but the other Services as well. In 1938 regular meetings were arranged between the scientific staffs collaborating in valve design, and representatives of the other Service establishments were also invited to attend. As the subject grew and more research teams became concerned with it, C.V.D. expanded and formed new committees. Thus the "10 cm. committee" was set up early in 1940. The most valuable feature of these committees was that they brought together the actual experimentalists who were working on the field both on the set design and on the valve design sides. Here it was that the set designer could ask for new or improved valves, and here also the valve designer could report on the progress he had made and on his hopes for the future. The success of this venture was due in no small measure to the co-operative spirit shown by the industrial concerns as they were brought in. Thus knowledge and techniques which before the war were carefully guarded secrets, were willingly passed to other firms if this would help them in their work. In 1940 there was appointed a full-time secretary of C.V.D. and co-ordinator of C.V.D. activities.

The radar operator on a British warship at his action station in a British convoy escort. He passed range (from the cathode-ray tube immediately in front of him) and bearing (from the cylindrical box near his right hand) by voice-pipe to the bridge.

Centimetric Working

The most revolutionary advance which resulted from this great accession of strength was the realisation of the hopes for centimetric working. In 1938 actual observational experiments had been undertaken with centimetric equipment, but the available transmitter power and receiver performance were inadequate and the already deferred hopes of 1935 were further deferred. Now the team at Birmingham set themselves the task of generating pulse powers of the order of tens of kilowatts at a wavelength of 10 cm., and it was not long before they produced power of the order of a kilowatt from a magnetron. This was a splendid achievement, and was the result of a brilliant adaptation of the old split-anode magnetron to use cavity resonators which are so efficient and convenient at these wavelengths. The industrial laboratory was then brought in to design the valve in a manner suitable for production, and the first sealed-off model was made by them in July, 1940. Later a research team of another commercial organisation began work on the magnetron, and these three teams, in very close collaboration, and aided by the very valuable theoretical work done by university teams at Manchester and at Leeds, have overcome all the numerous difficulties which have arisen and have designed a large number of valves for different applications, all derived from the original cavity magnetron. This magnetron is now used as the transmitter in all the centimetric radiolocation equipment, and generates power not of the order of kilowatts but of hundreds of kilowatts.

Thus in the summer of 1940 it appeared that a transmitter giving reasonable power output on 10 cm. wavelength could be made. But what of the receiver? The main requirements were for a low power, easily tunable oscillator and a first detector or frequency changer so that a sensitive superheterodyne could be built. These problems were being tackled by the Clarendon and Signal School (A.S.E.) teams. A local oscillator using the velocity modulation principle and a single cavity resonator was first put into a convenient and makeable form at A.S.E., Bristol, and later improved by a commercial research team. For the detector, it was soon found that the old crystal and cat's-whisker gave the best results, but the problem was how to make it sufficiently robust and stable for use in Service equipment. This was solved by a combined effort on the part of T.R.E. and teams at the industrial research laboratories, and the crystal is now as robust and easily handled as any valve.

These were the valves which in the summer of 1940 made it possible to do experiments at T.R.E. on the possibilities of radiolocation on 10 cm. Sets were erected at Worth Matravers, near Swanage, where echoes were detected from sheets of tinplate, boys on bicycles, men on foot, by the still rudimentary but rapidly improving equipments. These, with their prominent parabolic mirrors, were ranged in a row at the back of a field which became familiarly known as "Centimetre Alley." Then came responses from aircraft in flight, and the new era of radiolocation had opened.

The first application to take shape out of the general exploration of centimetric radiolocation techniques was the construction at T.R.E. of a full-scale set designed to demonstrate the advantages to be gained from a centimetric G.L. set. The new accuracies attained in measurement of bearing and angle of elevation, and the very considerable reduction of the troubles due to unfavourable siting conditions, were essential to any hope of really remunerative shooting against the invisible aircraft, whether at night or in daytime cloud. From this full-scale model there developed in Great Britain and in Canada two versions of G.L. Mk. III, while United States development produced the very valuable and versatile SCR 584, which, as has been shown, played a dominant rôle in the defeat of the flying bomb.

The first application of the centimetre technique to see active service was a naval set. The models at T.R.E. had demonstrated the tremendous advantages to be gained by using this technique for the detection of small objects on the sea. An Admiralty party joined T.R.E. to study the technique, and in a remarkably short time after this the first naval sets were being fitted to destroyers and escort vessels and were beginning to play that vital part in the anti-U-boat campaign which had continued throughout the war.

These applications could use separate mirrors for the transmitter and receiver, but for aircraft installations it was essential that only one mirror should be used. Methods had been worked out at T.R.E. for doing this at longer wavelengths, but the extension of these methods have not proved successful at 10 cm., mainly owing to the ease with which crystals could be damaged by electrical impulses. It was not until June, 1941, that the Clarendon team, in close collaboration with T.R.E., showed the way that this problem could be solved by the use of a gas-filled cavity resonator. This discovery led immediately to the development of the airborne sets. There were two main objectives: a centimetric A.I. set was required to overcome the serious difficulties in using the then existing sets at ranges greater than the flying height (so that all save high-flying aircraft could be followed from short pick-up ranges only), and to give more accurate guidance at all stages in the interception. A centimetric ASV set was required to continue the anti-U-boat war after the enemy had provided himself with listening equipment, as he was certain to do, to facilitate evasion of ASV search on the longer wavelengths. The development in these two directions, and the way in which ASV gave birth to the "gen box" which revolutionised the bomber offensive have been already described.

Many other valves have been developed for various purposes, such as modulator valves, to provide the high power necessary to drive the transmitter valves; valves and diodes for switching R.F. power, and all the valve firms with any development effort had been brought in to help in the most suitable way and have attended the appropriate C.V.D. committee.

With the apparatus already developed in a few years of intensive experiment, it is possible to produce pulses of high-frequency waves carrying powers which rival the output of a large electricity generating station (for the short duration of the pulse) and at wavelengths which can truly be measured in centimetres. The method of using centimetre waves is uniformly their concentration into a narrow beam (narrow in either one or both dimensions) by means of a radio mirror.

The beam is made to "scan" the area under investigation, and the device for displaying the received intelligence is often, but not always, the plan-position indicator, described elsewhere.

Thus from the early C.H. station have diverged the many varieties of later radiolocation equipment, now given a unity of form as they "grow up into centimetres," although having an ever greater diversity of applications.

(*To be continued*)

A Steel-stringed Ukulele

A general view of the completed instrument.

Constructional Details of a Special Type of Musical Instrument

By "HOBBYIST"

A UKULELE is about the easiest musical instrument anyone of average intelligence could play. It is largely a matter of mastering a number of chords, or vamps, which are, on professional sheet-music copies, indicated by tiny charts above each bar of the voice stave. These charts *show* the fingering; one does not need to know a note of music consequently, in order to provide a harmonious accompaniment to the melody.

Now, while the tonal qualities of ordinary-sized gut-stringed ukuleles are quite good,

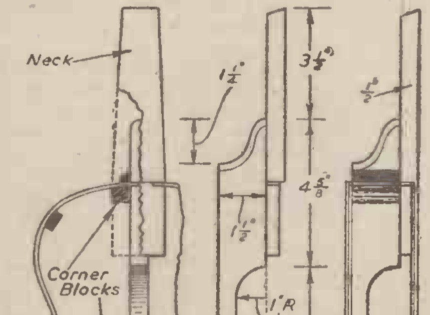


Fig. 1.—Front cut-away view, with details of spine and neck.

there is a rather "twangy" effect, with the "vamping" somewhat muffled. One cannot obtain a sustained chord, such as that produced by a guitar, especially the steel-stringed Hawaiian guitar. The writer, wanting a ukulele which *sounded* like a guitar, thought of building an extra large model and fitting four steel strings to it, such as mandolin strings.

This instrument is illustrated herewith. The illustrations give a good idea of its size. Despite the fact that it was constructed from odds and ends of wood, with strings removed from an old mandolin and fitted and tuned by wooden pegs (it is usual to have all-metal, slow-motion peg fittings for tuning steel strings, incidentally), results came up to expectation. The miniature guitar, played like a ukulele, which the writer often dreamed about, became a reality!

The tone, as with most newly made instruments properly tuned for the first time, was a trifle disappointing. But after a time in use the tone improved. The strings, which had a tendency to slip out of tune, due to the metal squeezing into the stems of the pegs slightly, became "set" and seldom needed tuning for weeks on end. This "slipping-out-of-tune" business is always a fault with gut-stringed instruments, as the gut is affected by changes in the atmosphere, the strings either becoming slack or so taut that they break.

If, therefore, you want a good, trouble-free ukulele, the cost of which is practically nil, why not try your hand at making the model shown and described herewith? Only a few fretwork tools are necessary, including scrap pieces of deal and 3/16in. plywood, plus a piece of oak (or other hardwood) for making the finger-board and pegs.

Making the Spine

Unlike the construction of ordinary wooden ukuleles, the larger model requires a "backbone" or spine. The latter is cut (from ½in. wood) to the size and shape shown in Fig. 1. The edges, please note, should be planed to the finished width to be straight and square; if you do not possess a small block plane, cut the spine from the planed edge of, say, a piece of ½in. deal flooring or similar wood. Satin walnut fretwood is excellent stuff to use for making the spine, neck and head.

Having cut out the spine, prepare the neck

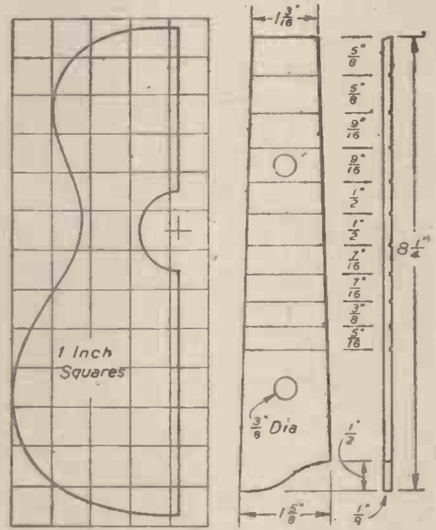


Fig. 3.—Half shape of front, with details of finger-board.

piece detailed in Fig. 2, this being cut from ½in. thick material. Note how the shoulder block is reduced to ⅜in. thick, with 1/16in. saw cuts (kerfs) made ½in. deep at the sides of the shoulder. These side cuts are for the thin, short-grained wooden strips which surround the back and front of the body.

Note, also, that the neck end is cut at a slight angle. The neck itself, also detailed at Fig. 2, is cut from ½in. wood and its joining end cut at a slight angle. When both parts are fixed together by three small dowels, the head takes on a proper tilt for the strings (see side view at Fig. 5).

Having cut the head to shape and bored the peg holes, plane the reverse side to ⅜in. thick, as shown. To make the dowel holes

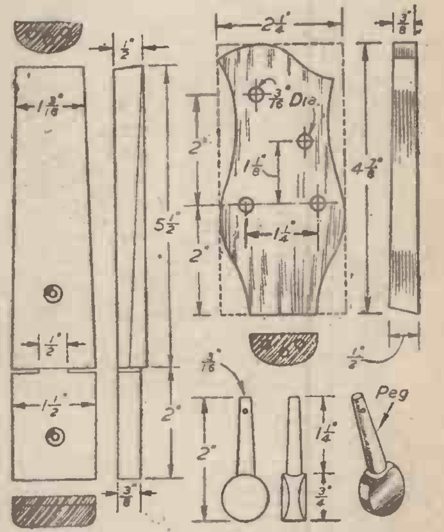


Fig. 2.—Size and shape of neck, head and pegs.

correspond, mark their position on the end of the head, then drive in thin panel pins, remove the heads to leave a ⅛in. projection which is filed to a point. Press the head against the neck end carefully; the pointed projections make indentations in the wood, and it is only a matter of withdrawing the points and boring the ⅛in. or 3/16in. dowel holes to a depth of about 1in. or less, following which the dowel stumps (about 1¾in. long) are glued in the head, then the head glued to the neck. Do not worry unduly if the joint is not absolutely perfect; the main thing is to get a good, strong joint, but try to be as neat as possible. The neck and head should not be worked to the shaping sections at the moment.

Body, Front and Back

Only a half shape of the body front piece is outlined in 1in. squares at Fig. 3. To ensure a true shape, the half portion should be marked out on squared-up paper and cut with the scissors. Having ruled a centre line down the wood, the paper is used as a template for marking the complete shape.

The writer, having a piece of three-ply wood 3/16in. thick, resorted to a simple dodge which reduced the wood and provided him with 1/16in. stuff for making the body side strips. He simply removed one of the plies from the plywood by means of a table knife. This made the plywood, for the front and back, $\frac{1}{8}$in. thick.

The latter were then cut to shape with a fretsaw, the front piece only having a 2in. sound hole. The edges of the wood were trimmed with a spokeshave, then rebated 1/16in. deep by 1/16in. wide at the inside surface by means of a tiny cutting gauge and the careful use of a penknife (see detail at Fig. 6). The rebate was done on the roughened side of the wood, i.e., the side from which the ply was removed.

The grain direction should, by the way, run with the width, rather than the length, of the body pieces. By removing one ply, the remainder of the plywood has a tendency to bend or curl. When the grain runs with the width, the spine helps to straighten out the slight curvature in the wood, so this point should be remembered.

Body Construction

Having prepared the spine and the front and back body parts, attach the spine to the middle of the back piece, as shown by the views at Fig. 1. Use glue and drive in a few panel pins to keep the wood against the spine.

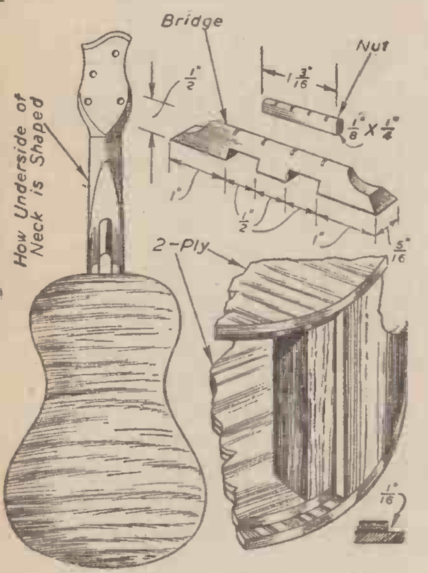


Fig. 6.—Back view, with details of bridge, nut and assembly.

Fit corner blocks, as shown, then mount the rib blocks to be flush with the edge of the rebate. You might have to drive in a panel pin to keep the blocks in place; use glue as well. When the blocks are attached (the length is $1\frac{7}{8}$in.), fit on the body front piece, again using glue and panel pins. See that none of the blocks project over the rebates, as the latter must be clear for the proper "bedding" of the side strips.

The side strips measure exactly 2in. wide by 1/16in. thick. They should be cut so the grain is short to facilitate bending around the body shapes. No "steaming" of the strips will be necessary. Simply fit a length temporarily around the body, working from the shoulder end.

If the strip is not long enough to go half-way around the body shape, cut it so a join can be made along the centre of one of the rib blocks. Having fitted one piece, remove it and glue it back in place. Continue in this manner until the body shape is completely surrounded by the strips; use plenty of glue, but do not overdo it. If some strips have a tendency to "bulge" outwards, these can be kept in by winding cord around the body and by "packing" with strips of card.

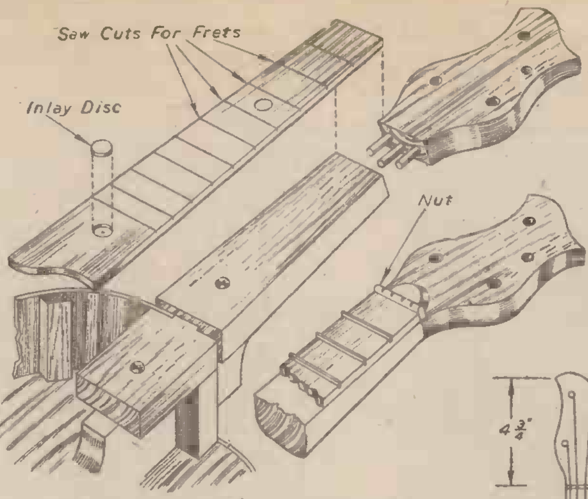


Fig. 4.—An exploded constructional view, showing method of assembly.

Cleaning Up the Work

Allow the glue to properly set, then proceed by "cleaning" up the wood surfaces and joints by glasspapering. Use, first, a medium grade of glasspaper, then smooth off with a fine grade, such as No. $1\frac{1}{2}$. Finish by rubbing with No. 1 or 0.

The underside of the neck and head requires to be rasped and glasspapered to the shape indicated by the sections. The views at Figs. 4, 5 and 6 are helpful in this connection. Do not rub the surface side of the neck piece.

Finger-board and Frets

The finger-board is cut, preferably, from $\frac{1}{8}$in. oak fretwood, walnut, etc. The best way to prepare the finger-board is to get a piece measuring $8\frac{1}{4}$in. by $1\frac{3}{8}$in. The fret positions are set out along its length by means of a pencil and a set-square, the distances of the fret lines being indicated at Fig. 3.

Having cut the kerfs (with a tenon saw guided by a steel set-square) 1/16in. deep, the finger-board is carefully cut to its shape and then glued upon the neck as indicated at Fig. 4, the top end being level with the neck joint. When the glue sets, the "spots" are inlaid upon the finger-board. The spots are merely $\frac{3}{8}$in. diam. discs cut from 1/16in. thick coloured celluloid, mother-o'-pearl, etc.

The recesses are made with a $\frac{3}{8}$in. dowel bit to a depth of 1/16in. Having glued the discs in their recesses, the surface of the finger-board is glasspapered smooth, then the fret cuts dusted. The frets are merely pieces of 1/16in. thick celluloid cut $\frac{1}{8}$in. wide. When glued and tapped into their kerfs, the frets are levelled off by rubbing with glasspaper held in a flat piece of wood. The frets should not project more than 1/16in. When levelled, hold a folded piece of fine glasspaper in the fingers and rub this lightly over the tops; this removes the sharpness from the edges of the frets.

Nut, Pegs and Bridge

A nut is wanted for the top end of the finger-board. It is cut to the size shown at Fig. 6 from a hardwood or a piece of white bone, comb, etc. The four string notches are about $\frac{1}{4}$in. apart. Glue the nut in position; if desired, it could be "backed" with a semi-circle of $\frac{1}{8}$in. wood.

The pegs are cut from $\frac{3}{8}$in. oak, then shaped and drilled as shown at Fig. 2. Have the stems quite smooth and circular, with a slight taper to make them a force fit.

Regarding the bridge, this is cut from 5/16in. thick oak and prepared as shown at Fig. 6. The notches are, of course, to be $\frac{1}{2}$in. apart.

Finishing Details

To finish the instrument, the writer applied ebony spirit stain and thin ebony polish to all parts, with the exception of the bridge. A single application of stain and two alternate coats of thin black shellac polish, brushed on, will suffice. If a high gloss is wanted, the second coat is lightly glasspapered (with a "flour" grade of glasspaper), then the finishing coat applied with a rubber in the usual manner. If the finger-board and the bridge have been made from walnut or oak, do not stain or polish these parts, as they look best in the natural state.

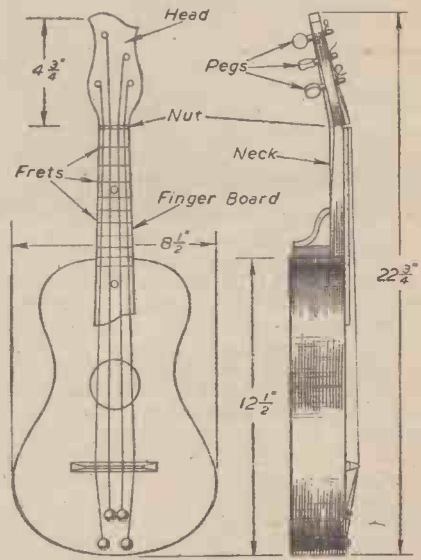


Fig. 5.—Front and side elevation, showing overall sizes.

The mandolin strings are fitted to the instrument in their usual order, the thicker string going to the left side of the finger-board. The strings are "anchored" at the base end of the body by means of brass round-headed chair nails, which are driven into the wood; the loops on the strings, of course, go around the nail points. The usual tuning for a ukulele is G, C, E and A on the piano.


A close-up view of the finger-board.

The Foundations of Thermodynamics—3

Heat Engine Theory, Carnot's Principle, and the Cycle of Work

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

(*Continued from page 87, December issue*)

IN the first two articles of this series an outline has been sketched of the development of the subject of thermodynamics along its "energy branch," from the early speculations of philosophers as to the nature of heat to the researches of Rumford, Joule, Hirn, and others, and to the discovery of the first law of thermodynamics and principle of conservation of energy. The energy branch, as it has been seen, is largely concerned with the problem of converting mechanical work into heat. The other branch to which thermodynamics traces its origin is sometimes described as the "entropy branch," and deals mainly with the converse problem of converting heat energy into mechanical work. The fusion of the energy and entropy branches was brought about by the reconciliation of Carnot's principle to the first law of thermodynamics (in its original form the proof of Carnot's principle conflicted with the first law of thermodynamics), and out of this fusion came the second law of thermodynamics, and the main stream of the subject.

Early Steam Engines

Practical solutions of the problem of converting heat into mechanical energy have been known for many centuries. Engines for producing mechanical power from fire or hot gases were in use in the time of the early civilisations, but the theory of the transformation of heat into work is a product of relatively modern times and is based on an essay published in 1824 by a French engineer, Léonard Sadi Carnot, on the motive power of heat. Engines which used steam as their working substance had been in general use for approximately 120 years before Carnot's essay appeared. In 1698, Thomas Savery, a Cornish mine manager, patented the first commercially successful steam engine, and used it to pump flood water from the galleries of his mines. Seven years afterwards Thomas Newcomen, a Dartmouth ironmonger who had worked in conjunction with Savery, introduced the piston and cylinder principle into steam-engine design. Great advances were made with this form of engine later in the 18th century by James Watt, and by George Stephenson, Robert Fulton and others, who successfully adapted it to transport by land and water in the early 19th century. The first 120 years of the age of steam power seem to have passed by without much thought having been given to the theoretical aspect of the conversion of heat into work; nor was it necessary to ponder this question at any length, as considerable progress could be made, and was made in the early stages, by the practical method of trial and error, in which a detailed knowledge of the properties of steam and iron and a theory of heat were not at all essential.

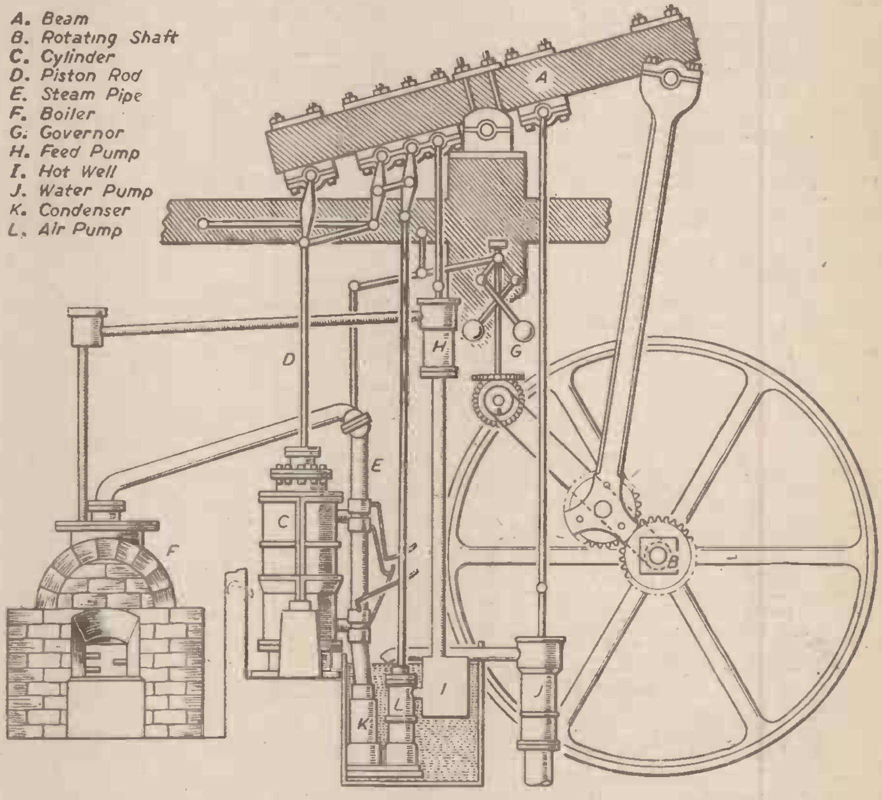


Fig. 6.—Type of steam-engine in use in Carnot's time.

Heat Engine Theory

It was not long before steam engineers discovered that whereas all their engines worked on the same general principle by burning wood or coal to boil water to raise steam whose pressure moved a piston in a cylinder, there existed marked differences in the performance of different engines. It became the practice to rate pumping-engines in a vague way by comparing the weights of coal consumed with the bulk of water lifted, and out of this custom grew the notion of heat engine efficiency. The real need of a heat engine theory was felt when it was realised that further increases in steam-engine efficiency could no longer be expected from the hitherto successful method of trial and error, but could only be achieved with the aid of a knowledge of the rules of heat-work transformations. Sadi Carnot's thesis on this subject ranks as a work of genius in the literature of physical science.

The problem of explaining why an engine turns heat into work presented itself to Carnot as a three-fold one, and he set himself the task of solving it by finding the answers to the following three questions:

(1) What are the necessary conditions which must be fulfilled in order to convert heat into work?

(2) If these necessary conditions are all satisfied, is there any particular type of engine which will make the conversion in a more efficient manner (i.e., turn a bigger fraction of the supplied heat into mechanical power) than any other engine?

(3) Are there any other conditions, apart from the type of engine used, which affect and control the efficiency of the engine's performance?

Carnot's reflections on these questions led him to the now well-known conclusions which

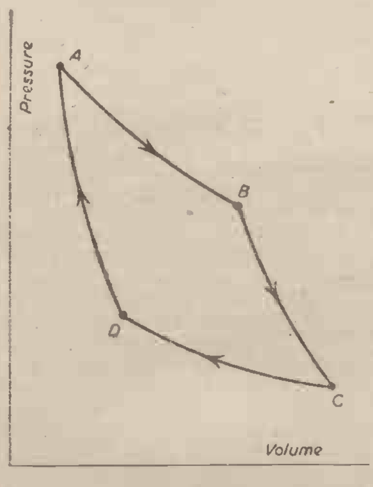
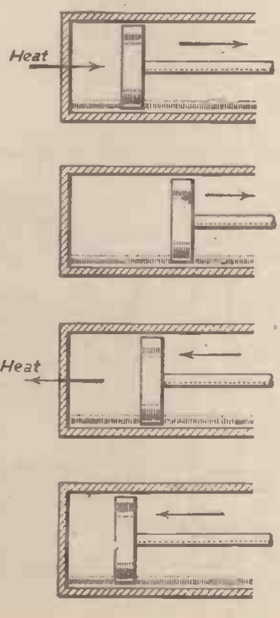


Fig. 7.—Diagram illustrating the Carnot Cycle (1824).



Ideal gas absorbs heat through cylinder cover and expands isothermally. (Line A to B.)

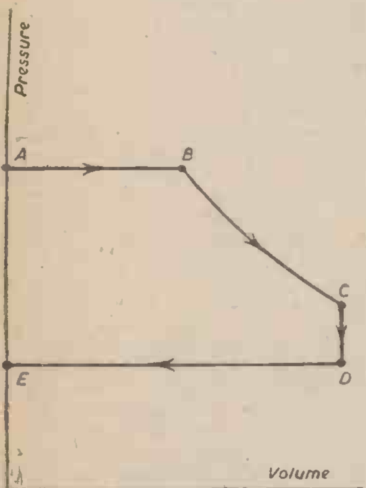
Cylinder thermally insulated. Gas continues to expand adiabatically with consequent cooling. (Line B to C.)

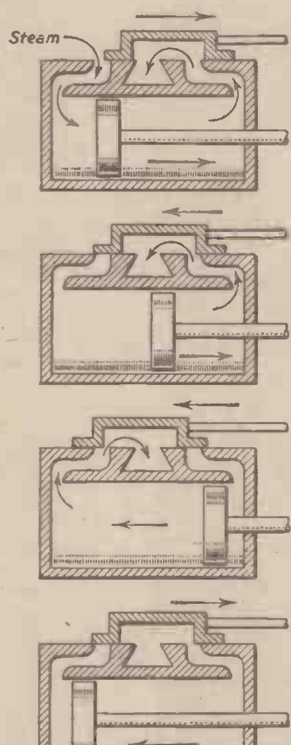
Return stroke of piston compresses gas isothermally, with ejection of heat balance into sink. (Line C to D.)

Cylinder thermally insulated. Gas is compressed adiabatically with consequent rise in temperature, until initial state A is regained in readiness for next cycle. (Line D to A.)

form the foundations of present-day heat engine theory. From the time of their publication they have been regarded as rules of fundamental importance and seemingly beyond dispute, though at a later date, some time after Carnot's death, it became necessary to revise his method of arriving at certain of them, in order to make his theory consistent with the discoveries of Joule. In answer to question (1) Carnot stated that three conditions were necessary and sufficient in themselves for the conversion of heat into work, namely :

(a) An adequate supply of heat.
(b) The maintenance of a steady temperature difference.





Steam admitted to cylinder with expansion under constant boiler pressure. (Line A to B.)

Following steam cut-off at point B, steam expands adiabatically. (Line B to C.)

Following opening of exhaust valve (point C), the expanded steam is released at the constant pressure of the atmosphere or condenser. (Line D to E.)

As the piston nears the end of its stroke (point E), steam valve is on point of reopening to admit steam for the next cycle.

Fig. 8.—Diagrams illustrating the Rankine Cycle (1859).

(c) A suitable mechanism (the engine), for conveying the supplied heat from the higher temperature to the lower one.

He laid much emphasis on the necessity of having all three of these conditions satisfied, and pointed out that the satisfaction of two of them alone could not lead to the production of work. Thus a steam engine, no matter how mechanically perfect, could never be made to yield mechanical power, no matter how much heat were available for use in it, if there were no difference of temperature between its boiler and condenser, any more than a water-mill wheel, no matter how frictionless its bearings and perfect its balance, could be made to revolve by immersing it in static water, no matter how abundant the water supply. A difference of heat level (i.e., temperature) through which a supply of heat may be lowered, is as essential to the successful operation of a heat engine, as is a difference of gravitational level, through which water may be poured, to a water wheel.

Carnot's Principle

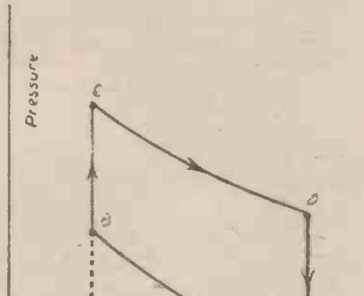
In answer to question (2) Carnot stated that if a selection of engines of different sorts were arranged to operate under adequate supplies of heat between two fixed temperatures, no engine amongst them could have an efficiency greater than that of an ideally reversible engine working between these same two temperatures. This law is usually described as "Carnot's Principle," and it carries the corollary that all reversible engines which are working between two specified temperatures possess equal efficiencies, no matter how much or how little heat they use in their cycles of operation. Carnot failed to find an answer to the third question. He guessed, and guessed correctly as it was afterwards shown, that if all the conditions demanded in questions (1) and (2) were strictly adhered to (by supplying sufficient quantities of heat to an ideally reversible engine working between two definite and different temperatures), the only remaining factor with any influence on the efficiency of the engine's performance would be temperature, or more explicitly, the numerical values of the two fixed temperatures between which the engine operates. His failure to find a formula for this relation seems to have been inevitable, as he established his famous theorem without making use of any particular theory of heat, and both the dynamical conception of heat and the thermodynamic definition of temperature are required, as it was afterwards found, to formulate efficiency in terms of temperature.

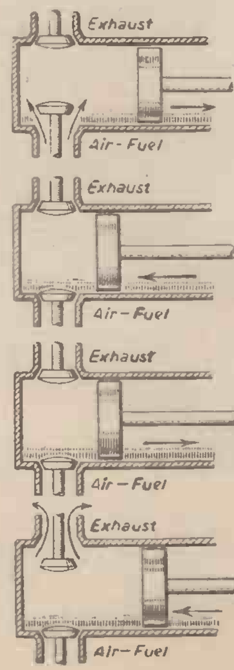
It is still a matter of some amazement that such a far-reaching principle could have been discovered without making reference to some theory of the nature of heat, whether caloric or dynamical. Carnot died of cholera in Paris at the age of 36. It is considered highly probable that had he lived longer to pursue his investigations, the discovery of the temperature formula for efficiency would have been his, as his note-books, when examined after his death, revealed a tendency towards the view that heat is an energy of motion. Some 20 years later, after William Thomson had introduced the thermodynamic scale of temperature in the year 1848, it was proved that the efficiency of a reversible heat engine could be expressed in the formula $(T_1 - T_2)/T_1$, where T_1 denotes the absolute temperature of the source from which the engine draws its supply of heat, and T_2 the absolute temperature of the sink into which the engine ejects the balance of heat not converted into work.

The publication of Carnot's principle introduced two new ideas into scientific theory which have since become of fundamental importance in the subjects of thermodynamics and heat engineering. They are respectively the notion of a cycle of work performed by the working substance in the engine's cylinder, and the conception of thermodynamic reversibility. The pictorial representation of a cycle of work by means of a graph of simultaneous pressure and volume values was first made by B. P. E. Clapeyron, a French engineer who edited and published the manuscripts of Carnot after the latter's death.

The Cycle of Work

Any substance which may conveniently be confined in a cylinder by means of a piston, and which alters its pressure and volume when heat is supplied to or withdrawn from it, acts as a vehicle for conveying the heat from the high to the low temperature between which the engine operates, and is called the "working substance" of the engine. The vapour of water, the vapour of oils mixed with air, and the mixture of coal-gas and air are in common use as practical working substances, the first in the external combustion engine and the others in the internal combustion engine. Hypothetical working substances have also been used in imaginary engines to solve problems of theoretical interest. An analysis of the properties of an ideal Carnot engine using





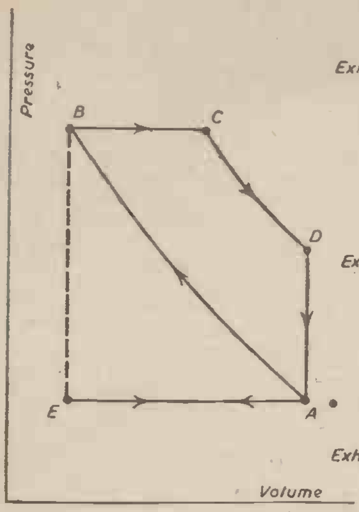
Suction stroke of piston draws air-fuel mixture into the cylinder through open gas valve. Exhaust valve closed. (Line E to A.)

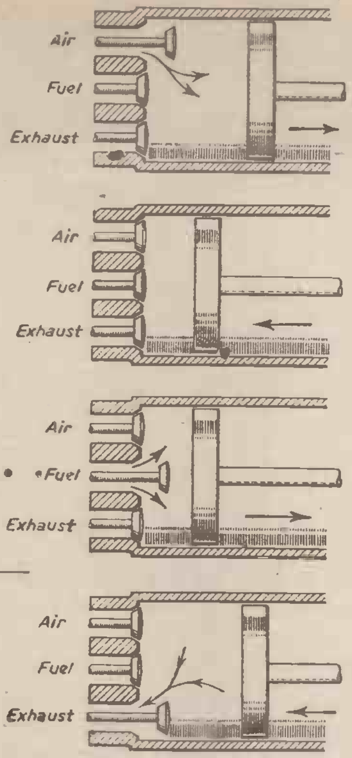
Both valves closed. Return stroke of piston compresses gas-air mixture in readiness for ignition. (Line A to B.)

Both valves closed. Spark is passed and explosion causes sudden increase in pressure (line B to C), followed by adiabatic expansion of the hot gases. (Line C to D.)

Opening of exhaust valve causes sudden fall of pressure (line D to A), followed by scavenging of cylinder through open exhaust valve. (Line A to E.)

Fig. 9.—Diagrams illustrating the Otto Cycle (1876).





Suction stroke of piston draws air into cylinder through open air valve. Fuel and exhaust valves both closed. (Line E to A.)

All valves closed. Return stroke of piston compresses air adiabatically (line A to B), with consequent rise in temperature.

Oil fuel sprayed into hot compressed air through open fuel valve. Combustion of air-fuel mixture with expansion at constant pressure. (Line B to C). Fuel valve closes and expansion continues adiabatically. (Line C to D.)

Opening of exhaust valve causes sudden fall of pressure (line D to A). Followed by scavenging of waste gases through open exhaust valve. (Line A to E.)

Fig. 10.—*Diagrams illustrating the Diesel Cycle* (1894).

electromagnetic radiation in its cylinder leads to a verification of Stefan's radiation law which finds practical application in the measurement of furnace, solar and stellar temperatures. The problem of finding the effect of change of temperature on the surface tension of a liquid can be solved by discussing the behaviour of an imaginary engine whose cylinder contains a film of liquid which contracts and moves the piston under the action of its surface tension.

When a given quantity of such a substance starts from certain specified values of pressure, volume and temperature, undergoes a sequence of changes in pressure, volume and temperature as heat is passed into or out of it, and finally returns to its initial state of pressure, volume and temperature, it is said to have performed a cycle of work. Such a cycle is represented graphically as a closed loop on a pressure-volume diagram. A well-known elementary calculation proves that the net amount of work performed per cycle by the gas is measured by the area of the enclosed loop, and that when the working substance is a gas, this work is done by the gas on its environment if the direction of the cycle is clockwise, and is done on the gas by the environment if the cycle is counter-clockwise.

The pressure-volume diagrams of the cycles of work performed by certain idealised engines are outlined in Figs. 7 to 10. Fig. 7 shows the four stages of the cycle of work of a Carnot engine (1824), using ideal gas as its working substance. Its work diagram consists of an area bounded by a pair of isothermals intersected by a pair of adiabatics. (The construction and action of this particular engine will be considered in more detail in a later section.) Fig. 8 illustrates the Rankine cycle (1859), performed by an idealised Carnot engine using steam as its working substance. The cycle begins at a point A at which steam is admitted to the cylinder causing an expansion at the constant pressure of the boiler steam, represented by the line AB. At point B the steam supply is cut off and the steam already present in the cylinder continues its expansion with consequent cooling, represented by the adiabatic BC. At C the expanded steam is suddenly released to the atmosphere or condenser as the exhaust port opens, corresponding to the short constant volume line CD. From D to E the exhaust port remains open and the remaining steam is driven from the cylinder by the return stroke of the piston. The line EA represents the transition of the

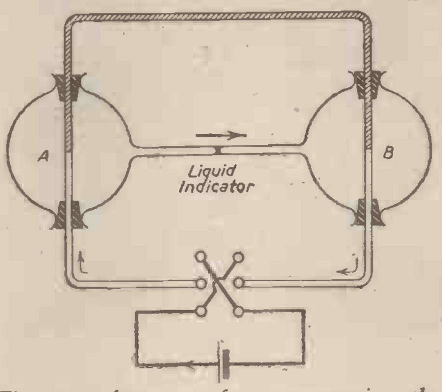


Fig. 11.—*Apparatus for demonstrating the Peltier thermoelectric effect.*

condensation water from condenser to boiler where it is converted once more into steam in readiness for admission to the cylinder. The above operations refer to steam in the space on the left-hand side of the piston in the diagram, Fig. 8.

Fig. 9 shows the idealised Otto cycle (1876), in which gas-air or petrol-air mixtures are used as working substances. A suction stroke (EA) fills the cylinder with the air-fuel mixture which is compressed adiabatically by the return stroke (AB). The passing of a spark causes ignition and a sudden rise in pressure (BC), after which the hot gases of combustion expand adiabatically in a power stroke (CD). When the exhaust valve opens the pressure of the waste gas drops to that of the atmosphere (DA), and the gases themselves are swept from the cylinder by the scavenging stroke of the piston (AE). The ideal Diesel cycle (1894) is represented in Fig. 10. A charge of air is drawn into the cylinder and compressed adiabatically by suction and compression strokes (EA, AB, respectively), as in the Otto cycle. The air temperature is sufficiently high as a result of the adiabatic compression to cause the injected fuel to burn immediately with expansion at constant pressure (BC). An adiabatic expansion (CD) follows the closing of the fuel valve and the spent gases are released to the atmosphere and swept from the cylinder as in the Otto cycle.

Thermodynamic Reversibility

A physical change is said to be reversible in the thermodynamic sense when a reversal of its direction of operation completely reverses the direction of the heat transferences involved in the change. Conversely, an operation in which reversal of direction does not alter the direction of the heat transference is said to be thermodynamically irreversible. Striking examples of reversible and irreversible changes are to be found in certain thermoelectric phenomena. One of these, the Peltier Effect, discovered in 1834 and named after its discoverer, is observed when an electric current is sent round a circuit composed of two chemically different conductors from a cell or some other external source of electric charge. At one of the circuit junctions heat is absorbed into the conductors from the surroundings as long as the current flows, and simultaneously a flow of heat is given out from the other junction. If the direction of the current is reversed, heat is at once absorbed at the junction where previously it was given out, and is evolved at the other junction where previously absorbed. These heat changes are thermodynamically reversible. At the same time the flow of current round the circuit is accompanied by an evolution of heat at all points of the conductors, in accordance with the Joule law of conversion of electrical energy into heat energy, and when the electric current is reversed, this heat continues to be given out from the circuit to the surroundings as before. Apparatus for demonstrating the Peltier effect is illustrated in Fig. 11. The junctions A and B of the two different conductors are surrounded by glass envelopes containing equal masses of air. The envelopes are joined by a narrow horizontal glass tube carrying a small quantity of liquid as a pressure indicator. The passage of a steady current round the circuit generates equal amounts of "Joule heat" in the glass bulbs and creates the same increase in pressure on each side of the liquid indicator, but the absorption of "Peltier heat" at one junction and its evolution at the other upsets

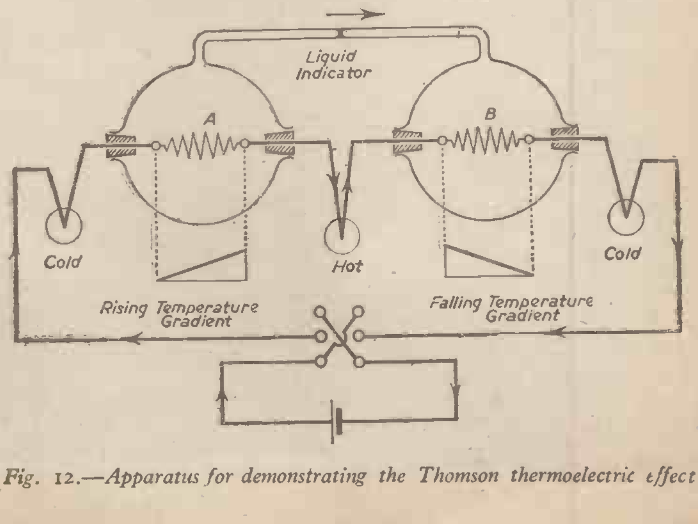


Fig. 12.—*Apparatus for demonstrating the Thomson thermoelectric effect* this balance of pressure, causing the liquid to move towards the low-pressure bulb. This movement is reversed by reversing the direction of the current.

Similar reversible changes are exhibited by the Thomson thermoelectric effect. William Thomson discovered in 1855 that when an electric current is sent round a circuit consisting of a single chemically homogeneous material which has a temperature gradient maintained along its length, heat is absorbed or evolved as long as the current flows along its entire length, wherever the current climbs or descends the temperature gradient. These heat changes are thermodynamically reversible and are always accompanied by the steady irreversible evolution of heat at all points of the circuit, due to the electrical heating of the conductor. The effect may be demonstrated by means of the apparatus illustrated in Fig. 12. Equal sections A and B of a single conductor are enclosed in glass envelopes containing equal masses of air. Opposed temperature gradients are maintained along these sections by heating the centre of the conductor and immersing its ends in cooling baths. The glass envelopes are connected by a horizontal tube carrying a liquid indicator. The indicator remains undisturbed by the equal increases in pressure in each bulb due to electrical "Joule heating," and heat flow from the temperature gradients, but the balance is upset by the absorption of "Thomson heat" over one of the sections and its evolution over the other. The reversibility of the effect is shown by the reversed motion of the indicator when the current direction is changed.

The conception of thermodynamic reversibility is applied to a heat engine by considering the quantity of heat it withdraws from its heat source, its delivery of mechanical work, and the balance of heat it returns to the heat sink per cycle. An engine in the process of working forward (i.e., making a net output of work per cycle), may absorb isothermally a quantity of heat Q_1 from its heat source at a temperature T_1, return a residue of Q_2 units of heat at a lower temperature T_2, in order to make a delivery of work W in each cycle of operations. If this engine requires an intake of the same amount of mechanical work W per cycle to drive it in reverse, and in this process abstracts Q_2 units of heat isothermally at the low temperature T_2 and delivers Q_1 heat units at the high temperature T_1, it is considered to be reversible in the thermodynamic sense. *(To be continued)*

Masters of Mechanics—108

Cody, the Aviator

The Story of a Picturesque Pioneer

DO you remember "Cody, the Aviator," the "Flying Colonel," or the "Kite Man," as they used to call him at one time or another? The rather strikingly handsome showman-turned-airman, with his brilliant short black beard pointed at the end and his enormously large theatrical "cowboy" hat apparently several times too large for him, but always seated securely and at a somewhat absurd angle on his broad, well-shaped head.

This was "Cody, the Aviator"—the "Comical Colonel," as a few deriding folk nicknamed him. This was the enterprising American-born but naturalised Englishman who, with the praiseworthy encouragement of the late Lord Northcliffe and his *Daily Mail*, played a pioneer's part—and died, also, a pioneer's death—in the establishment of practical flying in Britain.

You will not remember Cody and his many sensational exploits unless you are able to cast your memory back to the two or three years immediately prior to the first Great War of 1914-18, during which period the name of this intrepid individual became almost a daily word in the newspapers. But to those who can remember the press publicity which the "Flying Colonel" gained during those last few hectic years of his will, no doubt, be willing to confess that of all the pioneer flying men who were then more or less constantly before the public eye, the redoubtable S. F. Cody was by far the most popularly romantic figure of the lot, even when overcome and eclipsed by others during his periods of practical failure.

There was nothing of the trained and method-wise engineer or scientist about Cody. He had never systematically studied science, physics, engineering, or anything else for that matter, and possibly this defection had a lot to do with some of his practical failures and also with the curious designs which he sometimes brought out.

Nevertheless, Cody possessed deep within himself a tiny streak of the intangible brain and heart substance which is the essence of genius, and it was this little trace of genius which was responsible for all his many activities and, perhaps, even for some of his many oddities. Without it Cody would no doubt hardly ever have been heard of.

Cody was nothing if not a supremely high-powered enthusiast. Not only was he

Samuel Franklin Cody—a characteristic portrait taken in his heyday.

completely indefatigable, but invariably he worked at a high personal potential, so much so that by dint of his superabundance of energy not only was he able to build complete aeroplanes by himself, but, more amazing still, perhaps, he could enter for an aeroplane race, experience a crash during the course of it, at once repair his machine at top speed and then continue the race as if nothing particular had happened.

"Buffalo Bill"

Aeroplane "races" in those days were, of course, more of the nature of endurance flights from town to town, a complete circuit of towns often taking several days to complete.

There have been rumours that Cody was a relative of the famous American showman, "Buffalo Bill," who, in Victorian days, organised the celebrated "Wild West" circus, and whose real name was William Frederick Cody.

Let it now be stated authoritatively that all such narrations are perfectly untrue. There was no connection between the two Codys. "Cody, the Aviator," was Samuel Franklin Cody, and although during his early days he followed a showman's life, he had nothing to do with the "Buffalo Bill" Cody.

Samuel Franklin Cody, the future airman, was born in 1861, and, appropriately enough, at a little place called Birdville, in Texas, U.S.A. His parents were poor, and he received very little education. Indeed, he must only had been a very young lad when he joined up with a travelling circus cowboy troupe, an occupation for which he must have been well fitted, for records tell us that, as he grew in years, he became a fearless bareback rider of horses (including those of the "wild" variety), and that his accuracy at trick shooting was amazing.

A "bamboo biplane," one of Cody's early machines.

Cody's Circus

S. F. Cody was good in the circus line. He made money, too; and the money which he made he expended on his one hobby in life, which at that time was kite flying.

Kites had always fascinated the imaginative Cody. He even aimed at making a kite which would take a man up in the air with it, and by dint of painstaking experiment he eventually achieved that end.

Cody never experimented "scientifically." His method was the old-fashioned "try-and-try-again" system, at which modern experts often so contemptuously turn their noses but which has been productive of such excellent results in the past. In the end Cody's method put him in the position of being the world's premier authority on kites.

Eventually, Cody threw up his showmanship life. His aim was to take up aeronautics seriously and to devote the remainder of his days to it.

Coming to England at the end of the last century, Cody met the renowned Sir Hiram Maxim at the Crystal Palace. Maxim had made a great name for himself as the inventor of the machine-gun and also as an aeroplane experimenter. The two struck up a friendship, and Maxim seems to have shown Cody the ropes in this country, so that the latter very quickly settled down.

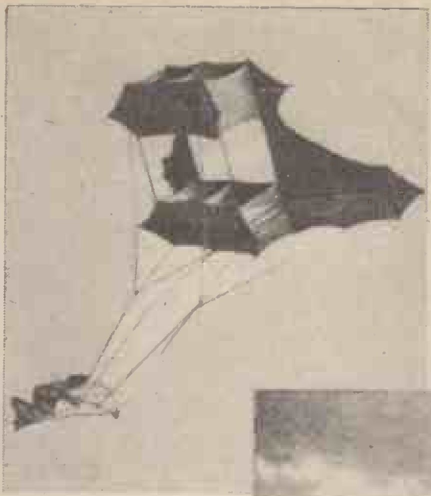
Man-carrying Kites

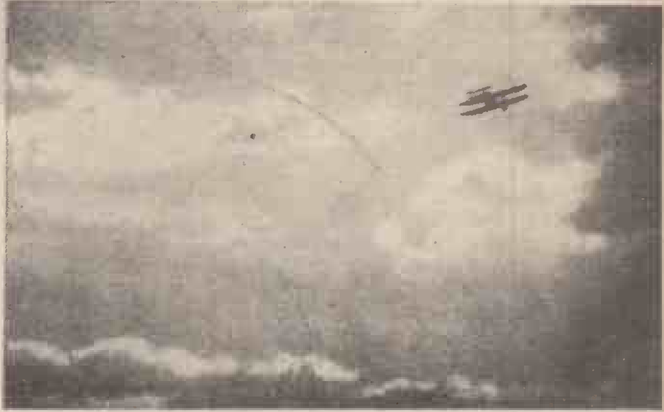
Cody's first task after becoming established in England was to develop his man-carrying kites and to give exhibitions of kite flying at various meetings. In this small way he began to call attention to himself during the early years of the present century.

The success of Cody's kite experiments was such that it was not long before the British War Office became interested in his feats. Relationships gradually became established between the two, and after a time we find S. F. Cody "working for the War Office."

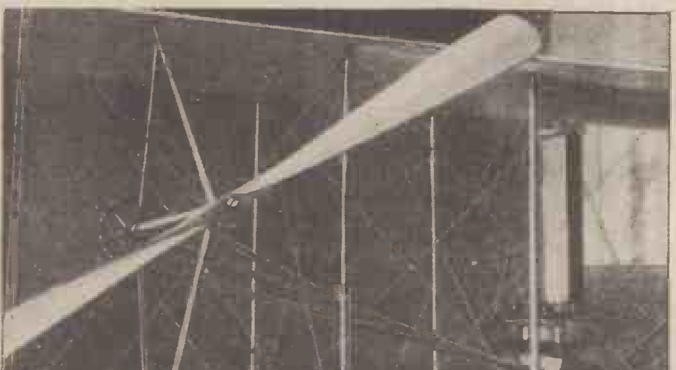
It was at the old Military Balloon School, which was then run by the Royal Engineers at Farnborough, that Cody was first employed by the War Office to continue his kite experiments. It was here, also, that he held the official post of "Kite Instructor."

His wife, Lela Marie Cody, herself a former successful actress, did much to assist him in his experiments, and was frequently the willing "subject" of his kite trials. This lady became almost as intrepid as her husband at the kite flying game. Years after his death she related some of her experiences. How, for instance, her husband "put her up" some 3,000ft. into the sky on a kite, and then, giving his attention to other work, completely forgot all about her until his memory was jogged by some spectators, when he at once feverishly proceeded to haul her down.





(Above) Cody's man-carrying kite. It is seen here carrying a woman, Mrs. Cody, who, with her husband performed many pioneer flying flights. (Right) Cody in full flight.



A close-up of the chain-driven two-bladed propeller used by Cody in his 'planes.

The Cody man-carrying kites ascended up to about the 4,000ft. level and were controlled by a thin wire cable wound on a windlass. Frequently enough the kites were able to withstand strong winds and other adverse atmospheric conditions which would spell certain ruin to an ordinary captive balloon.

"Nulli Secundus"

The success of Count Zeppelin with his dirigible airships excited the emulative spirit of the British War Office. A plan was prepared for imitating Zeppelin's feats and, if possible, surpassing them. After a good deal of experimentation a semi-rigid airship, *Nulli Secundus* ("Second to None"), was evolved. This was put on its trials in 1907. It was produced by Colonel J. E. Capper and by S. F. Cody working as an assistant. This airship had an envelope some 25ft. in diameter, and it was covered with 15 thicknesses of goldbeater's skin. But the envelope material was too water-absorbent, the consequence being that the airship was entirely wrecked after encountering a shower of rain.

Then followed *Nulli Secundus II*. This had a 42ft. diameter envelope and a 100 h.p. engine. The fabric was also waterproofed. The airship made a trial trip from Farnborough to London but was afterwards wrecked by a gust of wind.

So much, therefore, for Cody's work on airships. It was altogether undistinguished, like most British airships have been.

But Cody's mind was on other things besides airships. The exploits of the Wright Brothers and their final practical proof of the possibility of human flight in a heavier-than-air machine had long claimed much of his thought. He resolved to make a similar demonstration in England.

Wilbur and Orville Wright made their first power-driven flights in 1903, and other pioneers on the Continent had at a later date imitated their pioneering exploits. England at this time was hanging back in the matter of aeronautics, despite the intense interest in it in France. The British Government evinced no interest in the aeroplane. The public looked upon the very idea of an aeroplane as an inordinately expensive and troublesome means of suicide, and, generally, a complete apathy to all things aeronautical was very much in evidence in this country.

A Bamboo Aeroplane

It was to a large extent S. F. Cody and a few other pioneering contemporaries who changed this public apathy and even public aversion to an attitude of mass interest and mass excitement.

Cody worked for about two years on his first aeroplane. It was an extraordinary assemblage of bamboo poles and taut wires, and it looked like a Wright machine with the addition of a tail. It was actually a biplane, but Cody persisted in calling it a "power-kite."

The Cody aeroplane or "power-kite" had a 40ft. wing span, and it was driven by an eight-cylinder, 50 h.p. Antoinette petrol motor (a French production) which did about 600 r.p.m. and drove a couple of two-bladed propellers, the propeller drives being by means of chains which were little more substantial than that of an ordinary bicycle chain.

The first flights which Cody made with his machine in 1908 on Laffan's Plain were successful, the machine lifting itself off the ground and running for some 100 yards. Nevertheless, the altitude of these flights was not very spectacular, being of the order of about *6in.!* On October 5, 1908, Cody was getting better results, but he had a serious crash which wrecked the machine.

Undaunted, however, and more enthusiastic than ever, he at once proceeded to "reconstitute" his machine, and, after making several alterations to it, achieved his first "big" aeronautical success by flying 1,200 yards over Laffan's Plain on May 14, 1909.

In the eye of the British populace, then sorely, as now, tried with political questions, S. F. Cody had genuinely "arrived." He fitted an 80 h.p. engine to his machine, and on the ensuing July 21 he flew for about four miles. In the following month he carried a passenger—the first passenger flight in England—and on September 8, 1909, he made a cross-country flight of more than 40 miles in 66 minutes, this constituting the world's record.

Samuel Franklin Cody was, indeed, the first man to rise from English soil in an aeroplane, although at that time he was not a naturalised Englishman.

First Circular Flight

After his achievement of the world's record, Cody subsided again to the comparatively humdrum task of giving his biplane trials on Laffan's Plain, of finding ways and means of coaxing it round corners and straightening it out again, of increasing its stability and the general serviceability of its controls.

Before long we have the energetic Cody, who was at this time by no means a young man, demonstrating to British Army officials the fact that he could make a circular flight of about two miles and land close to his starting-point.

It was in 1909, also, that Mrs. Cody flew with her husband above Laffan's Plain on the "Army" biplane, thereby taking to herself the honour and celebrity of being the first woman to fly above English soil. On that occasion it is said that the Codys made several turnings and even performed a figure of eight.

In 1909, also, Cody completed his naturalisation process as a British subject. He immediately celebrated the event by entering for the *Daily Mail* £1,000 prize for the first British pilot to complete a circular flight of one mile on an all-British aeroplane. Bad luck dogged him in this attempt, however, and he was forestalled by Mr. Moore-Brabazon, who eventually captured the prize.

Cody was active at the various flying exhibitions of 1910, despite the fact that he had a good deal of poor luck in this year. But in 1911 he built for himself a machine which he considered to be the embodiment of all his intensive experience in the flying art.

The "Cody Cathedral"

It was truly an extraordinary machine, an affair of bits and pieces, of additions and further additions, of "supplementary surfaces" which, in Cody's mind, performed special functions in stabilising and in increasing the efficiency of the general turnout. The machine was of very large size, and it was, perhaps, in view of its general massiveness, that it quickly became nicknamed the "Cody Cathedral," a term which was used in places with a certain degree of derisiveness.

Yet the "Cody Cathedral" turned out to be a winner after all. During the early portion of its career it won two Michelin flying trophies, and in the following year (1912) it performed some 7,000 actual flying miles, which was then an extraordinarily good achievement.

During the 1912 season the "Cathedral" not only won a Michelin cross-country prize, but, out of the 26 eager competitors, it won the War Office prize of £5,000 for a military aeroplane. During this test the "Cathedral" rose to a ceiling height of 5,000ft., which was at that time characterised as an "indescribable altitude."

A New Biplane

In 1913 Cody built a new biplane for the purpose of entering into the *Daily Mail's* £5,000 contest for a seaplane race round Britain.

The new biplane was very like the original "Cody Cathedral." It was still mostly made of bamboo, but it had a shorter tail than the original "Cathedral," and it carried one large rudder instead of two smaller ones, as had previously been the case.

On August 7, 1913, Cody was completing his tests with this machine above Laffan's Plain, the biplane having been fitted with a special land undercarriage for the purpose. For eight minutes the 'plane had performed excellently, and Cody was proceeding to land it from a height of approximately 200ft. when suddenly, and without the slightest prior warning, one of the spars of the lower wing fractured, and immediately the whole machine collapsed in the air.

Cody's Death

Neither Cody nor his passenger (a Mr. W. H. B. Evans) was strapped in. The result was that both of them were thrown out into the air when the machine turned over and were killed immediately. Had they been strapped in, they might have survived, for the 'plane wreckage landed on a clump of trees, and its central portion was found to be more or less undamaged.

Such was the end of "Cody, the Aviator." It was quick, sudden, painless, perhaps, and probably as spectacular as he would have wished.

The first Great War, which came a twelvemonth after Cody's death, inaugurated a new period of flying history, and it is perhaps strange that Cody's son Frank was destined to be killed during this war whilst on flying duty over the German lines. But the metal-clad machines which began to evolve as a result of war experience were far from the mind of the original "Flying Colonel." He had pinned his faith to bamboo poles and strong linen and had achieved extraordinary successes and popularity with them. The machines which came after him belong to another and an altogether different chapter of aeronautical history, whose narration must be left for some subsequent occasion.

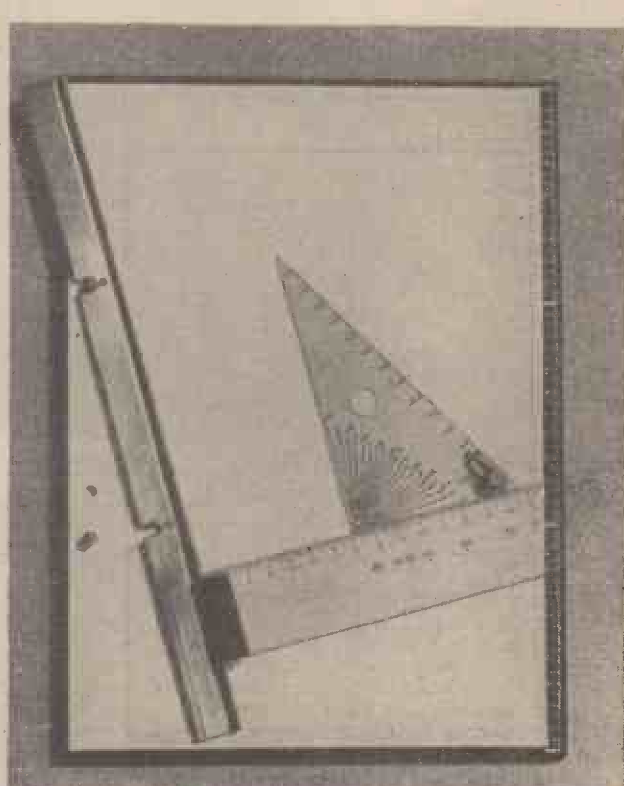
A Miniature Draughting Set

IT is an unfortunate feature of the sketches made by the average mechanic, or practical man, that they frequently fail to clearly put over the idea they illustrate mainly because these sketches are not sufficiently neat and well executed. While a competent drawing is largely the result of continuous practice, something has to be conceded to the instruments employed which are seldom available at the bench. In this connection an ingenious miniature draughting set has been designed and placed on the market by a Swedish firm in Gothenburg (A.B. Goteborgs Kontorsbokfabrik), which provides a ready means of making quick but accurate sketches. It is simple, self-contained, and quite adequate for most workshop, field and bench work, but it can also be used, if required, in connection with other drawing equipment.

The complete set in question, as shown in the accompanying illustration, consists essentially of three parts. (1) The pad is a loose-leaf one for standard size drawing or tracing paper, having a scale on the right-hand side and two push-button pegs on the left; (2) a flat metal side bar with two slots, having a transparent ruler attached at a 90 deg. angle, snaps on to the pegs, and provides a means for ruling horizontal lines quickly and accurately. For vertical lines, the bar is detached from the upper peg, swung round until it is horizontal, the exact position being determined by sliding the ruler to one side of the drawing pad, and the ruler is then ready for ruling vertical and parallel lines. Angles and oblique lines are easily struck by adjusting the sliding ruler to the correct angle by moving the ruler to the top or bottom of the metal bar, then pivoting the bar and ruler around one of the pegs until the point indicating the desired angle on the ruler coincides with the base line of the scale on the right-hand side of the pad. Parallel lines of the desired slope are then rapidly drawn. An alternative short-cut for drawing vertical lines is provided by the help of small notches on the bottom edge of the transparent ruler, which enable the user to keep the pencil point in place while the ruler is moved up or down. (3) The final item of the outfit is a set-square compass of transparent plastic material having 90, 60 and 30 deg. angles, which is also arranged to serve as a protractor, enabling any angle between 5 and 90 degrees to be set off by means of holes set 5 degs. apart. By this means three points would be made to indicate the required angle, and the points then connected by lines.

At the 45 deg. corner, the set-square is provided with a screw-down needle point, which is lowered when the instrument is to be used as a compass. Holes one to 12 are set at distances of 10 mm. in the case of the metric set illustrated, adjustments of 1 mm. being obtained by moving the screw-down needle point along the millimetre scale provided on the frame. Circles are drawn around the needle centre point by inserting a pencil in the appropriate hole 1-12, and pulling the set-square round.

The size of the drawing pad, illustrated, which is the metric model, is 12in. by 9in. The scales fitted can either be in millimetres as shown or in inches, or dual-purpose.



The complete draughting set.

Modern Coal-mining Machinery

Notes on the Operation and Working of Mechanical Coal-cutters

By G. F. HAMBLETON and S. McCALLUM

THE purpose of this short series of articles is to make mining machinery more widely known, thus giving an insight into mining equipment and practice hitherto practically unknown to the layman.

Modern coal-mining machinery had to come, just like all other industrial mechanisation. It did not displace labour to any appreciable extent, but brought to the engineering industries further scope for manufacture and labour.

The Samson Coal-cutter

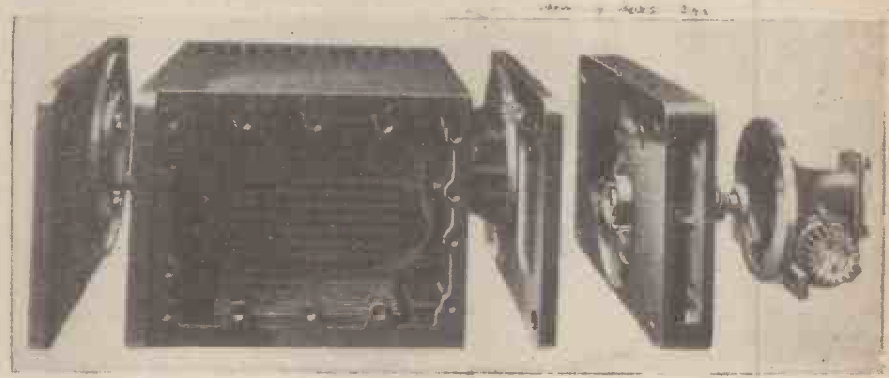
Great development has taken place over a very short space of time, but the chief desire is to get compactness, efficiency and strength. These features are ideally incorporated in the 19in. Samson coal-cutter manufactured by Mavor and Coulson, Ltd.

The machine comprises three units, namely, cutting end, motor unit and haulage end, which are held together by 12 1¼in. bolts, giving a length of 8ft., width of 2½ft., height 1½ft. The whole is mounted on a skid plate and bolted on with eight 1in. high tensile bolts. The driving medium may either be A.C. or D.C. electric or compressed air. The commonest type of motor for three-phase electric drive consists of a cast steel stator having a laminated core of notched discs coated with a preparation to keep down iron losses.

The stator is wound with enamelled copper hard asbestos insulated wire to a specified voltage, which may be anything between 400 and 650 volts, the output being 60 h.p. at 1 hr. rating. The rotor consists of a hub or spider on which notched discs are built as in the stator. Copper bars are driven through the slots in the discs and connected at each end by short-circuiting rings, a secondary set of bars being fitted between the main set to give a high starting torque.

The rotor shaft is keyed to the spider and is carried on two roller bearings, a single row ball-bearing being fitted to take the thrust. Oil sealing is by means of felt washers carried in bearing caps.

The starter, which may be either direct on or remote control type, is carried in a separate chamber in the stator shell, and the complete electrical apparatus is sealed off from the surrounding atmosphere to comply with the flameproof regulations laid down by the Ministry of Fuel and Power. The starter is connected to the stator leads and also to a flameproof socket, into which the electricity supply cable is plugged.



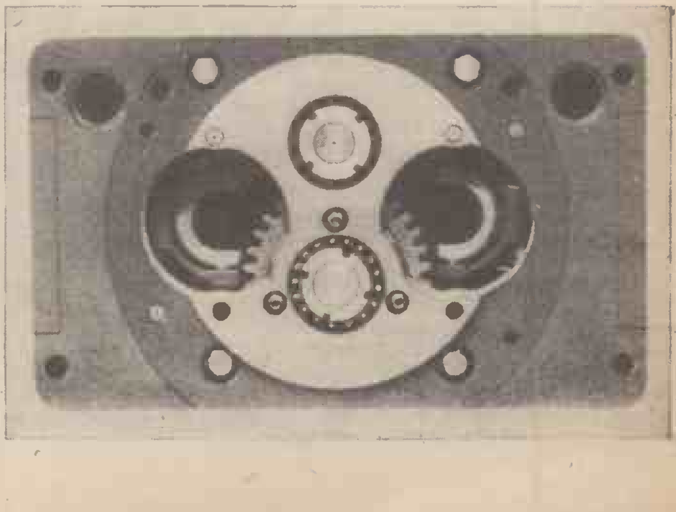
Split view of A.C. motor, showing stator casing with door and starter removed, end plates, rotor with bearing assemblies and flameproof glands. The worm reduction gear to the haulage end is at the right-hand side.

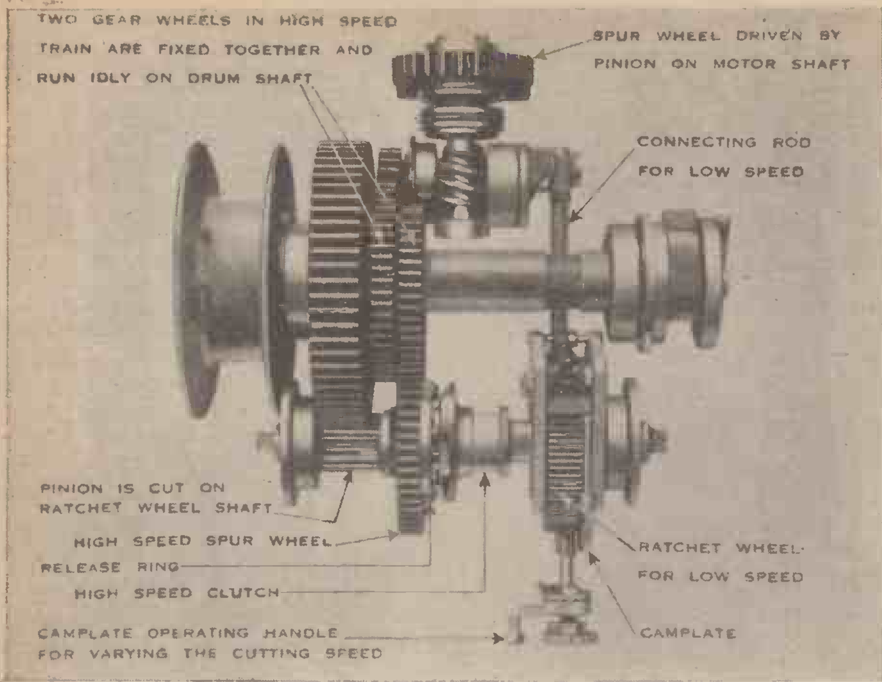
Driving Gear

At the gearhead or cutting end the drive from the case-hardened spur pinion on the rotor shaft is taken through a train of straight cut, hardened gears to a bevel pinion shaft driving a crown wheel, to which is bolted a hub or driving clutch carried on ball-bearings at the top of the vertical shaft, at the bottom of which the cutter chain-driving sprocket is keyed. The disengaging half of the clutch slides on splines cut in the shaft and is brought into operation by a yoke operated by a rod from the haulage end.

When engaged, the clutch dogs transmit the drive from the bevel gear to the sprocket, which in turn drives the cutter chain round the jib. At the same time the drive from the haulage end motor pinion is taken through a countershaft and worm reduction

(Left)—Exploded view of gearhead showing frame, bevel gear, clutch operating pinion, side door, jib-head and sprocket shaft assembly. (Right)—End view of the diaphragm in position with the trunnions for engaging in each sliding pinion (as used in the compressed air machine).





Plan of moving parts of haulage. The right-hand drum is removed to show hub and pawl.

gear to the crankshaft, driving a connecting rod which causes the rocking levers to oscillate to and fro.

The rocking levers carry a driving pawl, which engages with the teeth of the ratchet wheel.

A cam-plate, controlled by a handle, carries a bridge piece partially shrouding the ratchet wheel in the portion where the pawl is operating, and by altering the position of the cam-plate the feed may be varied from 0. to 5 teeth per stroke of the connecting rod. A spring-loaded stop pawl also engages on the teeth to take the load when the driving pawl is on the return half of its motion.

The stop pawl is carried at one end of a pair of plates on a fulcrum pin in the rope release box, and it is brought into operation by raising a crank which turns the assembly on its pivot. Release of the rope is effected instantaneously by knocking down the crank lever, the stop pawl being then free to disengage from the ratchet wheel.

The drive from the ratchet wheel is taken through a further reduction to the shaft carrying the rope drums, which may be independently engaged by pawls which engage in the driving hubs keyed to the shaft.

Rope feed is roughly 1ft. per minute on a single tooth feed of the ratchet wheel.

A further train of gears to give a flitting speed of 23ft. per minute may be fitted on ratchet and drum shafts and driven from a pinion fitted to the opposite end of the crank shaft to that carrying the connecting rod. The high speed is engaged by a yoke which operates a clutch sliding on a key on the ratchet wheel shaft, the clutch taking the drive from the spur wheel, rotating on a bush on the haulage drum shaft. As the rotation of the ratchet wheel shaft is speeded up, the ratchet drive is overrun if the pawls are in contact with it.

In the disengaging operation, when lowering of the high-speed handle is commenced, a projection on the yoke engages on an abutment on a release ring, thus preventing it from turning; axial projections on the clutch spur wheel then contact with those on the release ring in wedge-like manner and force the release ring to automatically push out the clutch, thus giving disengagement. The controls are grouped at haulage end in easy reach of operator, and they are the starter handle, cutter chain engaging handle, high-speed control handle, cam-plate operating handle, quick rope release lever and engaging keys for haulage drum pawls.

Turbine Unit

When compressed air is the power medium a turbine unit is fitted. This consists of a high-grade cast iron shell fitted with cast steel bearing housings at each end which support a pair of rotors on single row roller bearings.

The rotors comprise two pairs of helical gears pressed on to the rotor shafts and running in mesh with the absolute minimum of clearance.

The gears are made of high-grade cast iron to reduce wear to the minimum. The lower half of the casting is machined concentric with the housing bores, and the housings are dowelled to the casing during assembly and give a clearance of five thousandths between rotor and casing.

Compressed air is admitted from pipe lines through ports, either at gearhead end or haulage, and is controlled by a valve contained in the distance piece between the haulage and turbine castings.

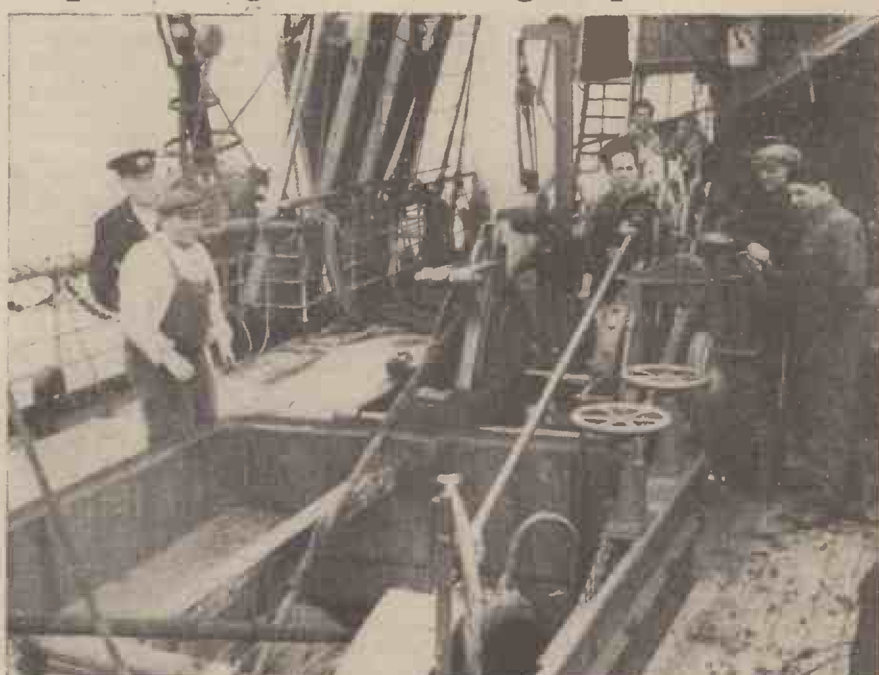
From the valve the air is led through a strainer to a chamber at the bottom of the distance piece, and then along a port in the bottom of the turbine casing to the central meshing point of the rotors, where it is admitted to the turbine rotor cylinders, thus causing rotation of the rotors, the normal speed being 1,800 r.p.m. The exhaust air passes out through apertures in the sides of casings. End thrust is taken up by a single row thrust bearing fitted to the left-hand shaft, the right-hand shaft taking the driving pinion at the haulage end.

At the gearhead end the shafts are splined and carry sliding pinions; these are engaged alternatively, depending on which side the jib is making its cut.

Engagement of the pinion is effected by means of trunnions and yokes operated from the haulage end of the machine. The drive to the sprocket is similar to that in the A.C. machine, except that the clutch on the sprocket shaft is omitted, the crown wheel hub substituted having a direct drive to the splines of the sprocket shaft. The A.C. and turbine units are designed to permit interchangeability, and conversion from one drive to the other is a fairly simple operation.

(To be continued)

Repairing a Telegraph Cable



This illustration, taken on board the Great Northern Telegraph Company's cable ship "Edouard Suenson" illustrates part of the work of repairing a fault in the cable between Newbiggin, Northumberland, and Marstrand, Sweden. In the illustration the cable is seen being brought in by the cable engine to go into the cable tank.

Rocket Propulsion

The Super-sonic Aircraft : Atomic Propulsion

By K. W. GATLAND

(*Continued from page 95, December issue*)

NOT only did the society's investigations cover the practicability of abstracting boundary layer by the suctional effect of the rocket exhaust, but a scheme was also developed by which it was intended to increase the mass delivery to the propulsor by the incorporation of a compressor. The improved induction, of course, would have its result in a more efficient abstraction of the boundary layer.

The compressor is driven directly by an internal thrust-turbine, connected on a common shaft, the system being a derivation of the thrust-feed turbine unit (Fig. 44), discussed earlier. In this instance, however, the propellent feed is effected by the incorporation of an auxiliary power motor and pump.

The original layout provided a light petrol reciprocating unit for this purpose, but it is now considered more desirable, in view of the V2 development, to use a light H^2O^2 superheated steam turbine.

The propulsion unit proposed is shown diagrammatically in Fig. 47. The four principal advantages of the "thrust-turbine" power unit over the exhaust-turbine motor can be set down as follows: (a) reduced risk of erosion and "burn-out" of turbine; (b) absence of rotor in gas stream allows improved velocity and conformity of exhaust flow; (c) the injection system provides a true "concentric-feed" arrangement, and facilities a better mixing of the propellent and (d) transmission losses are at a minimum.

The thrust-turbine/compressor unit, besides its use in an augmented rocket system is, too, suitable for adaptation in a light thermal-jet motor. A unit designed on these lines for model research is shown diagrammatically in Fig. 48.

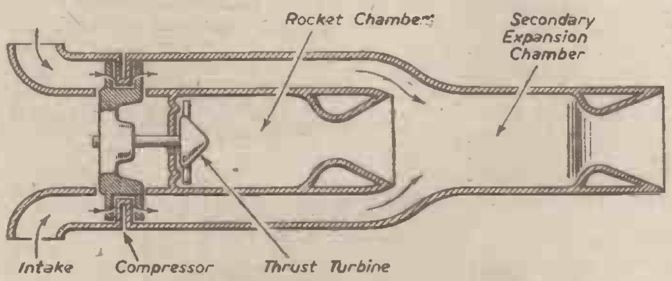


Fig. 47.—Diagrammatic illustration of the thrust-turbine/compressor air-augmented rocket unit.

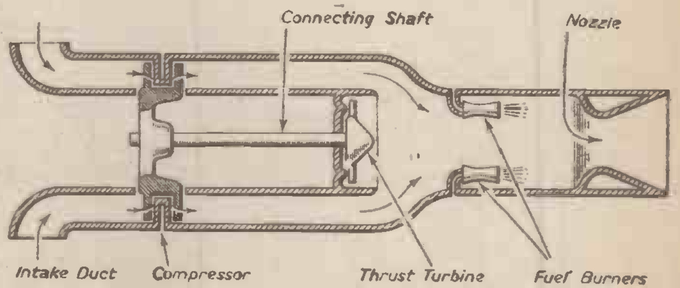


Fig. 48.—Diagram showing the thrust-drive turbine in a thermal-jet propulsor arrangement.

More General Observations

The remaining essential advantages the rocket powered aircraft would appear to hold over all other forms of propulsion are summarised in the accompanying schedule. (1) The power is applied in "direct reaction," there being no frictional transmission losses. (2) Advantages are presented with respect to altitude. Whereas contemporary power systems require atmospheric air to support combustion, the rocket system functions independent of the atmosphere, and, indeed, operates at maximum efficiency within a vacuum. (3) Owing to the improved thrust/weight ratio, the rocket system lends admirably to complete submergence, and facilitates a reduction in aerodynamic drag. It would, for instance, be ideal in an all-wing layout. (4) The less weight and greater simplicity of the power plant allows reduced installation space for a given thrust H.P. (5) The rocket motor functions without vibration, and torque is virtually eliminated. (6) It is capable of operating at maximum propulsive efficiency almost immediately after ignition. (7) The absence of an airscrew, as with the thermal-jet machine, enables the rocket aircraft to be of low build. (8) Location of the propulsor enables a better position of the pilot. (9) The simplicity of the rocket motor facilitates servicing and maintenance, and (10) it is a possibility to combine the thermal-jet and rocket systems, allowing independent function. A rocket propulsor, for instance, would be most desirable for accelerating a heavily laden aircraft into flight. This would allow a greater wing-loading due to an increased weight of fuel than would normally be possible for take-off. Another scheme might be the operation of the "jet" system up to its maximum effective ceiling, and the use of a rocket component above this region.

The Super-sonic aircraft

The question of aircraft flight in the ballistic speed range involves another limiting factor.

At super-sonic velocities there are not only profile drag and induced drag to be considered, but also a wave resistance which arises from an approach of the air speed to the speed of sound. When this limit is reached the air flow suffers a sudden change in character due to compressibility which has effect in an increase of the pressure and density, with accompanying severe increase of drag, and, in the case of an aerofoil, decrease in lift.

This problem of air compressibility is an aerodynamic phenomenon with which the propeller designer has had to contend for years. It has resulted in a limiting of the tip speed and the development of large area, thin section blades, which permit a low angle of attack. Despite these refinements, however, a compressibility wave is sometimes formed at the tip of the propeller blade, because the tip travels a great deal faster than the aircraft, due to its rotary and forward motion.

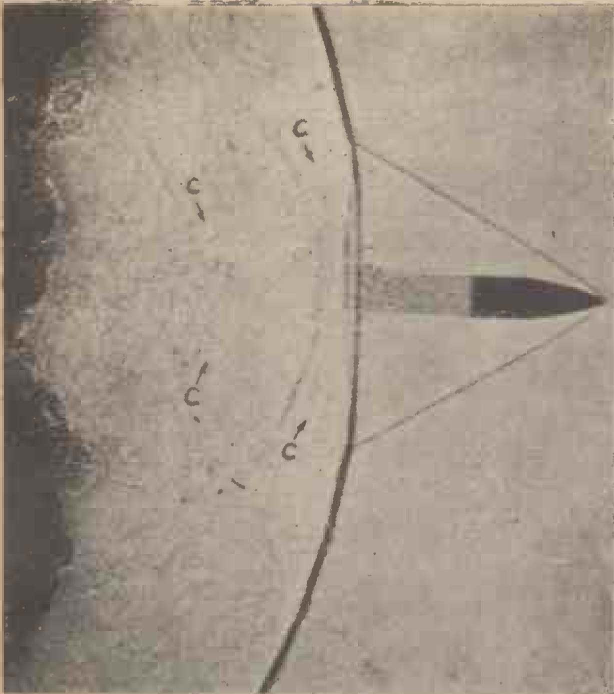
Reinhold Tiling during a demonstration of his folding-wing rocket aircraft at Hanover, Germany, in 1931. They were powder fuelled and capable of rising to heights varying from 1,500 to 2,500ft. ("Practical Mechanics," July, 1945, page 343.)
Shortly before the explosion which caused the inventor's death in 1933, Tiling had announced his intention of building similar rockets to span the English Channel.

The designer of fighter aircraft, too, has need to be conscious of compressibility. In present-day machines this takes the form of what we may term "local compressibility," which is common where contour changes occur. The speed at which the air flow changes is termed the "critical speed." This is normally lower than the sonic velocity, because the local air speed relative to the body may have attained this value at some points of the surface.

Ballistic Research

Experiments with shells and bullets have provided valuable empirical data, which, in many ways, is useful in investigating the problems of super-sonic aircraft motion.

In this research, screens are arranged in the firing path so that, as the projectile passes though, its time at each stage can be recorded. Thus it is possible to obtain



Photograph of a bullet in flight, showing compression waves. The bullet is 11in. from the gun muzzle—a .30 calibre Springfield rifle was used in the experiment—and, travelling in the region of 3,000ft. per second, has outdistanced the discharge waves. Note the deflection of the conical bow waves in the explosion wave area, indicated by the arrows "C"; also the stray powder particles which have created compression waves on their own account. (*Taken by P. P. Quayle, of the American Bureau of Standards*). *Courtesy of Kodak, Ltd.*

the velocity at each section by process of differentiation, and further differentiation, also with respect to time, will yield a figure for the acceleration at each section. This acceleration will, of course, be negative, and after the effects of gravity have been taken into account the final result will be the retardation due to air resistance.

Some interesting points arise from the figures thus obtained. Firstly, it is found that the drag is dependent upon several variables, and in the case of bodies moving with a velocity less than that of sound it is given by the formula of aerodynamics, namely:

$$D = kd.\ p.\ S.\ V^2.$$

where kd is the shape coefficient, p is the specific mass of the air, S is the maximum cross-sectional area of the body, and V is the velocity at which the body is travelling relative to the air.

Since we are taking the case of super-sonic motion, it is necessary to add a further coefficient to the equation. In experiment it has been found that this coefficient is constant at unity until the sonic velocity is approached. Its value then increases rapidly and reaches a maximum value of approximately 3.3 when V/v_s is just greater than unity. Since V/v_s increases beyond unity, the value of the coefficient falls, until it may again be regarded as a constant for velocities of over five or six times that of sound. The value of the coefficient will then be in the region 2.3 to 2.5, and the equation for drag can then be rewritten as:

$$D = kd.\ K.\ p\ S.\ V^2$$

Having shown that the value of the coefficient K is dependent upon the ratio between the velocity of the projectile and that of sound, it now remains to ascertain the values of the other terms of the expression.

When S represents the maximum cross-sectional area of the body, the other coefficient kd is found to depend upon the shape of the body. For a spherical shape it is approximately .106, reducing to .047 for a streamline body. Between these values there are, of course, very many others for diverse shapes, and the exact value for a given body will need to be found by means of wind-channel tests.

The remaining term, p, represents the specific mass of air at the place considered, and for varying heights it is found to follow an exponential law:

$$ps = p_0.e^{-h \cdot s}$$

where p represents the specific mass at zero altitude, s is the height in metres, and h is a variable coefficient dependent upon s.

The form of the air flow about a projectile travelling at super-sonic velocity is shown in the accompanying photograph. It can be seen that a compressibility region is built up at the nose of the body. Because of this the oncoming air has a denser region to traverse, and instead of passing evenly over the body the flow takes the form of hyperbolic sound waves, originating a short distance from the nose. This compression wave initially moves with the speed of the body, and in reducing to normal sub-sonic values produces the "bow wave" which constitutes the main drag. The curvature of the wave is indicative of the compressibility flow, and the velocity is

Fig. 49—Sänger "super-sonic" wing section.

damped exponentially, as shown by the straightening of the compression curve and its gradual dissipation to sub-sonic values.

There is, in addition, a sound wave produced by the rear of the body due to rarefaction.

The above, of course, is only the barest outline of the problems involved, and that only in so far as the body shape is concerned. There is yet the effect of compressibility on the aerofoil surfaces to consider.

Compressibility and the Aerofoil

The *wave resistance* is independent of the aspect ratio, and both the induced drag and the wave resistance are proportional to the square of the lift, depending on the Maché number (ratio of flight velocity to sound velocity). As a general observation, the greater proportion of the total drag in super-sonic flow for normal aspect ratio is due to wave resistance, while the induced drag represents only a small proportion of the total.

The aerofoil theory at super-sonic velocities is virtually opposite to that employed in the sub-sonic range. Whereas at sub-sonic speeds a relatively blunt contoured nose secures the most efficient results, the super-sonic aerofoil demands a knife-edge nosing.

At ballistic speeds, the body with the greatest penetration from the aerodynamic point of view is the flat plate of infinitely small thickness. The hyperthetic case for two dimensional frictionless flow can be expressed:

$$\text{Lift Coefficient} = C_L = \frac{4}{\sqrt{\left(\frac{V}{a}\right)^2 - 1}} \propto$$

where V is the flow velocity; a, the sound velocity; V/a, the Maché number in the undisturbed field, and $\propto$, the angle of incidence, assumed small.

The resistance coefficient, under these same conditions, is given by:

$$C_D = C_L \propto$$

and in the case of frictionless flow, the gliding coefficient is thus independent of the Maché number, as:

$$C_G = \frac{C_D}{C_L} = \propto$$

These simple equations are adequate to illustrate the case, but the actual calculations involved in super-sonic *aerofoil* theory, as might be expected, are considerably more involved. This subject is naturally beyond the scope of the present writing, and the reader desiring further information is referred to the specialised papers and books which have become generally available in recent years.

The super-sonic flow thus demands an entirely original aerofoil shape, and the most practical form has been found in the development of a conical section, the drag of which decreases as the apex angle is reduced. A super-sonic section accorded on these lines is shown in Fig. 49. It will be seen that whereas in the sub-sonic aerofoil every effort is made to reduce turbulence by maintaining a sharp trailing edge, the opposite is the case for super-sonic flow. A necessary quality at high speed is that the wing should be thin with the maximum thickness well aft. This is because the compressibility flow will always break away from the surface shortly behind the mid-section of the aerofoil, involving the trailing edge in pronounced rarefaction.

The outline form of a super-sonic rocket aircraft as envisaged by Dr. Eugen Sänger, the reputed Austrian engineer, is some indication of the practical application of these principles. The illustration (Fig. 50) is taken from an investigation of super-sonic 'plane motion, which Sänger carried out during the early 1930's, and included in this are detailed calculations relating to the proposed trajectory for such a machine. Because of the need for gaining maximum distance and

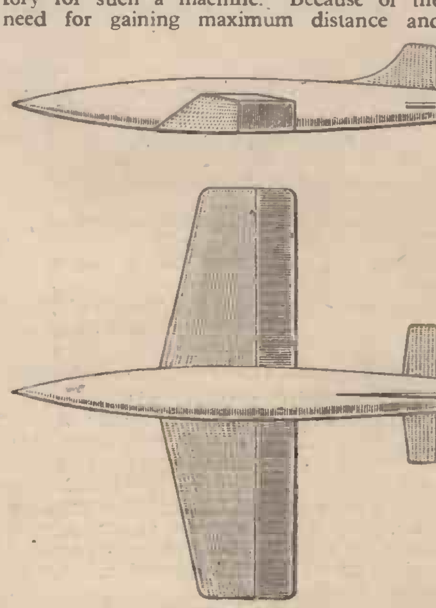


Fig. 50.—An impression of the super-sonic rocket aircraft suggested by Dr. Eugen Sänger, Austria (1933).

height within the shortest space of time, an ascent angle of 30 deg. is maintained until the desired height is reached. The machine is then levelled out and the motors "cut," allowing the balance of the journey to be made under momentum, the 'plane gradually losing speed and altitude until the destination is reached.

The conclusions arrived at provide a firing time of about 20 minutes, and a flight duration of approximately 70 minutes at an average speed of 1,600 miles per hour.

From the foregoing it is clear that no reasonably efficient aircraft can operate both below the ballistic velocity as well as above. The super-sonic aircraft must therefore be designed essentially for flight at ballistic velocities, and no account given to its operation at lower speeds.

It is obvious, therefore, that the engine/propeller combination is immediately precluded from operation in the true ballistic speed range. A substantial problem would be the provisioning of sufficient thrust to operate an aircraft against the drag at such speeds, and as we have already observed, the conventional propeller is the first to be influenced by compressibility. It is obvious that the super-sonic propeller blade section is not a practical solution for a variety of reasons.

Thermal-jet Aircraft

The prospect is much improved by the thermal-jet aircraft, as we have already seen in the record-breaking trials of the Gloster Meteor. With further developments in jet-propulsion we may confidently expect still closer approaches to sonic values, and it is not unlikely that the jet-compressor will ultimately allow speeds in excess of sound. The powers that will be required to overcome the vast increases in drag, however, will be out of all proportion to those required to gain a few extra m.p.h., at more moderate speeds, with fuel consumed at profuse rate. It is possible, in fact, that the true rocket aircraft may be a more reasonable comparison at ballistic velocities.

Whatever its means of power, however, the super-sonic aircraft will involve several further design headaches; principally, the investigation of the stresses subject to the wings and airframe, but perhaps, more particularly, the attainment of adequate flight control.

In travel above this speed region the rocket aircraft—even if designed along the correct principles of ballistic motion—would nevertheless operate far below a practical working efficiency. Clearly, the atmosphere is the chief barrier to further substantial progress in this direction, and remembering that the rocket engine is at highest efficiency when functioning in vacuum and at high speed, an alternative worthy of serious investigation is the true projectile craft.

Atomic Possibilities

The harnessing of atomic energy, however, can be expected to alter this picture completely. With atomic reaction motors, the flight of large aircraft near the velocity of sound, and capable of travelling to any part of the earth without need for refuelling, would be commonplace.

The size of present aircraft is limited by the engine powers available and the arrangement of the airframe. Larger and more powerful aircraft are already well advanced in design as the result of the recent great strides in thermal-jet propulsion, but the largest aircraft that is ultimately possible using jet-power would obviously be small, and its performance far less effective than the machine powered by atomic reaction.

The "All Wing" Layout

The conventional fuselage and cantilever arrangement of wings and tail assembly are not suitable for dimensions above a certain practical limit which is approached in present designs.

In very large aircraft it becomes increasingly more necessary to spread the weight uniformly over the span.

It is therefore obvious that the "all-wing" shape is the ideal to be aimed at, not only because it is structurally more stable, but due to its improved aerodynamic efficiency. Estimates indicate that the flying-wing has from 33⅓ to 50 per cent. less drag than the conventional type, and this has its result in that considerably less power is needed to attain a given speed.

There seems no particular structural limit to aircraft which take this form, and it is likely that a further half-century's development will witness the accommodation of passengers and freight entirely within the wing section, and in numbers and weights to rival those of the smaller ocean liner.

This is an encouraging prospect, but we must not lose the perspective. It is possible that many years will elapse before the atomic reaction engine becomes reality, and as has already been stressed, there are likely to be many difficulties requiring solution between the experimental engine and its commercial counterpart. True, an "atomic engine" of sorts has already given promise of early development, but it is extremely crude and certainly not of great significance for use in aircraft.

This "atomic generator" employs the radio-active U-235 with admixture of graphite, which serves as a moderant and controls the rate of energy released. It is contained in a tank which is fed with water, and upon its bombardment with "slow neutrons," the substance becomes incandescent, the water acting to slow down the fast neutrons released and returning them to carry on the process. The atomic fission can hence be made to continue as a self-propagating reaction until the fission of all the substance has taken place. The water is rapidly condensed into steam energy, which is used either in driving a turbine or reciprocating engine.

Apart from the use of moderants, it is further possible to control the energy by sleeving the active substance with certain metals that the neutrons cannot penetrate, allowing only a small section to be exposed at a time.

This form of "atomic power" would be most suitable for electricity generating stations, ships, and perhaps even locomotives. It would require an entirely different arrangement to drive aircraft and road vehicles.

In these latter instances it is assumed that *direct reaction* arising from the fission of ultra-high-speed particles would provide the propelling force. This is a far less simple scheme than the atomic steam generator, and introduces problems of control and construction that may take many years to overcome.

(To be continued)

The Gloster Meteor

The Gloster Meteor jet-propelled aircraft which Mr. Eric Greenwood flew at 603 m.p.h. over the Herne Bay course recently.

The Mechanics of Meteorology—2

Air Temperature, Frost, and the Formation of Clouds

By G. A. T. BURDETT

(Continued from page 81, December issue)

Fig. 11.—Thermograph or recording thermometer. Records on a seven-day chart changes in air temperature.

THE point at which a volume of air can contain no more water, and further lowering of the temperature would cause the air to release some of its water, is called its dew point.

The dew point, or the temperature to which a volume of air must be lowered when it precipitates water, will depend upon the temperature to which it was first raised in order to absorb moisture and of the moisture in the vicinity of the heated air.

Fig. 9 shows a hygrometer for reading relative humidity.

Formation of Dew

The dew found on the grass in the early part of some mornings is formed in this manner.

Throughout the day the sun has heated the ground. It has also evaporated some of the water from the lakes, rivers and the sea. As a result the air has a high moisture content. Then at sunset the temperature of the ground drops, due to radiation. Therefore the air in contact with the ground also cools.

This lowering of the temperature of the air means that its relative humidity increases so that in time its saturation point (dew point) will be reached. A further drop in temperature means that the air will deposit its moisture on the grass or anything else susceptible to the formation of dew. Some bodies, such as rocks, have a high specific heat. Therefore as their surface cools, heat from the body of the rock is conducted to the surface, which is thus able to retain its temperature above dew point. For this reason dew is rarely deposited on rock, but grass, which has no such heat reservoir, is soon covered with dew.

Dew is formed when the following conditions prevail: (a) Where the bodies, grass is one, radiate their heat rapidly. (b) The sky is clear so that heat is radiated into the upper regions of the atmosphere (a layer of cloud prevents this). (c) The atmosphere is calm. When there is a wind the air is circulated rapidly, which mixes the cold air near the ground with the warmer upper air and prevents it reaching dew point. (d) The air is moist, such as in marshlands and along the banks of rivers.

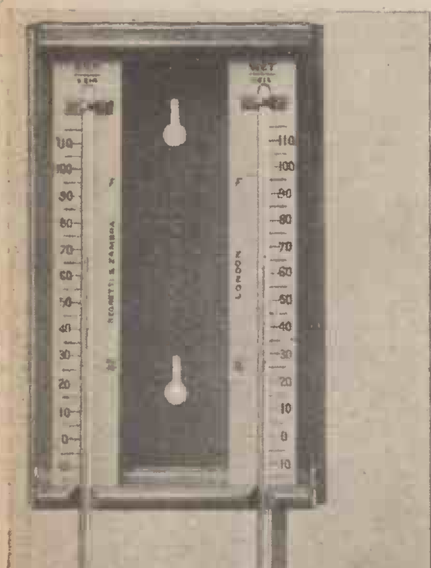


Fig. 9.—Standard hygrometer. Showing two ordinary thermometers. The bulb of the wet tube is enclosed in a piece of muslin from which wicks are suspended into the jar of water.

Air of low relative humidity, that is, containing a small percentage of moisture, will, of course, have a low dew point. In fact, the dew point of very dry air may be well below freezing point, that is, less than 32 deg. F. This means that before the air will release any of its moisture its temperature must be reduced to a point below 32 deg. F.

When its dew point is below 32 deg. F. and the temperature of the air drops to dew point temperature a ground frost occurs. The moisture in the form of water vapour given off by the air reaching its dew point will at once freeze, and the grass, trees, shrubs and everything else exposed to the open will be covered with hoar frost, which is frozen moisture.

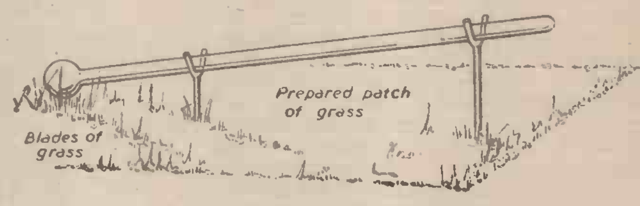


Fig. 10.—A grass thermometer.

Hoar Frost

This largely occurs during the winter months when there is very little sun to evaporate the water, and the air, owing to a prevailing easterly wind, has travelled not over the Atlantic, as in summer, but over the Continent, the relative humidity of that air will be low.

A grass thermometer can be used for measuring the temperature at the tips of blades of grass, Fig. 10. By observing the readings the possibility of a frost occurring can be forecast.

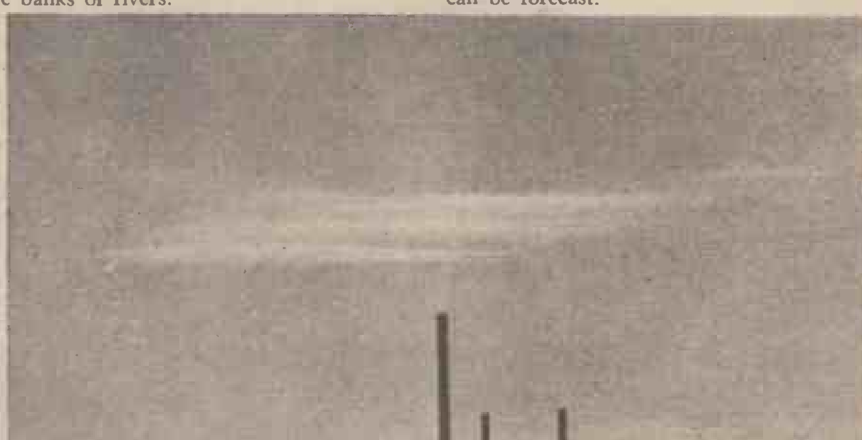


Fig. 12.—Cirrus Cloud. Lenticular form. First sign that a warm front and bad weather is on its way.

Fig. 13.—Cirrostratus. With wisps of cirrus. Follows the early cirrus. Usually confirms the approach of a warm front.

What Is Frost ?

Rarely in the British Isles is the dew point below 32 deg. F., except in winter, late autumn and early spring. During this period frost is most likely to form when the sky is clear and there is a slight and falling wind. The most likely position where frosts will occur is in valleys. Experience has proved this, for where a frost has occurred in late spring following a spell of warm weather, fruit crops in the valleys have been ruined, whereas those in the higher positions have been untouched by frost. This was particularly noticeable in 1944 when a frost in May destroyed a large portion of the fruit crops, most of the damage occurring in orchards lying along the valleys, viz., the Vale of Evesham in Worcestershire.

A further example during the war was in the Chess valley in Buckinghamshire, where attempts were made to grow potatoes close to the river. These attempts met with little success owing to the occurrence of late spring frosts.

The reason for this is that the ground on the hill top cools quickly owing to rapid radiation, with a result that the dense, cool air rolls down the hillsides into the valleys, remains there, and frost develops. One has only to descend into a valley after sunset in the autumn, when the above conditions prevail, to notice a marked drop in temperature.

Frost Warnings

Other than in times of war, frost warnings are a feature of weather forecasts broadcast to the public. Military authorities receive such warnings at all times, of course.

In April, 1945, the Government considered that it was in the national interest to broadcast such warnings over the radio, although at that time the "blackout" on weather, except in the Straits of Dover, had not yet been lifted. In spite of these warnings the severe frosts which ultimately occurred destroyed considerable proportions of our fruit crops.

Frost is forecast when the factors outlined above are present, viz., clear sky, calm, or a light wind. In addition, the reading of dry and wet bulb thermometers give a good indication of likely frost, provided the other factors are favourable. A big difference in the readings at sunset indicates that the air is very dry and dew points will be below 32 deg. F., a temperature which should be reached with a clear sky and rapid radiation.

When these conditions prevail, and with the frost "season" not yet past, the meteorologist will in most circumstances predict a ground frost. The only time he will not is when a warm front is approaching and is likely to reach the area before the frost forms.

One night during the period mentioned (April, 1945) a frost warning was broadcast, but later this was cancelled owing to the approach of a warm front which was travelling faster than at first predicted.

It is of interest to mention here that some fruit farmers have installed special anti-frost apparatus to protect their crops against late spring frosts. One type of protection consists of the lighting of smoke fires on the windward side of the orchard. The smoke then drifts over the trees and forms a cloud or canopy. The cloud then acts as a blanket and reduces radiation, and the frost does not form. The effect is, of course, similar to that of ordinary layer clouds, of which fuller details are given below.

The cost of operation precludes the use of anti-frost apparatus for more than about twice in the fruit season.

The Formation of Clouds

Even those who have never given the sky more than a cursory glance will have noticed that clouds form and, after a few hours, or even minutes, will appear to disperse, and others, maybe of different types, again fill the sky which only a short while before was clear without the smallest trace of a cloud.

Some people have the impression that when clouds over a particular district disperse they have either blown to another area or they have released their water, in the form of rain, and therefore no longer exist. This to some extent is true. Clouds do blow away, and they do give off moisture in the form of rain, snow, or sleet, but that is only one small part of the story.

In the first place we will examine how low clouds form.

The steam from a kettle which changes to visible vapour shortly after leaving the kettle spout, and vapour from the mouth, also visible on a frosty day, are both forms of cloud.

Both steam from a kettle and the breath from the body must necessarily have a high relative humidity. Therefore their dew points will be of comparatively high temperature, thus facilitating the formation of "clouds."

Clouds seen in the sky are formed in a similar manner. It was shown above that temperature decreases with altitude. Consider, therefore, a volume of warm, moist air which, being light, ascends into the atmosphere. As it ascends it reaches a point where the temperature of the surrounding

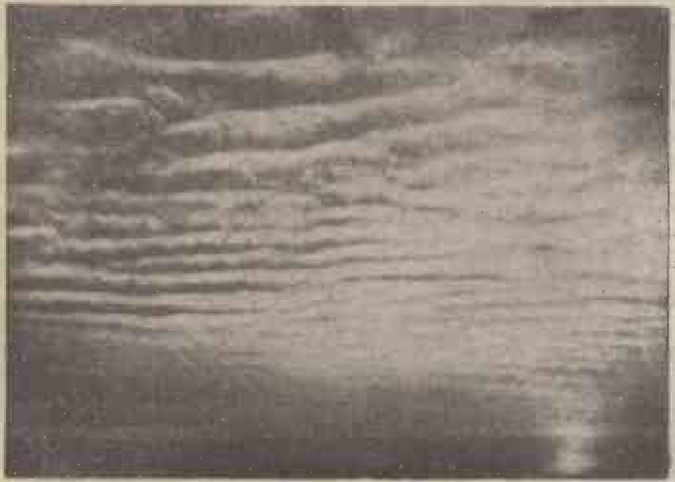


Fig. 14.—Cirrocumulus. High cloud of the cirrus group.

Fig. 15. Altocumulus. Having appearance of small cloudlets like flocks of sheep.

Fig. 16.—Altostratus. Its presence indicates approach of a warm front with rain to follow.

air coincides with the dew point of the ascending current, and at this point its moisture will be released and vapour (or cloud) will form.

Although the moisture will have left the warm current of air, if the temperature of the air is still higher than that of the surrounding air it will continue to ascend, but in a more or less dry state until, by gradual cooling, it reaches air of the same temperature, with which it then mixes.

As these currents of moist air continue to rise, a dense layer of cloud will thus form as the moisture is released. There is, however, a limit to these upward currents, otherwise the whole atmosphere would become one dense cloud through which the sun could not penetrate and life on the earth would cease to exist. Nature does, therefore, produce a balancing effect.

As the sun is gradually shut out from the earth, due to the cloud layer, the heating of the earth is reduced, and this in turn results in a decrease in the rate of the rising currents of moist, warm air and the formation of further cloud then ceases.

Cloud Acts as a Blanket

When the sky is completely covered with cloud, the air below is relatively warm. This is because the warm air can no longer pass through the cloud, which now acts as a blanket or an insulation against the loss of further heat. Therefore, while there is no further rise in the temperature of the earth, the heat dissipated is shut in and warms the air between the earth and the cloud. As a further illustration of the formation of a blanket of cloud, we will consider what often happens during fine weather in Great Britain in the summer season.

Diurnal Variation of Low Cloud

At night the sky is clear and the stars are seen. The sun rises, the sky is still clear, and a fine day is probably anticipated. To the disappointment of many who may have decided to take advantage of the fine weather, shortly after sunrise the sky becomes completely overcast by cloud maintained at a height of between approximately 2,000 and 3,000 feet. Towards noon, however, the sun has penetrated through the cloud, the latter soon disperses, due to the rising currents of hot air, and the remainder of the day is hot and clear. The clear sky thus remains until about the same time on the following morning, when the diurnal cycle of operations is repeated.

The explanation of this is as follows:

During the day the sun will have evaporated a large amount of moisture from the rivers and lakes, giving the air a high relative humidity. During the night, although the radiation is at a maximum, there is little or no convection, and the moist air is not carried high enough to produce cloud. When the sun rises, however, sufficient turbulance will take place due to the warming of the earth, so that the moist air will be carried to a height of 2,000-3,000ft. where cloud will form when the dew point of the air is reached.

By noon in the summer the cloud will disperse, and the remainder of the day will be hot. When conditions are favourable this diurnal variation may continue for days and possibly for weeks.

Clouds appear in varying forms and at differing heights. Sometimes they are in small patches, and at other times they resemble flocks of sheep. There is the "mackerel sky" and the sky where the clouds appear in layers, or waves like the sea. During continuous rain they appear as one very thick layer.

Clouds are divided and classed into various specific types or groups: high, medium, low and heap.

High Clouds

The base of these, that is, the distance from the earth to the underside of them, is between 20,000 and 40,000ft. The name given to them is cirrus, being Latin for hair. This cloud does, in fact, resemble wisps of hair and is sometimes called mares' tails.

These clouds, owing to their height and moisture content, are composed of ice crystals. When seen against the blue background of the sky it is practically certain that bad weather is on its way. Fig. 12 illustrates this type of cloud in its normal appearance. It is in this type of sky when the condensation trails, or contrails, are formed from aircraft flying at great heights. Contrails were very prominent on certain days in 1940 during the Battle of Britain, where enemy aircraft were operating at high altitudes to evade our defences. Just before dusk one evening in October of that year the writer witnessed a giant question mark being formed over the centre of London, and this caused some speculation about the enemy's subsequent intentions. Some readers may remember the circles formed in the sky which led to rumours that special targets were being marked by the enemy for subsequent attack. Not only was the enemy not attempting to adopt a daylight pathfinding policy, but he did his best to avoid making such contrails, since they obviously gave away his position to our defences.

The second cloud of the high cloud group is the cirrostratus, Fig. 13 (cirro meaning high). This is similar to the cirrus, but instead of wisps or mares' tails, it is formed in layers. We shall see later that the layer cloud is usually referred to as stratus. The cirrostratus is usually referred to as stratus, and usually follows the cirrus, being a further sign that bad weather is on its way. The

Fig. 17.—Stratus. This is a layer cloud and often covers hills and high ground.

best effect of the cloud is seen at night when the moon is up, for a large "halo" is formed. Thus in weather lore we are told that a "halo" round the moon is a sign of rain.

Another, the third of the high cloud group, is known as cirrocumulus, Fig. 14, but the cloud is rarely seen, and is of little importance to the meteorologist. When it does appear it resembles small flakes, and is known as the true mackerel sky, which is not to be compared with the false mackerel, or the altocumulus (see below), the latter being a more common sight.

Medium Clouds

The bases of these vary between 8,000 and 20,000ft. They bear the prefix "alto," which means medium. In this group there are two main cloud types—altocumulus, Fig. 15, and altostratus, Fig. 16.

Now the altocumulus cloud has a misleading title. Cumulus clouds are the heap clouds (cumulus being Latin for heap), whereas the altocumulus cloud is a medium layer cloud and not a heap.

The altocumulus is easily recognised by its regular pattern of small cloudlets, not unlike flocks of sheep, Fig. 15, and produces what is known as a "false mackerel" sky. Rarely is the whole sky covered by this cloud, and therefore large areas of blue are usually visible. Little, if any, importance is attached to the altocumulus cloud either by aviators or meteorologists.

The other medium cloud, altostratus, is of great importance, since its presence indicates the approach of a warm front or an occluded front, and that rain is to follow.

Sometimes rain or snow falls from the cloud itself, but the precipitation is either evaporated before reaching the ground, due to the presence of warm air, or there appears to the observer on the ground slight precipitation, more commonly expressed as "spitting with rain."

Since the approach of more heavy rain is highly probable during such periods it should serve, and often does, as a reminder to take an umbrella or mackintosh when going out in the open for any length of time. Aviators always attempt to avoid flying into the altostratus cloud owing to the great risk of icing.

Low Clouds

The base of low clouds usually varies between ground level and 8,000ft. There are three main types: (1) Stratus, (2) nimbostratus, and (3) stratocumulus. (All of these are layer clouds, stratus being Latin for layer.)

Stratus cloud has a fog-like appearance, see Fig. 17. When just off the ground, but not resting on it, stratus is termed lifted fog. When at ground level it is termed fog and not cloud, and often develops just after sunrise. As the sun gets up the fog lifts, due to the warm air rising from ground level, and forms stratus, which gradually lifts to a height varying between 500 and 1,000ft., or, alternatively, disperses. Those who have been on high hills and mountains when stratus has lifted will have noticed the fog-like appearance and will no doubt have termed it hill fog. Slight rain is sometimes given off by the stratus cloud, but it rarely develops into a heavy rain.

The nimbostratus cloud is the rain cloud. It is the fourth cloud of the warm front cloud system, cirrus being the first, cirrostratus the second, and altocumulus the third. If a warm front is approaching, therefore, nimbostratus (the rain-producing cloud) should follow closely on the "heels" of the altocumulus. Rain or snow does not always fall when the nimbostratus is present, so one must be careful not to take that as the criterion when distinguishing cloud types.

Nimbostratus is dark grey in colour and covers the sky. It has great vertical thickness, sometimes extending to more than 15,000ft. Its base becomes very low when rain, snow or sleet is falling, and often covers high hills. Aviators always avoid flying into it where possible, since it causes ice to form on the aircraft, while the visibility in the cloud may be down to 10 or 20 yards or even less. The risk of flying into hills or high ground becomes great. Good, clear photographs of this cloud are not available owing to the conditions prevailing, e.g., rain, and it would be difficult to distinguish a cloud comprising a single sheet covering the sky.

Stratocumulus, the third low cloud, is a normal dry-weather cloud. It appears in layers or rolls of small cloudlets not unlike the waves in the sea. These rolls are caused by upward and downward currents of air produced when the wind blows over obstructions, particularly during winter anticyclones.

Immediately above the altostratus clouds the air is usually very dry and of a higher temperature than that below the cloud. This is due to the ascending warm air which has given off its moisture when passing through the cloud, as mentioned in the first article of this series.

(To be continued.)

Birth of a Merchantman

IMAGINE for the moment that you are going to buy a ship—not a model, but a real ocean-going 10,000-tonner. You have the capital, the wharfage and design. All that remains is a long interview with the men who test the ships down at the National Physical Laboratory, at Teddington, on the Thames. There your plans will most probably have to be modified.

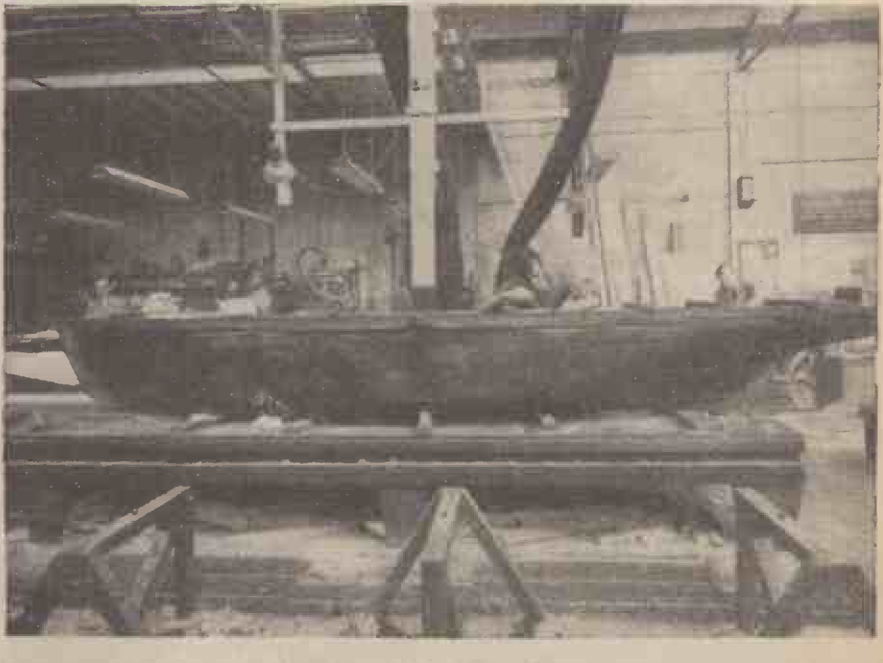
They might have to lop off a foot or two from the bows to suit limited wharfage; speed invariably yields first place to capacity.

Designing ships' lines is still more of an art than a science. There is no formula in the world which enables a man to put pencil to paper and produce the graceful, flowing lines of a ship in embryo. It is done with a 5-ft.-long piece of pliant, a match-thin wood called a spline. The spline is laid across the huge drawing-board, held down by weights from bows to stern, and the "ships' lines" are tapped into shape with the end of a pencil, a ruler, or perhaps the end of your finger. That is how a ship is born. Just like that! Easy? Well, you need four years in a shipyard, perhaps twice that number in a marine draughtsman's office, and, say, 20 years' practical experience before you get the hang of "ships' lines."

Wax Model

First they make a model ship in wax. Using your plans as a guide, moulders fashion a huge china-clay impression in a box like an immense coffin. At the same time other workmen make a fragile, canvas-covered ship's "core" out of wood thwarts and laths. The core is lowered into the clay mould and half a ton of molten wax is poured in between the clay and the canvas. Result: a hard, buoyant model of your vessel. When the model is finished it is then given its first test in the 550ft. long "Yarrow" tank, which was built in 1910 at a cost of £20,000, generously given by the late Sir Alfred Yarrow. The model is placed under a huge 15-ton carriage, which carries the test instruments and the scientific officers, and glides the length of the tank on geared rollers, travelling at any speed up to 25 feet per second.

If your model ship is successful in the numerous tests at Teddington, the lines plan is rolled up and sent to the shipyard. By tireless experiment yet another tested vessel has been added to the new ocean-going fleet of merchantmen which Britain is building up for the peace years.



The completed model in wax is the result of joining the china-clay mould with the canvas-covered ship's "core." The model is hard and heavy enough to react to water pressure in exactly the same way as the ocean-going vessel it represents; in this case, a fast cargo ship. It is adjusted to the contours of the Lines Plan, then goes to the tank for testing.

News and Notes

Spun-glass Lighter Wicks

LIGHTER wicks of spun glass are likely to make their appearance on the market in the near future. It is reported that the wicks are already being made by a Glasgow firm, but all the present supplies are going to troops abroad and to the Navy. Wicks of spun glass are also to be made for oil lamps and stoves. The glass strands used for the wicks are about one-fifth the thickness of human hair.

Veteran Stirling for Australian Museum

A LARGE section of "B for Beer," a veteran Stirling bomber which has flown practically all its wartime sorties with an Australian crew, is to be preserved for the Australian War Museum.

"B-Beer" flew on 76 operational sorties against the enemy, which is nearly a record for a Stirling.

Squadron Leader Jeff Button, D.F.C., of Yaraka, Queensland, piloted the Stirling on 55 sorties. After each sortie "B-Beer" had another mug of beer painted on its side, instead of the usual bomb. Never once did the Stirling have to return early because of mechanical fault.

Because it was nearly always flown by an Australian pilot or by a crew which included a member of the R.A.A.F., the aircraft was known on the R.A.F. Squadron as the "Aussie Kite."

The complete nose section back to the mid-upper turret, but excluding the engines and wings, has been sent to Australia.

Britain's New Carriers

FOUR of the Navy's new Fleet carriers, serving with the British Pacific Fleet, have now been named. They are H.M.S. Colossus, H.M.S. Venerable, H.M.S. Vengeance, and H.M.S. Glory.

These ships are a small version of the Fleet carrier built under a special wartime building programme, to augment the larger ones in the Far East. They have proved invaluable for convoy protection duties, as well as operating with the Fleet. They have a speed of about 25 knots, and carry a normal complement of 33 aircraft.

They are fitted out with the latest central messing system and each ship has a large up-to-date laundry. There are also recreation rooms, libraries, and many other amenities which are essential when ships are at sea for a long period.

9,000 Passengers Flown Without Loss

FROM its formation early in 1944 until the end of R.A.F. 2nd T.A.F., the Communication Squadron of that versatile command carried over 9,000 passengers and travelled over 1½ million miles without sustaining a single fatality. During that period there were only two accidents involving passengers—one due to circumstances beyond the pilot's control—and in all two passengers received minor injuries.

Last winter, when extremely bad weather over the Continent reduced flying to a minimum, the squadron's aircraft not merely ran to schedule, but, owing to operational demands, even increased their services.

Large Steam Plant for Canada

A STEAM plant with a generating capacity of 1,500,000lb. an hour, claimed to be the largest in Canada, has been built since the commencement of the war to serve the synthetic rubber plant of the Polymer Corporation, Sarnia, Ontario. It is stated that the plant produced 60 million pounds of rubber during its first year of operation. Electric power requirements necessitated the installation of turbo-alternator equipment of 27,000 kVA capacity, and there are two separately-fired superheaters capable of supplying 100,000lb. of steam an hour at 1,400 deg. F.

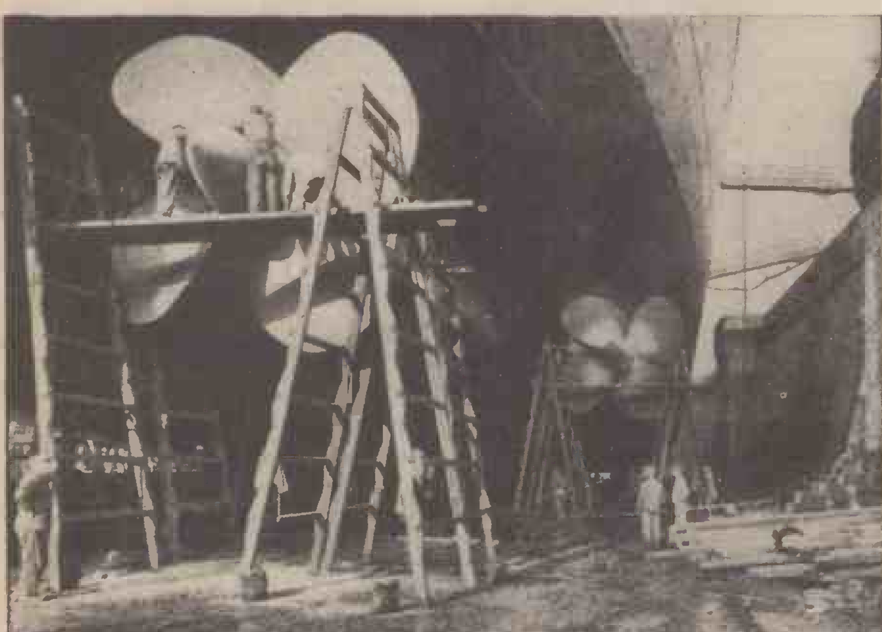
2,500 h.p. Gas Turbine

A GAS turbine power plant of 2,500 h.p. has been built for the United States Navy by the Elliot Company, of Pennsylvania, U.S.A. According to a report the new unit operates at a temperature of about 1,400 deg. F. It occupies a space of 16ft. by 12ft. by 12ft., and weighs less than 30lb. per horse-power developed. Air is compressed by two separately-driven Lysholm compressors, which are arranged in series. After passing through a regenerator, the air is further heated by the combustion of fuel. It then proceeds to the high-pressure turbine (which drives the low-pressure compressor) and passes through another combustion chamber to the low-pressure turbine. The latter drives the high-pressure compressor, and also the propeller of the ship.

R.A.F. Exhibition at Warsaw

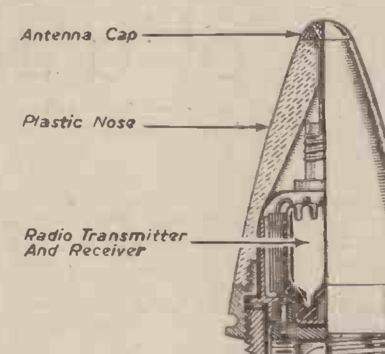
ACCORDING to an Air Ministry report, the R.A.F. Exhibition at Warsaw has been an unqualified success. Several thousand Poles passed through the barriers every day, and before the exhibition closed it was estimated that a quarter of a million people would have seen the exhibits. Record day was on Sunday, November 18th, when nearly 45,000 visitors were admitted.

A film taken on the first day by the R.A.F. Film Production Unit, showing the Polish Prime Minister and Air Chief Marshal Sir Sholto Douglas, K.C.B., M.C., D.F.C., declaring the exhibition open, was screened at the exhibition to large audiences.



The great Cunard liner, "Queen Elizabeth," was recently in dry dock at Southampton, and our illustration shows men at work on the huge propellers.

The Radio Fuse

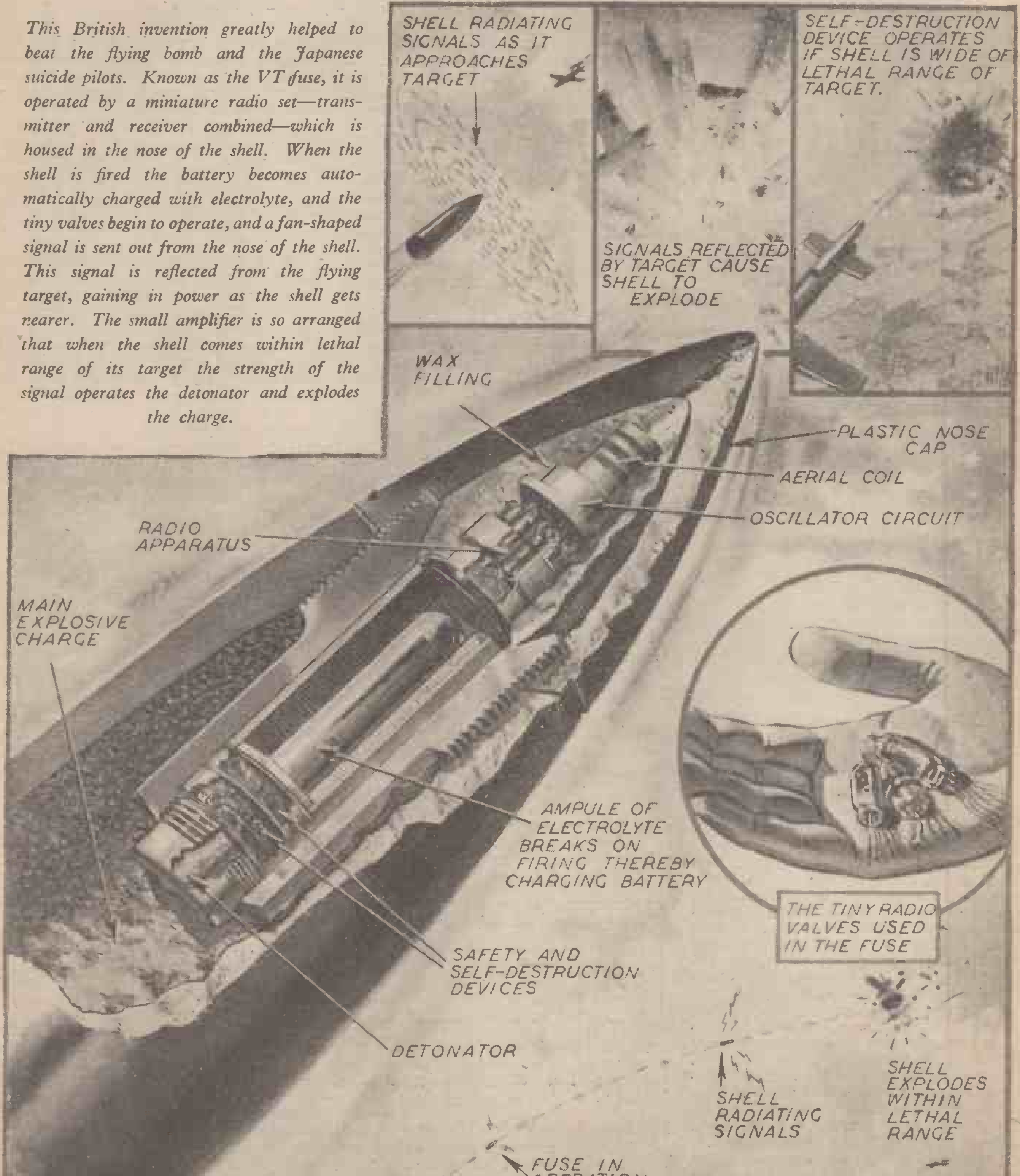


One of the well-kept secret weapons of the war is the radio, or V.T. fuse, which revolutionised anti-aircraft shooting. The fuse, which was in use for over two years of the war, combated the German flying bomb, and helped to break Japanese air power in the Far East, without being discovered by the enemy, owing to the incorporation of the self-destruction switch. The part-sectional drawing shows clearly the disposition of the various parts.

(See also the illustration on opposite page.)

The Radio Fuse

This British invention greatly helped to beat the flying bomb and the Japanese suicide pilots. Known as the VT fuse, it is operated by a miniature radio set—transmitter and receiver combined—which is housed in the nose of the shell. When the shell is fired the battery becomes automatically charged with electrolyte, and the tiny valves begin to operate, and a fan-shaped signal is sent out from the nose of the shell. This signal is reflected from the flying target, gaining in power as the shell gets nearer. The small amplifier is so arranged that when the shell comes within lethal range of its target the strength of the signal operates the detonator and explodes the charge.



Inventions of Interest

By "Dynamo"

A fine underside view of the Shetland flying-boat undergoing its trials. This new 58-ton air cruiser, largest British 'plane, has been built by Short Bros. and Saunders-Roe. It can carry up to 70 passengers, has a top speed of 267 m.p.h., and four engines of 2,500 h.p. each. Wing span is 150ft., length 110ft.

For the Counting House

AN interesting contrivance for office equipment has been submitted to the British Patent Office. The purpose of this device is to enable entries and calculations to be made on one side of a record card or a two-sided document while the other side is in view. Such an arrangement is eminently convenient where entries are made and records kept on cards in connection with factory times of attendance, wages, etc.

In the use of these cards it is customary for the clerk to refer constantly to the particulars on one face of a card preparatory to making related entries on the other side. This repeated turning of the card is irritating and causes a considerable waste of time. Therefore an invention which renders such manipulation unnecessary is a welcome and time-saving accessory in a counting house.

The new contrivance consists of an optical reproduction device which comprises a transparent writing platform constituting the roof or cover of a hollow chamber, having a lateral open-topped extension beyond the platform.

There is a multiple reflecting system so placed in the chamber and in the extension that an erected image of the under surface of a card or similar record sheet, when laid upon the platform, is visible. As a consequence, the clerk, while making entries on the top surface, can see the entries already inscribed on the under surface by merely shifting his or her gaze to the reflection.

Anti-Damp Brick

ONE of the latest ideas connected with building is a wall which is more waterproof than that constructed with the common brick.

The designer of the new brick remarks that, in the case of ordinary bricks, water usually penetrates through the bed or cross joints, causing dampness inside the structure.

Normally this penetration is due either to inferior mortar or to the joints being hollow.

The principal object of the invention is to prevent this moisture even under the adverse conditions mentioned.

A brick is made with top and bottom surfaces or bottom surface only, so formed that, when the brick is laid, parts of the surface are adapted to enter the mortar and constitute a barrier against moisture. At the same time there are furnished channels designed to lead moisture to the outer face of the brickwork irrespective of whether the brick is laid as a "header" or a "stretcher."

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

The surfaces in question are made with a series of intersecting longitudinal and transverse ribs of practically inverted V-section.

For Launching Model 'Planes

A MODEL aeroplane is not only a toy, but it is also a means for an object lesson in flying. An invention containing an improvement respecting the launching of model aircraft has made its advent. The primary object is to enable a model aeroplane to attain height before commencing the flight proper, thereby permitting a longer flight and ample opportunity to find the correct gliding angle. This obviates the risk of damage to the model caused by a faulty start.

The aircraft is provided with a launching member detachably secured thereto and qualified automatically to separate from the aeroplane after it has been projected by a catapult-like arrangement.

Preferably, the aircraft is formed with folding wings spring-urged towards their spread position. And the launching member, when secured to the 'plane, is made to retain the wings in their folded position until it is automatically separated therefrom, when the wings will spread under the action of their springs.

The launching device is constructed to drop by gravity. Its trailing end disengages from the model before its leading end. This may be effected by securing the ends of the launching member to the model by frictional gripping means and ensuring that the means of the leading end of the member exert a stronger grip than those at the trailing end.

Stereoscopic Pictures

THE British Patent Office has accepted an application for a patent relating to the stereoscopic presentation of pictures by projection on to a viewing screen. The invention is applicable not only to still pictures but also to moving pictures, including such as may be furnished by television.

The apparatus comprises a projection screen made up of narrow vertical elements inclined to the general plane of the screen in opposite directions, alternately to constitute a waved surface.

In the projector are means for subdividing the picture into narrow vertical strips representing elements of left eye and right eye views and corresponding in width to the screen elements. This is effected in such a manner that each left eye picture element is adapted to be projected on to a screen element facing to the left as viewed by the spectator, and each right eye element on to one facing to the right.

There is a shutter or its equivalent so made and adapted to be operated as to render visible in succession pairs of strips, each comprising a left eye strip and right eye strip on the right-hand side thereof, the two strips of any pair appearing and disappearing simultaneously.

Accommodating Car Mirror

A DRIVING mirror which makes itself generally useful has been contrived with the object of reducing the number of accessories on a motor vehicle.

At the back of this mirror there is fitted a casing containing a lamp bulb. In the casing there is a white-light window or aperture on the side of the bulb opposite to the surface of the mirror. The mirror surface also has a clear patch coloured red, through which light from the same means of illumination shines in the rearward direction. Consequently, when the light is switched on, red shows in the rear through the red-coloured portion of the mirror. At the same time white light is directed forwardly through the aperture in the lamp casing.

Thus the device fulfils all the requirements of a driving mirror, a rear lamp and a parking light, without interference with the efficiency of the mirror for driving purposes.

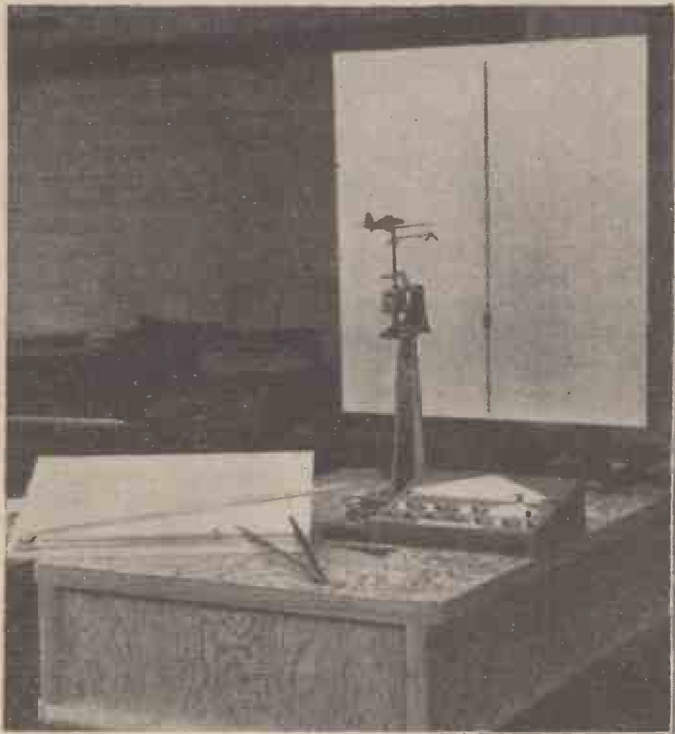
Wartime Application of Scale Models

How the Maker of Scale Models Helped the War Effort

By W. J. BASSETT-LOWKE, M.I.Loco.E.

THE planning for the great D-Day invasion; identification of enemy and allied ships and aircraft; navigation of vessels holed in action; these are just a few of war's necessary projects which have been helped by the scale model-maker.

At the outbreak of war it became the policy of the Government to turn all possible industry over to the war effort, including, not least of these, the craft of model-making. One of the most hard-pressed industries in the early part of the war was that of scientific instrument-making, and it is now well known that many optical and photographic instruments were more highly developed by German and American industries, so the model engineering industry was called in to assist this department of British endeavour.



The Camera Assessor, showing the bracket and ball joint, which controls the model aircraft so that it can cast a shadow at any angle on the measured screen. Range-computing scale and bullet-grouping attachment are also shown.

The Camera Assessor

Take, for instance, certain equipment which is used for assessing the degree of accuracy of fire in fighter aircraft. The camera-gun registers a film record, and this is examined by a process of assessment to determine the result of the action. The prototype of the "assessor" was made from "bits and pieces" which were available at one of the fighter stations in those days when England was being severely "blitzed." On proving its worth, the instrument was put into the hands of a model engineering firm with instructions to generally "clean up" the design and produce prototypes suitable for bulk production.

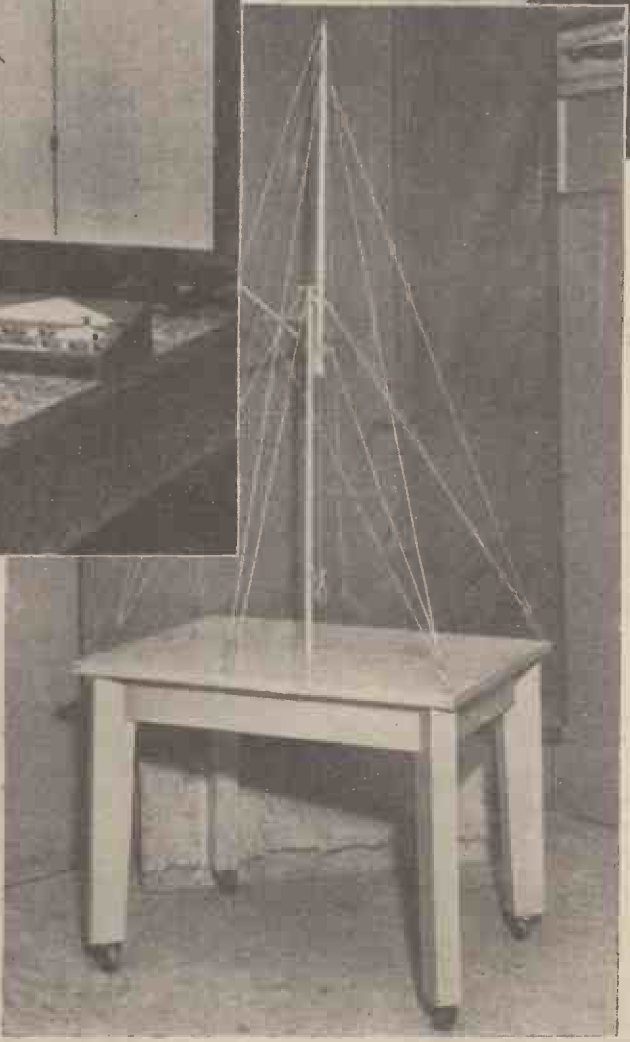
Many thousands of these instruments and sets of equipment have been made, both for this country and the United States, and they still supply a vital part of the training of R.A.F. personnel.

Models for the Royal Navy

With the modern warfare of high explosives, torpedoes, blockbuster bombs and deadly mines, the old method of pumping the section of a ship dry, when it became damaged, has had to be improved upon. The developments in this direction have been tested out in model form, for special models have been constructed to react in exactly the same manner as the prototype ship would do in the event of underwater damage. The models, constructed to the scale of ¼in. to the foot—or 1/48th actual size—were of a battleship, an aircraft carrier, a cruiser and a destroyer. Each one was made of thin sheet metal and fitted with the lower decks and internal main bulkheads, forming all the various watertight compartments, each of which could be flooded by a valve operated from the deck.

Craftsmen working on the model of the "King George V" class battleship for the Damage Control School. Scale ¼in. to the foot.

For a demonstration the model would be floated in a large glass water tank—a specified damaged portion of the hull would be flooded, thus showing in miniature the exact reaction of the ship. Then the correct procedure would be given — flooding other sections to counteract the list, thus keeping the ship on an even keel, better able to beat off attacks and get home safely to port.



The mast and rigging of a cruiser: scale 2 inches to 1 foot. This mast model is made for the Admiralty to train seamen in the setting up and rigging of masts. (Photographs on this page by Bassett-Lowke, Ltd.).

A gunnery instructor teaching a class of naval ratings the special armaments of different types of warships, with scale models.

This type of model has helped in the training of senior officers in the Navy, and has no doubt been the means of saving many ships. It was used at the Navy's "Damage Control School."

In the daily newspapers recently it was revealed that all officers of the Royal Navy will, in the near future, be trained in "damage control"—the science of keeping damaged ships afloat—fighting fire and action damage to their ships.

"Damage control" is no new thing, but under the conditions of modern warfare it has been necessary for men to be trained and new equipment provided to minimise the extent of possible damage.

In August, 1942, the Admiralty instituted the Royal Naval Damage Control School in London, and during the war more than 7,000 officers have passed through the school. This comparatively unknown department of the Royal Navy possesses records of every ship damaged during the war, and it has been estimated that over half the chances of saving a damaged ship depend on initial training of personnel in the art of ship stability and correct use of equipment.

The Admiralty have for several years used the technique of models for training. In the last war they were using small waterline models of ships for recognition purposes, and for this war the effort was greatly intensified, and models of every conceivable British, Allied and enemy war or merchant ship were produced in bulk. Also, before the war, I was privileged to visit one of their established naval schools, with lecture rooms fitted out with model devices for instructing the sailor of the future. One of these, which has been used to great effect during this war, is the model of a cruiser forecastle, with deck complete with cable holders, capstans, and all the equipment used in anchor work. This model was made to show the process of anchoring, mooring to a buoy, and also weighing anchor—highly technical operations on the "real thing"—which could be comprehensively demonstrated in miniature.

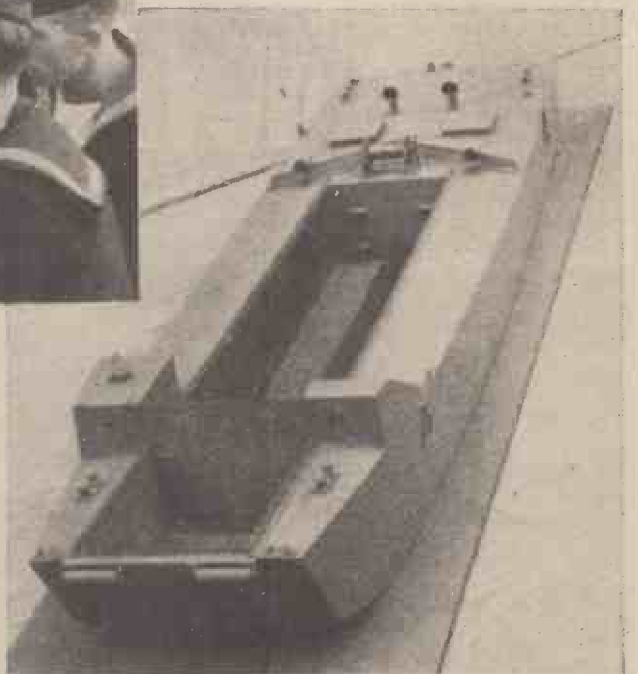
Another model which has been turned out in bulk by model firms in these war years is that of a mast, made to train seamen in rigging and setting up this very important part of a modern cruiser. The models were built to the scale of 2in. to the foot, and were mounted on tables with castors for ease in moving from room to room.

The tremendous task of building up our Forces after the dark days of 1940 called for speed in the training of men, and speed meant models!

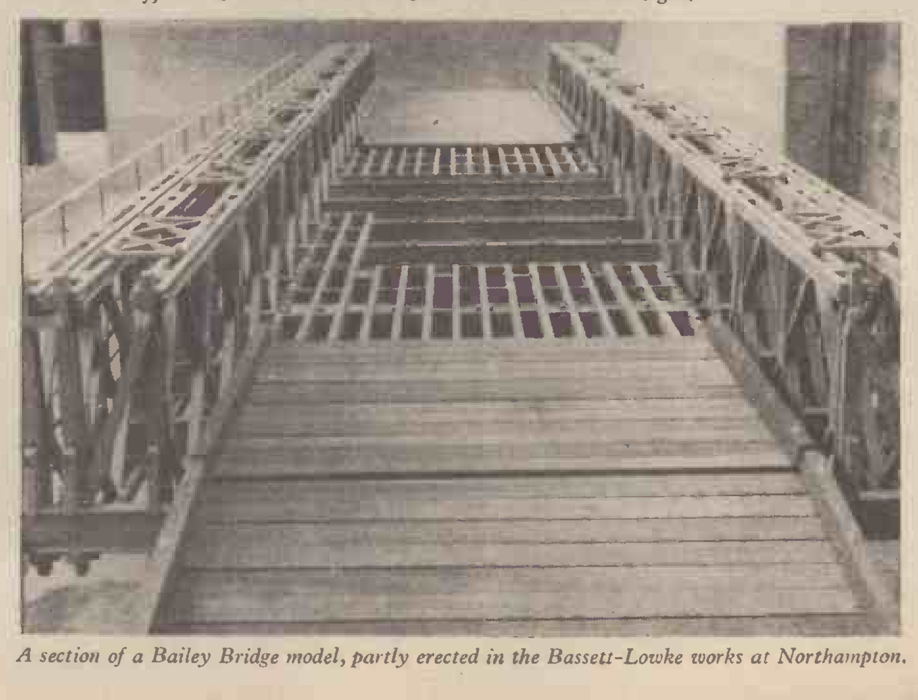
The submarine, a compact complex machine, needs to be understood by every member of its crew. Models were made of the hydroplanes, or fins which control the diving and surfacing of the vessel. Much of the mechanism is outside the pressure hull, and therefore in contact with sea water. It is vital that this mechanism is maintained in perfect condition and lubricated regularly, and the hydroplane models are valuable training instruments, showing in miniature the mechanism and exactly how it is operated.

Up to the moment I have dealt mostly with the Navy, but it is well to recall that the waterline models I have mentioned—hand-made of wood from official drawings, all of which are secret—were also used by the Fleet Air Arm and the Royal Air Force for recognition purposes, and that the Army made use of models of bridges, tanks, armoured cars, guns—in fact, Combined Operations Headquarters must have had a miniature D-Day long before June 6th, 1944!

Before the invasion, the Prime Minister, Mr. Winston Churchill, was provided with models of the enemy defences to enable him to discuss last-minute preparations. Senior officers and admirals have also used models to familiarise themselves with the many types of landing ships and craft, and it is interesting to learn that Combined Operations Headquarters have in their possession the most up-to-date fleet of models of landing ships and craft in the world. This model fleet includes every type that has yet been built, and many of the larger ships weigh several hundredweight.



Model of an Assault landing-craft—$\frac{1}{2}$in. to the foot.



A section of a Bailey Bridge model, partly erected in the Bassett-Lowke works at Northampton.

A 5ft. wing-span model of the Handley-Page Halifax bomber, large numbers of which were made by The English Electric Company. The propellers on the model were made to rotate by using small 3-phase motors.

The Bailey Bridge in Miniature

Much has been heard of the Bailey Bridge, which has been described by Services chiefs and high-ranking officers as one of our finest war-winning devices.

For some time the actual bridge was used to train the Royal Engineers in speedy erection of the units, but, when its infinite application came to be realised, models were made, to the scale of 2in. to the foot. Thus in a compact form the sets of model equipment could be sent out with ease and speed to distant stations, also executive staff could try out the many possibilities opened up by this revolutionary development in bridging engineering—obtaining valuable data in the minimum time and without using scores of men in the field.

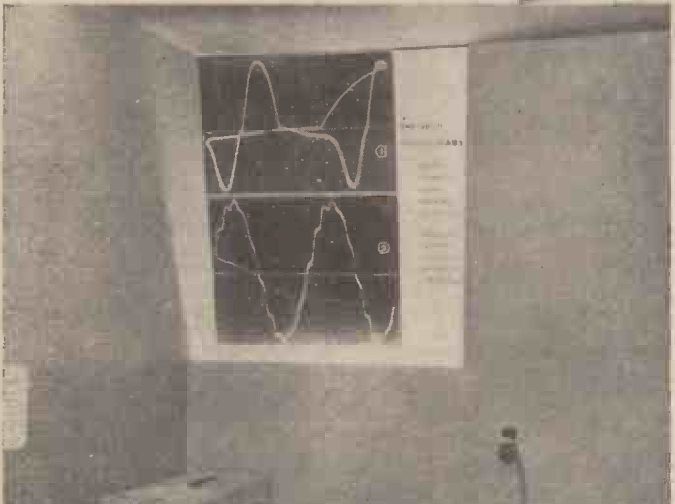
The bridge itself is capable of being quickly assembled to take light traffic, and, almost overnight, can be strengthened and doubled in its structure to carry the heaviest armoured vehicles and tanks. It is interesting to know that the models, when built up, reacted to loads and stresses put upon them in exactly the same manner as the prototype does.

An entirely new type of war weapon was produced in model form—the small amphibious craft which were so useful in retaking the Pacific islands from the Japanese. Large-scale models, motor driven, were used at the National Physical Laboratory, producing essential data in connection with water speeds and stability.

All the foregoing models have been made by model-making firms who specialise in that class of work only, but of the many exhibitions which are being organised at the present time, showing the wartime products of the major industries of the country, the display of the English Electric Company, Ltd., at Queens House, Kingsway, is made up largely of models made in their own works.

One outstanding example is that of the "Comet" tank, which is to the scale of 2in. to the foot, showing the tracks moving. These are operated by means of a hidden belt. The realistic action in the swing of the turret and the elevation and depression of the gun shows remarkable ingenuity in model engineering.

One-sixth scale model of the Comet tank, which was made to work in the Exhibition by being mounted on moving bands. All external parts of this model are faithful reproductions of the original details, and everything external is made to work.



A cathode-ray oscillograph used in connection with strain-gauge measurements, with a model aeroplane wing with strain-gauge attached, for use in the demonstration.

The model of the Halifax bomber is again a fine example of aircraft modelling, and with the rotating propellers driven by three-phase motors housed in the nacelles is a most attractive exhibit.

The other work of the English Electric Company is more in the "scientific instrument" category, but the model of the turbo-alternator set with condensing and five-stage heating plant taken from the power station at Little Barford—a fine piece of intricate work by Bassett-Lowke, Ltd.—was also very well displayed.

And so models, among many other everyday devices, used in peacetime for quite different purposes, have played their part in the war effort—just one more confirmation of Hitler's slogan, "This is a total war."

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This handbook, written with special regard for service requirements, will enable even the beginner rapidly to become proficient in sending and receiving.
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Letters from Readers

Photo-engraving at Home

SIR,—Having been a fine-etcher in process engraving for over 30 years, I was very interested in the article, "Photo-engraving at Home" in the November issue of PRACTICAL MECHANICS. I must agree that this is a very good description of the process, and I have a suspicion that E. H. Jackson has more knowledge of the trade, especially operating, than this article would lead one to believe, yet at the same time I question very much whether, in the hands of people with no knowledge of the trade, the result would justify the expense. Used by an experienced process worker good results could be obtained. Even if used by a jobbing printer, as an addition to his plant, results would be inferior to what could be obtained at any of the process engraving establishments in the City or West End.

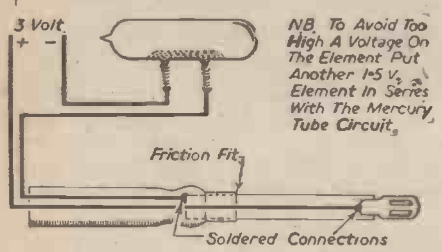
The method of etching described is one known in the trade as "taking it straight down" and good results, without a knowledge of trade, cannot be obtained in this way.

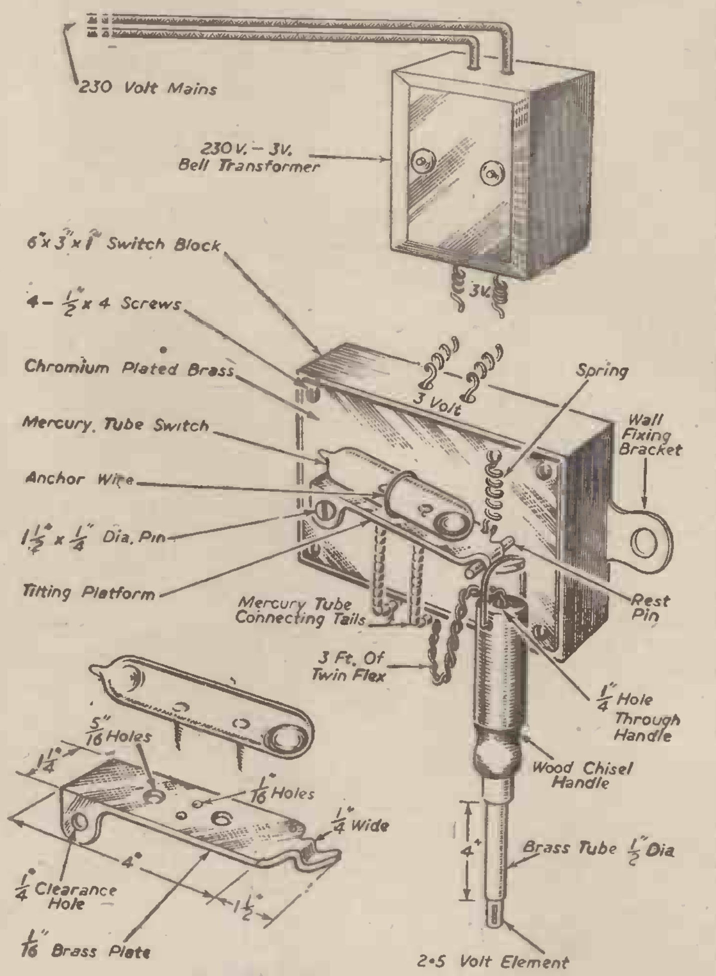
Treatment of the plate while it is being etched, known as fine-etching, is necessary here to obtain good results.

Like every other trade you can become a good amateur, but to become really proficient you must work at it commercially.—F. J. WELLS (Woodmansterne).

All-mains Gas-lighter

SIR,—Referring to the article, "An Electric Gas-lighter," in your October issue by "Hobbyist," three years ago I designed an electric gas-lighter operating from the house





General arrangement of an all-mains gas-lighter, and details of the mercury switch.

mains supply, using the door-bell transformer, thus doing away with batteries or accumulators. Of course, I use the secondary side of the transformer—3 volts—also the same type of element as mentioned by "Hobbyist." The operating switch is automatic. I bought a mercury tube contact, which I mounted on a brass chromium-plated platform 4in. long by 1in. wide, hooked at one end and pivoted at the other; the contact is made by virtue of the element being lifted off the hook for use. The element is fitted into a ½in. brass tube 6in. long, and the tube then is inserted into a wood chisel handle which has a ¼in. hole bored through it to allow for wiring (twin flex). For replacing the element back to the mercury switch a wire loop is provided on the wood chisel handle, this, of course, switches the element off. This effect is very useful as it obviates any possibility of leaving the switch on. The whole unit is fixed on a 6in. x 3in. x 1in. ordinary wood switch-block, which again is screwed on the wall near the gas stove.

The lighter in question is very efficient and costs ½d. per annum for electricity, i.e., one unit.—GEORGE TOVEY (Edgbaston).

Book on Finger-prints

SIR,—With reference to the letter in your November issue from Mr. A. Bosworth, of Derby, inquiring about a book dealing with finger-prints, there is a very comprehensive work entitled "Classification and Uses of Finger-prints," by Sir E. R. Henry, G.C.V.O., K.C.B., which is on sale from H.M. Stationery Office. Its pre-war price was 3s.—J. DUDLEY PANK (Thorndon).

Charging Car Batteries

SIR,—We have read with interest the article on "Charging Car Batteries" in your October issue.

We would point out, however, that the rectifier units described therein have long since been obsolete, and are now unobtainable. As we are now receiving quite an amount of correspondence on the subject, we shall be obliged if you will bring the matter to your readers' attention.

Of the units to which you refer, the LT.6 is replaced by either the LT.44 or LT.45, depending on the output required, and the A.6 by the LT.45. Details of these, with circuits and tables of resistances, are given in our Data Sheet No. 30, copies of which can be had from this address.—WESTINGHOUSE BRAKE AND SIGNAL CO., LTD., Pew Hill House, Chippenham, Wilts.

Whitefield Model and Engineering Society

SIR,—Many thanks for the notice in PRACTICAL MECHANICS of the proposed model engineering society in the Prestwick and Whitefield districts of Lancashire.

The club has now been formed and given the official title of Whitefield Model and Engineering Society, and meets every other Friday at 7.30 p.m. at Stand Grammar School for Girls, Whitefield. A meeting was held on Friday, December 14th. We have 22 members to date and hope for many more in the near future.

I hope it will not be long before one can buy PRACTICAL MECHANICS at any bookstall or shop, as before the war.

Our members wish continued success to your paper.—ALAN F. STEVENSON, Hon. Sec., 2, Newlands Drive, Prestwick, Lancs.

NEW BATES HANDLEGRIP

WHAT would appear to be one of the first "better class" handlegrips produced since the war is being made by Messrs. Bates, of London, the well-known lightweight manufacturers.

The grips are 4½in. long and of eccentric section, having ½in. thick rubber at the top for shock absorption, and into this thick part deep grooves are cut to enable a current of air to pass between user's hand and grip, preventing hot, sweating hands and assisting the dampening of vibration. On the underneath four hollows are moulded across the grip, the four fingers set snugly into these, preventing the hand slipping and providing a firm and comfortable handgrip. These hollows are formed well to the front, so that when the hand is "in position" the whole rider's palm is comfortably settled on the handlegrip.

The name "Bates of London" is raised in script on each side of the grip, forming a sort of "tread," thus further ensuring a good gripping surface.

A smear of rubber solution is all that is

necessary to secure a real tight fixing. Made in black rubber, and priced at 4s. 9d. per pair (postage 3d.), the Bates anti-shock grip is obtainable from the firm's head depot, 461, Lea Bridge Road, London, E.10, or 275, Green Street, E.7, or 17, East Street, Barking.

Our Cover Subject

THE illustration on this month's cover of a busy corner in a modern foundry shows an electric arc furnace with metal and slag taps.

(The photo is reproduced by courtesy of Thos. Firth and John Brown, Ltd.)

QUERIES and ENQUIRIES

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

Convex Mirror

COULD you please tell me how to make a convex mirror. I understand that there is a simple method of coating clock glasses with a silver nitrate solution, and afterwards painting the back with a damp-proof paint. I should be greatly obliged if you would inform me of the ingredients required, and the process.—J. C. Tudor (Wellington).

THE convex glass must be very thoroughly degreased and cleaned. Efficient cleaning of the glass is *essential*, otherwise the silver film will not adhere.

The silvering fluid is made up on a two-solution basis:

Solution A—

Silver nitrate .. .. 6 grams.
Distilled water .. .. 75 c.cs.

To the above liquid add, drop by drop, strong ammonia until the curdy precipitate which is first formed is just (but only just) redissolved. No excess of ammonia must be added.

Solution B—

Glucose .. .. .. 10 grams.
Distilled water .. .. 100 c.cs.

Immediately before the commencement of the silvering operation, mix together in a perfectly clean vessel equal parts of the above two solutions and pour them at once into the clock glass so that the latter is filled to its brim with the mixed liquid. The glass should be supported over a glass vessel containing hot water in order that the silvering liquid may gradually be heated.

Silvering will be completed in about six minutes, after which the silvered glass must be rinsed gently once or twice in distilled water and put aside to dry. The silver film, when perfectly dry, may be coated lightly with a little clean varnish.

The utmost cleanliness is essential to the success of the process. Even dirty fingers may spoil it, and, at the best, the silvering process is one which calls for skill and practice. Hence, do not be surprised if you do not get good results the first time. It is best to practise on a few pieces of waste glass beforehand.

The silvering solutions will keep for a long time if kept separately in clean bottles, but after they have been mixed their active life is not more than a few minutes.

Removing Grease and Oil: Electro-plating

PLEASE let me know the best method of removing old deposits of nickel or other plating from material to be replated. Also a solution for removing grease and oil.

Are accumulators suitable for supplying electric current for plating?—H. Lucas (Cardiff).

WE do not know of any reliable method of stripping old nickel deposits other than polishing off by buff. Grease and oil can be removed by means of a solution of 4 to 12oz. of potash in a gallon of water. The solution should be placed in an iron vessel and heated to about boiling point. The articles requiring cleaning are then immersed in the hot solution. Electrolytic cleaning can also be employed using a similar solution, passing current between the articles as cathode and carbon or steel anodes. Another method is to place the articles in a tank of trichlor-ethylene, having heating coils in the bottom of the tank and cooling coils in the top.

Accumulators can be used for electro-plating. The general procedure in nickel-plating is to first degrease the articles, these afterwards being pickled or etched as required, and then placed in the plating vat. The work should be carefully washed between each process. On some materials intermediate plating processes are required. After plating the articles should be passed through tanks of cold and hot water successively, and then dried in hot sawdust.

Bleaching Feathers

WOULD you kindly inform me if there is any method of bleaching brown goose feathers?—T. Ferguson (Maryport).

THERE are three methods of bleaching feathers, as outlined below. In all cases, the feathers should be washed gently in warm soap and water in order to rid them of grease beforehand.

(a) Lay the feathers in saucers or shallow trays and just cover them with strong hydrogen peroxide. Then add a little ammonia water to the peroxide and place the trays *in sunlight* until the bleaching action has been completed. Finally, wash the feathers well in cold water. Sunlight is usually *essential* for this process.

(b) Make a thin, sloppy paste of chloride of lime and water. Coat the feathers with this, and then dip them in a dilute solution of hydrochloric acid (1 part in 5 parts of water). Chlorine gas will be evolved and this will perform the bleaching action. The process can be repeated once or twice if necessary, but, before drying it is most essential that the feathers are most thoroughly washed for at least two hours in running water in order to get rid of every trace of the bleaching material, otherwise the whitened feathers will inevitably crumble in time.

(c) Immerse the feathers in a dark solution of potassium permanganate for five minutes. The strength of this solution is immaterial so long as it is sufficiently dark to be opaque. After withdrawal from the solution, the feathers will be stained brown. Rinse them under the tap and then immerse them in a solution of sodium sulphite (*NOT* sulphate). To this solution add a little dilute hydrochloric or sulphuric acid and stir well. Sulphurous fumes will be evolved and the dark brown stain on the feathers will disappear, leaving the feathers in a bleached condition. The process may be repeated if required. Thorough final washing is required before the feathers are dried.

It should also be noted that in the case of feathers which are not very darkly coloured, the mere exposure of the damped feathers to the above sulphurous fumes is sometimes sufficient to bring about a bleaching action without their actual immersion in the prior permanganate solution.

Petrification of Wood

COULD you give me an explanation of the natural process of the petrification of wood? Are there any particular regions of the world where this occurs, owing to the particular climatic conditions? Also, is it possible to reproduce this effect artificially?—G. Brown (Burnley).

THE slow petrification of wood is due mainly to the infiltration through the wood fibres of water containing lime and other salts which are afterwards deposited therein in an insoluble condition. Thus, the slow decay of the wood by rotting bacteria is permanently arrested, the wood tannins are insolubilised and hardened, and the wood is more or less preserved indefinitely.

A natural preservation of wood occurs in many parts of the world in peat bogs. In the bogs of central Ireland it is common for peat diggers to come across timber (mainly oak) at a depth of 10 to 15ft., the timber being blackened, hardened, but in perfect preservation. Such "bog oak" comprises timber which has been preserved by a natural process of semi-petrification.

Climatic conditions alone do not give rise to this effect. The timber must have been subjected to waters heavily charged with mineral salts, the constituents of which are insolubilised within the fibres of the timber.

To some limited extent the effect can be reproduced artificially by various processes. One of these consists in impregnating wood with a solution of calcium chloride and then similarly impregnating it with a solution of ordinary soda, whereby the insoluble calcium carbonate will be formed within the wood fibres, thereby hardening the timber and filling its pores with chalk (calcium carbonate).

Hard-setting Material

COULD you please give me the chemical constituents of a hard-setting material, but one which is not harsh and not liable to chip? Something like the material used to produce the heads of children's dolls would be like the material I have in mind. Plaster of Paris I find too brittle.

I would like to know more about vitreous enamelling. Could you give me the titles of books dealing with the process?—F. R. Cannon (Lincoln).

A SUITABLE hard-setting material which might suit your purpose is a composition based on the formation of magnesium oxychloride.

For this purpose, mix together 2 parts dry powdered calcined magnesite, 1 part fine sawdust, 1 part whiting. Slake these to a paste with a solution made by dissolving 40 parts magnesium chloride in 60 parts of water. The resulting paste will set dead hard in 30 hours. It can be coloured by adding a little dry colour to the mixture. Calcined magnesite and magnesium chloride can be obtained from any firm of laboratory suppliers, as, for instance, Messrs. Harrington Brothers, Ltd., 4, Oliver's Yard 53A City Road, London, E.C.1.

In place of the sawdust above mentioned, you may use any other fine inert material, such as rubber powder, powdered mica, limestone, sand, etc., but these, of course, will render the finished product somewhat heavy.

So far as we can trace, there is no specialised book on vitreous enamelling, which, as you probably know, is a very highly specialised process which is worked from "secret" formula. Your best plan is to write to the Institute of Vitreous Enamellers, Ranelagh Avenue, London, S.W.6, requesting information concerning any recently published papers and lectures on this subject, from which latter you may be able to pick up the information which you require.

Rewinding Vacuum Cleaner Armature

WILL you kindly supply me with a diagram of connections for the rewinding of a vacuum cleaner armature or otherwise direct to me as to how I may get this information.

Details of the armature and motor are as follows: Armature, 12 slots; commutator, 24 segments; armature coils, 24; two-pole motor; series connected. Each pole covers four armature cogs. Brushes are at 90 deg. to pole axis.—O. N. Phillips, (Harrow).

YOU could use a coil span from slots 1 to 6, etc. and 12 armature coils each having a central loop brought out for connecting to intermediate commutator segments. With the armature placed so that slots 1 and 6 are equi-distant from the centre of one pole face, number the commutator segment which then lies under the nearest brush, number 2. All numbering is considered clockwise at the commutator end.

For clockwise rotation at the commutator end connect the start of the coil in slots 1 and 6 to segment 3, the loop to 4, and finish of the coil to segment 5. Connect the start of the coil in slots 2 and 7 to segment 5, loop to 6, finish of the coil to segment 7, and so on. For counter-clockwise rotation at the commutator end subtract four from the numbers of commutator segments quoted above for the coil connections, connecting the start of the coil in slots 1 and 6 to segment 23, loop to 24, and so on.

Scumble Stain

WOULD you please supply the formula for making the graining type paint known as scumble stain? This is for use over a stone or mid-cream paint and is subsequently varnished to produce a "grained wood effect." The scumble stain is practically unobtainable to-day, and the "wartime quality" is not worth having. The only colour I want the formula for is light oak.—J. Model (Wembley).

THE compositions of the various so-called "scumble" stains are manufacturers' secrets. They are all, however, oil stains, and they may be used as a "flat" stain for bare wood or as a stain for the oil-painted wood so as to produce eventually a grained surface in the manner which you describe. Whilst we cannot give you a precise formula for the making of a scumble stain, we can tell you how to arrive at your own formula.

Make up a mixture of approximately equal parts of raw linseed oil and turpentine. Dissolve in this sufficient oil-soluble dye to give you the stain required. This is the scumble stain. Oil-soluble dyes are obtainable from Messrs. A. Boake, Roberts and Co., Ltd., Stratford, London, E.14; also from Imperial Chemical Industries, Ltd., Millbank, London, S.W.1. Small quantities are better obtainable from a good firm of laboratory suppliers, such as Messrs. Harrington Brothers, Ltd., 4, Oliver's Yard, 53A, City Road, Finsbury, London, E.C.1.

For a medium or light oak stain the preponderating dye would be a deep yellow. This would be toned with a little green, and a mere trace of black. A weak solution of Bismarck brown will also make a good stain, but it is not particularly fast to strong light.

This stain can be used for staining bare wood, although the ordinary bare wood stains are usually made up on a spirit basis, the dyes being dissolved in spirit, and not in oils.

Automatic Garage-door Opener

I WISH to fix an automatic motorised door opener to my garage, and would like your advice on the best method of operation. I am thinking of using an electric eye but I am not sure of the circuit. Is there any other method of operation?—N. T. Coleman (Warrington).

THE P.M. LIST OF BLUEPRINTS

The "PRACTICAL MECHANICS" £20 CAR
(Designed by F. J. CAMM),
10s. 6d. per set of four sheets.

"PRACTICAL MECHANICS" MASTER BATTERY CLOCK*
Blueprints (2 sheets), 2s.

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Full-size blueprint, 1s.

SUPER-DURATION BIPLANE*
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P.M. TRAILER CARAVAN*
Complete set, 10s. 6d.

P.M. BATTERY SLAVE CLOCK* 1s.

The above blueprints are obtainable, post free from Messrs. George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

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

THERE are many possible ways of controlling your garage-door opener, but we think the simplest method would prove the best. There are various points to be taken into consideration. It will be realised that a certain interval must elapse after operating the control before the door opens. If the garage opens on to a public highway it is obviously undesirable that you should wait with the car across the road. Another point is that you will not want the door to open each time anyone passes near the garage.

We suggest you use a floor contact to energise a contactor switch, other door-operated contacts being fitted to de-energise the contactor when the door has been fully opened. In order to avoid the door being opened by one person passing we suggest you use two pieces of wood end to end across the garage entrance to cover a width slightly greater than the width of the car wheels. The two pieces of wood could be hinged at the centre where they are together, the other ends operating contacts under the ground and being supported by springs. The contacts controlled by each piece of wood should be connected in series so that both must be pressed to cause operation of the contactor and motor.

Electrical Heating for Greenhouse

I WOULD be glad of information about heating a greenhouse of dimensions 30ft. by 25ft., maintaining a temperature of 55 deg. F. in winter.

The system I have under consideration is 3ft. lengths of 1½in. diameter metal tubing (gun barrel), with electric heating element running through same. Particulars are required as to number of tubes required, consumption of current, and amount of resistance wire.—H. M. Cullen (Blackrock).

THE heating tubes should be placed close to the ground and distributed fairly equally over the floor space. About 12 tubes could be used, each having a heating element of about 400 watts capacity, all the tubes being connected in parallel and the whole being electro-thermally controlled by thermostat. The tubes could be mounted with about 2in. fall in the 3ft. length, the ends of the tubes being left open to promote air circulation.

In each 3ft. length 30yds. of 28 S.W.G. Ferry resistance wire could be closely coiled and wrapped round an asbestos covered iron rod fitted centrally down the tube. All the tubes and the cases of the control gear and also the metal sheathing of the wiring should be efficiently earthed.

The amount of current consumed will, of course, depend on the weather conditions, up to a maximum of 4.8 units per hour. We anticipate, however, that you will find electrical heating of your greenhouse rather expensive.

Bituminous Emulsion: Coloured Asphalt

I SHALL be glad if you will inform me where I can purchase the following materials:

(a) Bitumen for mixing with cement for facing cellar walls to render damp-proof.

(b) Coloured asphalt for facing concrete floors in the same cellar, in colours.—N. S. Lott (Hastings).

(1) The type of bitumen needed for the concrete mixing is known as "Bituminous Emulsion." It may be obtained (in varying grades) from British Bitumen Emulsions, Ltd., Trading Estate, Slough. We believe that it is only supplied in minimum lots of 1 gallon.

Its efficiency when mixed with cement to form concrete has been called into question, and it is not much used for this purpose. Nevertheless, if mixed in the right proportions, we see no reason why it should not produce a perfectly damp-proof wall.

(2) Coloured asphalt mastic in red or brown may be obtained from any asphalt manufacturing firm, as, for example, the Limmer & Trinidad Lake Asphalt Co., Ltd., Tothill Street, London, S.W.1. Since, however, asphalt is difficult to lay without considerable skill and experience, asphalt manufacturers are not keen on supplying small lots of their material to individual layers of the asphalt, preferring to supply and lay the material themselves. Your best plan, therefore, would be to seek out a local asphalter, and to obtain the material from him.

We might add that, unless you have had special experience, you are hardly likely to have success in the laying of an asphalt floor yourself. Asphalt laying is a very tricky job, since the asphalt has to be laid hot and "floated" or surface-finished as rapidly as possible whilst it remains in the hot, plastic condition.

Waterproofing Fishing Nets

CAN you supply me with the recipe for the liquid used for tanning fishing nets for sea use? I have just made a trammel net, and feel that it should be treated in some way to preserve it.—J. Stokes (Folkestone).

THE protection of sea fishing lines and nets against the rotting effect of alternate wettings with sea-water and subsequent drying has always been something of a problem, and many attempted solutions of this problem have been suggested. The best treatment is by means of copper naphthenate, which both waterproofs the net and protects it from rotting, and fungoidal and insect attack.

Soak the net overnight in the following solution: Copper naphthenate, 30 parts (by weight); benzol, 50 parts; paraffin oil, 20 parts.

In making this solution heat the paraffin and benzol over a steam bath. Then add the green lumps of copper naphthenate in small amounts at a time, stirring the liquid the while. Remember that the liquid is inflammable.

The liquid will be a strong green in colour, and the net will also be dyed green.

After the overnight impregnation by immersion in the liquid the net is withdrawn and allowed to dry in the open for a day or two. It is then ready for use.

Note that the net material should be perfectly dry before immersion in the green solution, otherwise perfect impregnation will not take place.

The green solution will keep indefinitely if stored in drums having good seals. It would be advisable to apply the treatment to the nets at intervals of, say, once in every four months.

Copper naphthenate, price about 3s. 6d. lb., is obtainable from Messrs. A. Boake, Roberts & Co., Ltd., Carpenters Road, Stratford, London, E., who sell it under the name of "Novenate Copper."

Synchronous Motor: Commutator Rectifier

I HAVE in my possession a synchronous motor and a bell transformer giving 3, 5 and 8 volts output. I would like to know if it is possible to rectify the alternating current from the transformer by means of a commutator on the shaft of the motor. The motor has a rotor (permanent magnet) of 6 poles and the transformer is rated at 1.0 amp. Could you supply me with the necessary wiring diagram and position of commutator on the shaft, and number of segments for same? What current can be expected from this arrangement. I should like to be able to trickle charge a two-volt accumulator. —G. R. Walford (Bristol).

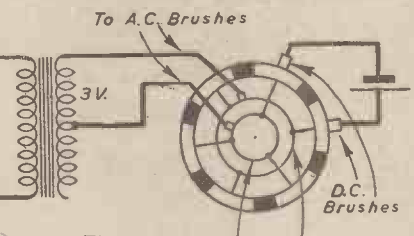


Fig. 1.

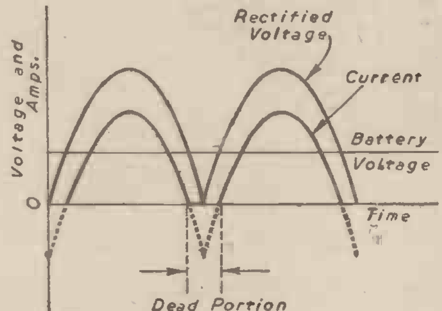


Fig. 2.

Connections for slip rings and current curves of a commutator rectifier.

YOUR synchronous motor will run at 1,000 r.p.m. on a 50 cycle supply. This is rather an odd speed for a commutator rectifier, and a 4-pole motor running at 1,500 r.p.m. could be used with a simpler arrangement. For your motor we suggest you use a six section commutator with two slip rings, connected as indicated in Fig. 1, alternate sections of the commutator being connected to each slip ring.

The back e.m.f. of the accumulators being charged causes the current to fall to zero when the transformer voltage is below that of the accumulator and, if the transformer is not disconnected from the accumulators during these intervals a reverse current will flow. This is indicated in Fig. 2. To avoid this there should be fairly wide insulating sections between the conducting sections of the commutator, these being roughly equal to one-third of the width of the conducting sections. The actual width will depend to a certain extent on the width of the brushes used on the commutator. In order to obtain best results we suggest you use a commutator having as many segments as possible, each section then comprising several segments soldered together at the ends, the odd segments between the sections then being left entirely disconnected so as to form the insulating portion. This construction will enable you to adjust the width of the conducting sections in order to obtain maximum charging current, as indicated by a moving coil ammeter, by soldering or unsoldering to vary the width of the sections. It is also an advantage to arrange that the D.C. brush position can be altered.

Automatic Voltage Control

WILL you please inform me how to construct an automatic voltage control for use when charging a 6-volt accumulator from a dynamo. The dynamo will charge at 18 amps., but I wish it to reduce its rate of charge, if possible by degrees, as the electrical content of the accumulator increases.—G. B. Foden (Thurmaston).

WE are not quite clear what type of control you have in mind. Actually, if the dynamo is designed so that it gives a fairly constant voltage on a varying load current the charging current will automatically fall as the battery voltage rises during charging.

Such a characteristic may be obtained from a compound dynamo, i.e. a dynamo which has a series as well as a shunt field winding. If necessary you could perhaps compound the existing field windings by winding a few turns of 17 S.W.G. copper wire on each shunt field coil, connecting the new winding in series with the armature. The series windings should have the same magnetic polarity as the shunt windings. A somewhat similar effect can sometimes be obtained by moving the brushes slightly round the commutator in the opposite direction to rotation.

Alternatively, you could use a time switch to connect resistance in the shunt field circuit to reduce the voltage and current output. It is not possible to suggest suitable resistance values without knowing the normal shunt field current of the dynamo, and knowing how the voltage varies with variation of field current, i.e. without knowledge of the magnetic characteristics of the machine.

Making Plastic Wood

WOULD you please supply a formula for the making of plastic wood as sold to aero modellers?—K. W. Handley (Worcester).

OBTAIN a quantity of sawdust. Dry it thoroughly in a warm oven for a day or so, and pass it through a fine wire mesh. This will give you a very fine variety of sawdust known as "wood flour." Such material is the basis of "plastic wood," which latter is merely a preparation of this wood flour and dissolved celluloid.

You may be able to obtain some thick celluloid varnish at a local paint store. If not, you will have to make it yourself, which is quite an easy matter. Dissolve scrap clear celluloid in a mixture of equal parts of acetone and amyl acetate (your local druggist should be able to supply you with an ounce or two of these mixed liquids).

The solution of the celluloid will necessitate much shaking of the liquid and celluloid. Do not use heat for the purpose on account of the great inflammability of the liquids.

When a celluloid solution of glue consistency has been arrived at, merely take a quantity of the wood flour and make it into a paste (like dough) with a little of the celluloid solution. If required, you may add, too, a little mineral colour in order to tint the plastic wood.

Do not make too great a quantity of the plastic wood at any one time, because the solvent rapidly evaporates, leaving the wood flour in a hardened condition. Keep the wood flour and the celluloid solution entirely separate and only mix them into a "dough" as and when required.

Liquid Furniture Polish

(1) I wish to make some furniture polish (liquid veneer type) for my own use. Could you please inform me as to the probable ingredients, proportions, and where can they be obtained?

(2) Also, can I make a "synthetic" cream for cakes, etc., using baker's (nut) oil as a base? If so, will you please state a suitable recipe?—G. Drake (Moor Allerton).

(1) The liquid furniture polish you mention usually consists of a mixture of white spirit and pine oil together with water, dye, and a trace of soap. It is effective on highly polished surfaces such as piano cases, etc.

You can make a similar polish quite cheaply according to the following formula:

White spirit or paraffin oil .. 2 parts.
Water .. .. 3 parts.

In the water, dissolve a very little soap and add to it a mere "pinch" of whiting (just sufficient—but not more—to give the water a *slight* milkiness). If desired, you may add a little water-soluble dye to the water or oil-soluble dye to the oil. You may, also, add pine oil to the white spirit or paraffin in order to disguise the smell of the latter, but, of course, all this dyeing and perfuming is quite immaterial to the qualities of the polish.

The liquid thus made will separate into two layers, as your original polish does, for water and oil are immiscible.

For use, shake the liquid up and apply with a soft cloth, subsequently polishing with a dry duster.

We can assure you that there is nothing miraculous or even wonderful or expensive about these so-called "liquid glazes" or "veneers." They are all based on oil-water mixtures, together with a little soap and/or whiting to act as a lubricant.

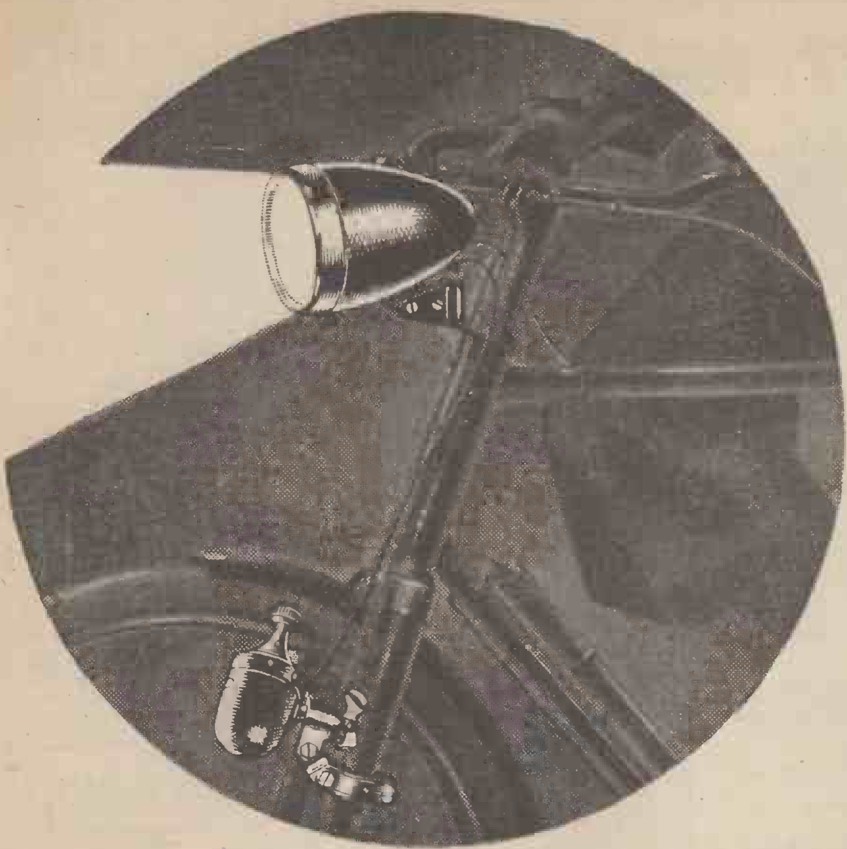
(2) To make a confectionery cream from arachis or nut oil, the ingredients are the following:

1 part (by weight) .. .. Milk.
¼ part (by weight) .. .. Margarine.
¾ part (by weight) .. .. Nut oil.

The oil and the margarine are gently melted together. The milk is heated and is added slowly to the melted oil and margarine, the whole being very rapidly stirred until cold. Sugar, may, of course, be added at any stage.

An inferior cream may be made by emulsifying the nut oil by means of gelatine alone.

Dissolve 5 parts of cooking gelatine in 95 parts of water. Heat the oil, stir it rapidly, and add to the oil about an equal bulk of the gelatine solution. Stir continually till cold. The consistency of the cream may be varied by altering the proportions of oil and gelatine solution, and, also, by varying the amount of gelatine dissolved in the water.



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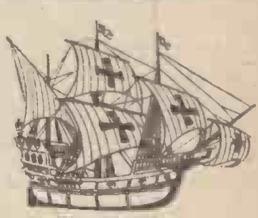

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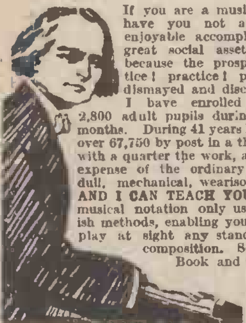

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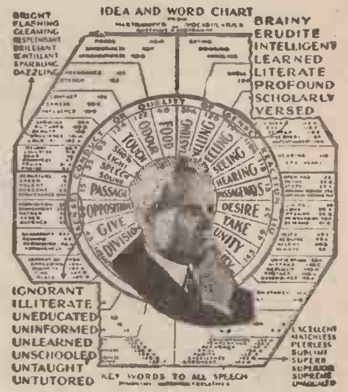

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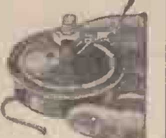

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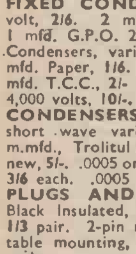

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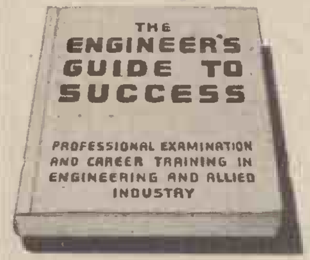

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THE Cyclist
Editor: F. J. CAMM

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Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London

VOL. XIV JANUARY, 1946 No. 287

Comments of the Month By F. J. C.

The First Thousand

WE learn that the thousand mark in the membership of the British League of Racing Cyclists was passed at the beginning of December, 1945, and as every member of the League is actively concerned in promoting cycling sport on the roads, it can thus claim to be at least as representative of sporting cyclists as another body. There has been a minor number of resignations from the League by those who have sought and received reinstatement into the ranks of the R.T.T.C. and the N.C.U. The latter body is, of course, not concerned with road sport, only with track racing, and the number of members of the N.C.U. interested in track racing as participants is much less than 1,000.

The *Daily Express*, some weeks ago, published on its front page a statement that massed-start racing on the roads is to be banned if the B.L.R.C. continue to promote such events. We are able to state that this is not so, and whether the statement in this newspaper was inspired or not we are able to give a categorical denial to it, on the authority of the Public Relations Officer of the Ministry of Transport. We have no doubt that the paragraph was published in good faith, but it would be interesting to know the source which inspired its publication.

Very understandably, there is some concern in rival circles concerning the great progress which this sport has made and the success with which it has run its events. The critics have been confounded in that the events have been run without accident or incident, the police and other public officials have co-operated in running them, and they have attracted a large amount of valuable publicity in the national newspapers. This can only redound to the good of the industry and the pastime, for none of the events in the normal cyclist's calendar attracts more than a few lines, if at all, in some obscure part of the sporting features. The reason is that the sport decided some fifty years ago that publicity was unwise in view of the known attitude of the police. That attitude, however, has changed and it has changed to the extent that the police are always informed by promoting clubs of the date and the course of important open events, so little is it feared that the police will swoop down as they did fifty years ago and prosecute riders. The R.T.T.C. has a rule concerning publicity and especially prior publicity. It is an offence to inform any newspaper for purposes of publication of the details of events in advance of those events. The hole-and-corner methods under which time-trials are run have done the sport great disservice in that newspapers, or at least responsible newspapers, honour this rule concerning prior publicity.

International Status

IF there is to be an improvement in our international status in the sphere of cycling sport, we must do our best to encourage the best types of athletes and provide them with opportunities for training at present denied them, except in so far as the B.L.R.C. are making strenuous efforts to make good the omission. A great deal of opposition to this body has been fomented by those who are jealous that a new body should be doing what older bodies should have done years ago. Fear of a new thing nearly always breeds opposition to it in the early days, but opposition is a stimulating thing and it usually has the reverse effect to what was intended. It gives publicity in the first place to the new body and it encourages rival camps, thus attracting new members.

The London County Council was impressed with the events run under the League's auspices in Battersea Park, which were definitely superior to those promoted by other bodies. Certainly none of the national bodies can point to one event in their calendar which has attracted so much attention, and if any of them were present at the finish of the Barnet to Biggleswade Race, when an orderly crowd of 2,000 enthusiastic cyclists, nearly all clubmen, cheered the victors, it is understandable that they should feel concerned at this thriving movement.

They know that legislation banning massed-start races cannot be introduced without time-trialing coming under the same ban, for massed-starts and massed-finishes, whether of time-trials or other forms of race, can be the subject of equal objections. We see no particular reason why anyone should want to heal the split unless it be the national bodies. And we first have to make up our minds whether there has been a split. If a number of cyclists decide that they want their sport run in a certain way and the national bodies think otherwise, it cannot be termed a split when those cyclists run events which do not compete with those promoted by the dissenting bodies.

In any case the matter has now developed to such an extent that there is no need for anyone to mollify the N.C.U. or the R.T.T.C. Each of the bodies can continue to operate in their respective spheres, and in our view each will benefit the other if a more friendly atmosphere can be promoted. At present the hand of friendship is extended on terms of suppression, and there can be no solution to a dispute where one hand is extended in amity and the other holds a pistol.

New Management

THE N.C.U. is now under new management in accordance with the recommendations of the Post-war Planning Committee, and perhaps a different atmosphere may now be allowed to permeate the sport. Both sides have aired their various viewpoints without finding a solution, and it must therefore be conceded that they should be permitted to go their respective ways. But there can be no peace in the movement whilst one body seeks by objectionable methods to get the other suppressed.

N.C.U. Centre Trophies

N.C.U. Centres are reminded by the N.C.U. Headquarters that at the outbreak of war most of the centre trophies were returned to Headquarters. These have been revalued and kept in the vaults of the Union offices. Centres may now wish to have these returned and they are, therefore, invited to apply for and fill in a form, when the trophy concerned will be despatched.

N.C.U. Diary

THE N.C.U. diary reviewed in this issue costs 3s. per copy, 2s. 9d. for orders of a dozen or over, and 2s. 9d. each to members of H.M. forces still serving abroad. Work on the touring handbook for 1946 is well advanced and Centre Touring Secretaries and Local Touring Secretaries are asked to send any relevant matter that may affect their territory. The names of all those non-recommendation caterers who have applied for inclusion in the 1946 handbook will be sorted into districts and be subject to enquiry and recommendation by the C.T.S. or L.T.S. A supply of special memo paper for this purpose is available. The union claims that its remodelled touring bureau will be very much in advance of its pre-war effectiveness.

The N.C.U. Racing Handbook will be published this year. Any outstanding racing event or item of interest should be sent to the N.C.U. Centres are urged to get down to the question of date fixing for sports meetings as early as possible.

It is still impossible to obtain supplies of championship medals and in consequence certificates must again be awarded until these are available. The certificates cannot be issued in bulk, but only upon application, naming the winner and championship concerned. These are then completed by the centre and signed by the chairman and centre hon. sec.

Centres should keep in touch with their local Town Councils on the question of town and country planning to ensure that recreation grounds or sports grounds figure in their deliberations.

The Legal Department of the N.C.U. announces an increase in accidents to members since V.E. Day. A recent settlement of a case for a London member resulted in compensation being awarded for £2,000—the biggest individual settlement for several years.

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Around the Wheelworld

By ICARUS

The "Late" Express

ON the front page of the *Daily Express* there recently appeared a paragraph which stated with all the authority of an official announcement that if the B.L.R.C. continued to promote massed-start racing on unclosed roads the M.O.T. would introduce legislation making it illegal. I have no hesitation in labelling that statement as untrue, and I have the authority of the Public Relations Officer of the M.O.T. for making that denial. I rang him immediately I read the paragraph and asked him whether his Minister had considered the matter, and he assured me that such legislation had not even been contemplated. I asked him, therefore, if his Ministry intended to deny the paragraph, but he told me that if his Ministry denied all of the erroneous statements that appeared in the daily papers it would be kept extremely busy.

Of course, it is not difficult to visualise the source from which this inspired statement came. I am only astonished that an important daily paper should be misled into publishing such statements without first verifying their accuracy. It would appear that this is another example of the underground intrigue of those who would like to see massed-start racing suppressed—methods which should not be associated with a clean sport, but which unfortunately have polluted the sport of cycling for the past 50 years. The Minister of Transport knows only too well that if he endeavoured to ban massed-start racing he would have to ban time trials, and he dare not do it. Even though he were so misguided, I can assure him that massed-start racing would continue, although it might be driven into the hole and corner methods under which time trials are at present conducted.

Annual Dinner of London Section B.L.R.C.

THE British League of Racing Cyclists has topped the thousand mark, and of this more anon. It would, however, have done the N.C.U. and the R.T.T.C. good, or struck fear into their hearts, had they visited the first annual dinner-dance and prize presentation of the London Section of the B.L.R.C. at Lysbeth Hall, on December 1st, 1945, when over 120 members and guests sat down to dinner, under the chairmanship of Mr. J. Kain. The toast of the London Section was proposed by Mr. F. J. Camm, who referred in scathing terms to the fear of the rival bodies that this new body was growing and may oust them. Since the first meeting in Brixton, in 1942, when the Section was formed, it had made great progress, due to the enthusiasm of Messrs. Kain, Clarke, Gibson, Stevenson, Boyden, Summers, and many others. In 1944 31 events were promoted at all distances and of all types, with six road races, including the first stage race ever to be promoted in this country—The Three-day Race, organised by Summers—which was such a huge success, and which received such unstinting support from the police, members of the public, and officials. Sections, during this year, were formed in Bournemouth, Newcastle and Scotland.

The year 1945 saw an even larger programme, with 35 events of all distances and types, with seven road races, the highlight of which was the five-day race from Brighton to Glasgow, with a French team competing, the first time a foreign team had ridden on the road in this country.

Since the formation of the section, cyclists have been able to witness racing in all parts of London and its environs for three years, with the N.C.U. feebly imitating. The section has done much to achieve their aim of placing the sport before the public and to lift it to a national status, which the N.C.U. has never been able to do. The toast was responded to by Mr. E. L. Lawton, and other speakers included Mr. W. Summers, Mr. W. G. Mills, Mrs. W. Fletcher, the ex-mayor of Battersea, Mr. S. Fussey (ladies, visitors and Press), Mr. G. Dorman and J. Day (the trade), Mr. G. Stone (absent friends), Mr. E. W. Tugwell and J. Kain (the chairman). The presentation of prizes was made by Evelyn Hamilton.

The Champions' Concert

THE first Champions' Concert and distribution of trophies and medals to be organised by the Road Time Trials Council took place at the Albert Hall on November 24th, 1945, when over 7,000 cyclists packed this famous hall. The Chairman was A. E. Armstrong, and the presentation of medals and trophies was made by Mrs. Madeline Horwood, widow of V.C. A. C. Horwood, sometime member of a cycling club, once famous. Apart from the presentation there was an excellent programme provided by Arnold Grier at the organ, The Coldstream Guards Band, Bert Wright and Zena, A Roller Racing Contest, Eddie Ready and Joy, Nicol and Merril, Billy "Uke" Scott, The Cairoli Brothers, and Gladys Ripley. The compere was Hubert, assisted by Vic Jenner, who had done so much to make the evening a success. The high spot in the presentation was, of course, the presentation of the trophy to J. Allison, of the Musselburgh R.C., the best all-rounder for 1945.

I am glad that the Road Time Trials Council has taken over this contest, and have shown themselves capable of filling the Albert Hall in a manner which does the greatest credit to them. It was altogether a memorable evening.

Charlotteville Annual Dinner

THE Annual Dinner of the famous Charlotteville C.C. was held at the "Lion," Guildford, on November 16th, when over a hundred members and guests were present to listen to some interesting speeches and to witness the presentation of prizes and medals, which was undertaken by Miss Judy England. An excellent programme of entertainment was provided, and among the guests were Mr. and Mrs. H. H. England, Miss Judy England, Marjorie Maunder, Mr. E. C. Coles-Webb, Mr. F. J. Camm, and many of the leaders of the cycling movement.

All the speakers paid tribute to the work of that famous Charlottevillain, Vic Jenner, who has contributed so much to the success of the club, which in many respects has replaced some of the older clubs, which have fallen into desuetude.

N.C.U. Membership Figures

ACCORDING to a contemporary, the membership of the N.C.U., as disclosed by Mr. A. P. Chamberlin, N.C.U. secretary, is as follows :—

Registered track riders (up to 29th October, 1945), 723.

Actual membership (club affiliations and P.M.'s), 23,138.

Apparently our contemporary was in error, in referring to the N.C.U. membership as 35,000, as appearing in the 1945 N.C.U. Diary, but this figure included between 14,000 and 15,000 *associates*, whom it would appear are not members at all, being utility riders without voting power, either on local or headquarters' committees.

From this it is quite obvious, as the N.C.U. exists to control track racing only, that its real membership is 723, and that being so, it is less of a national body than the B.L.R.C., which, as I have stated earlier, has a membership of over 1,000.

We, therefore, agree with the views of our contemporary which we quote herewith.

"If 40,467 (including 17,329 Associates) is used by the Union, it must not complain if we use that figure also.

"These figures give further proof—if such is really necessary—for the need of a controlling body for cycle racing, as the N.C.U. is not so powerful as one is led to believe.

"The track registration figure of 706 which we used was the total available from 14 sheets published by the N.C.U. in August, 1945, but the Union Secretary advises us that he was still waiting for the official figures.

"If these figures are not available to N.C.U. H.Q. even *after the track season has ended* how do the promoting organisations fare when they want them—*during the season.*

"The N.C.U. Secretary's letter concludes by stating 'The racing men of the Union are controlled by their *own* clubs, each one of whom has representation on the Union's Councils and by no other source.' If this is so—and we know it is—how many N.C.U. affiliated clubs have *no* track registrations at all, but whose delegates can vote on track racing matters ? We can think of dozens in the London area alone ! Also a club with large affiliated membership (say 200) and a small track registration (say 5 or 6) will have about 5 delegates to a N.C.U. Council meeting, whereas a track racing club with 20 registered riders may have only 1 delegate. Racing matters are controlled by touring members who outnumber registered riders by 32 to 1 ; approximately 3 per cent. (using 23,138), compared with our original statement of 2 per cent."

I understand from the N.C.U. that the following few members of the B.L.R.C. have applied for reinstatement and their applications have been accepted : D. N. Kingswell, C. Halliday, J. Pout, F. L. Ingleby, E. J. Runagall, E. W. Bouse, R. J. Bailey, G. J. Dixon, J. Wakeman, C. J. Anslow, R. R. Leftwich and G. Berger.

The B.L.R.C. is not perturbed concerning these few secessions.

British League of Racing Cyclists Programme for 1946

AT a National Executive Committee Meeting held in Manchester on Sunday, November 4th, 1945, the delegates decided upon the racing programme for 1946. In this, the fifth season of the League's activities, items of outstanding international importance were arranged :

(1) An international series of events in which Australia, France, Italy, England, Scotland and Ireland will definitely compete, with the possibility that a Russian team will also be seen in England for the first time. The date for this international meeting is not definite at the moment, but will most possibly take place in the second Brighton to Glasgow race that is being arranged for July/August of next season.

(2) A self-contained event that should also arouse great public interest will be a cycling "test" that is being arranged between four Australian riders who are representing the Australian Cycling Association, and four riders representing the B.L.R.C. It is possible that this test will comprise :

AROUND THE WHEELWORLD

(continued from previous page)

(*a*) Road race,
(*b*) Track events,
(*c*) Road time trial,
(*d*) Hill climb, and
(*e*) Team time trial in which both respective teams will compete, with the fastest three riders to count.

(3) A series of matches between the road and track champions of the National Cycling & Athletic Association of Ireland and the leading riders of the B.L.R.C.; this meeting has been arranged for the Easter period.

(4) The National Road Race Championship of Great Britain has been allotted to Scotland, the Scottish section of the League being responsible for the organisation, and it is certain that with the tough mountainous courses which will be available, this race will be "Champion" in every sense.

(5) The British Junior Road Race Championship has been allotted to the Southern section (Bournemouth) and the testing nature of the country in this area will test the qualities of these under 18 riders.

(6) British Ladies' Road Race Championship. This has been allotted to the North-eastern (Newcastle) section, over a course of 25/30 miles.

The Reunion of Cyclists

RACING and club cyclists had their first view of post-war racing and light-weight bicycles and tandems on December 12th, at the Seymour Hall, London, W.1, when a display of new machines formed the background for the great reunion of cyclists. The function, known as Claud Butler's "do," was one of the big events of the cyclist's calendar in pre-war years, and was being revived for the first time since the war. The main feature of the evening was a special welcome home to all Service cyclists. It was a great evening and does credit to this well-known manufacturer of light-weight bicycles.

Road Accidents—October, 1945

MORE people were killed or injured on the roads during October than in any previous month this year. The total was 13,997, which included 534 killed and 3,249 seriously injured.

Fatal accidents to child pedestrians numbered 117, the highest total for October ever recorded. Two-thirds of the victims were under eight years of age, and in the majority of cases the accident was the sequel to a dash into the roadway—a type of accident which kerb drill is designed to prevent.

The ending of Summer Time, with the consequent advance in the time of dusk, was followed by a sharp rise in fatal accidents to children during hours of darkness. Nineteen child pedestrians were killed during these hours, compared with seven in October of last year.

Attention is called to the fact that many school children are now for the first time returning home from school in the dark. Parents and drivers are asked to do all they can to ensure the safety of these children—the former by instructing children in kerb drill and arranging for them to be accompanied whenever possible by older persons, and drivers by exercising special vigilance.

The total number of deaths among child cyclists and child pedestrians was 136. This means that, on an average, one more child was killed every day than in October of last year.

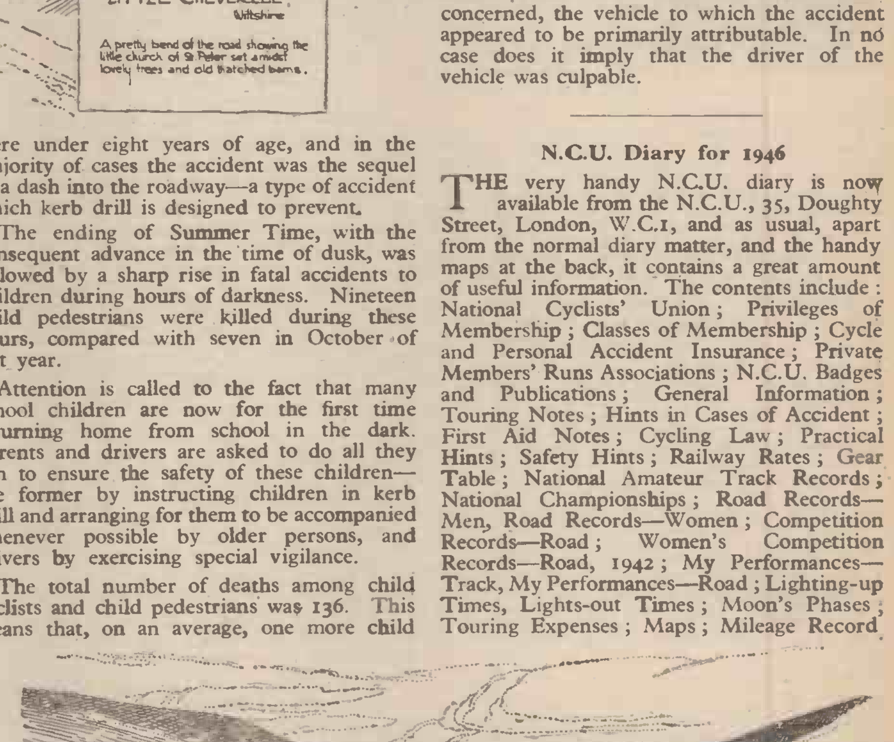
The following table is an analysis of the number of deaths according to the type of vehicle primarily involved, in September and October:

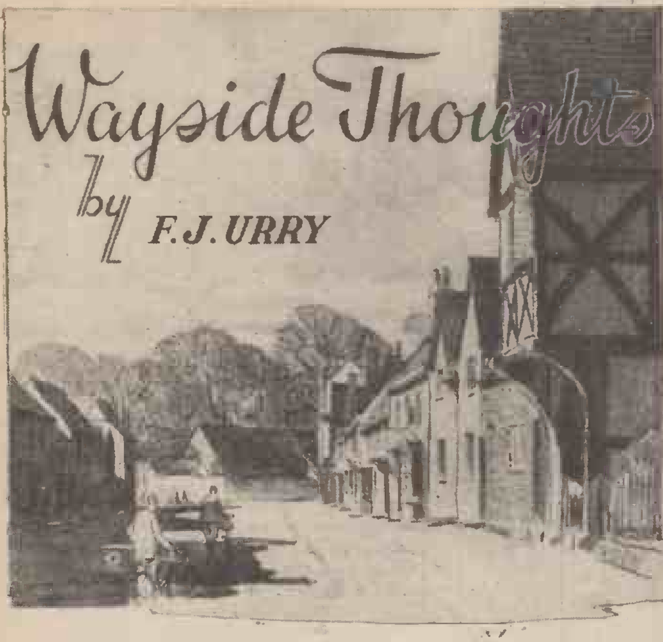
Type of Vehicle	Number of Deaths September	October
Service (British, Dominion and Allied of the three Services) ..	53	74
N.F.S.	3	2
Public Service and Hackney	65	78
Goods	93	118
Private Cars	87	108
Motor-cycles	75	76
Pedal Cycles	56	61
Others	20	17
Totals	452	534

The term "vehicle primarily involved" means where more than one vehicle was concerned, the vehicle to which the accident appeared to be primarily attributable. In no case does it imply that the driver of the vehicle was culpable.

N.C.U. Diary for 1946

THE very handy N.C.U. diary is now available from the N.C.U., 35, Doughty Street, London, W.C.1, and as usual, apart from the normal diary matter, and the handy maps at the back, it contains a great amount of useful information. The contents include: National Cyclists' Union; Privileges of Membership; Classes of Membership; Cycle and Personal Accident Insurance; Private Members' Runs Associations; N.C.U. Badges and Publications; General Information; Touring Notes; Hints in Cases of Accident; First Aid Notes; Cycling Law; Practical Hints; Safety Hints; Railway Rates; Gear Table; National Amateur Track Records; National Championships; Road Records—Men, Road Records—Women; Competition Records—Road; Women's Competition Records—Road, 1942; My Performances—Track, My Performances—Road; Lighting-up Times, Lights-out Times; Moon's Phases; Touring Expenses; Maps; Mileage Record.





Wayside Thoughts

by F. J. URRY

Age Cannot Wither

CYCLING as a pastime goes to the blood in some people and keeps them young even unto the four-score of years. I should never dare to tell this story were it not for the fact that I have witnesses, for I admit it sounds like a romance conjured up by an enthusiast who wants to put his case over to the people. One of my correspondents wanted to know if I could find him a place to stay for a couple of nights in the City of Birmingham, where he had business to transact, among it the purchase of a specially built bicycle to be made and sent home directly the best of things are obtainable. As we had exchanged many letters and I felt I knew my corresponding friend fairly intimately, I asked him to stay with me; so one day he came along from the borders of Radnorshire full of vigour and with the declared intention of filling all his appointments inside two days. Now, I knew he was well on in years, but was rather amazed to discover he was 80, a very virile and enthusiastic 80, with a flair for the very latest thing in bicycles, and a firm intention of getting them too. Upright, active, full of the stories of experience, for he was, and indeed is, a well-known figure in the yacht racing world, I had four days'—or the evenings thereof—(his stay was extended) most interesting company with a man who knew cycling eight years before I was allowed to venture on two wheels. He had started riding at the age of 16, 64 years ago, and never had been without a bicycle since, although he also rode a motor-cycle and drove a car. "But the bicycle, my lad," he said to me, "is the one form of wheeled travel that possesses character for an active man; the others are a mere matter of convenience."

The Fit Man

SO, you see, our conversation started well, and continued along that line during the whole time. We dug up from the past all sorts of things relative to cycling, the early days of spring frames, the first "pudding" Dunlops, the Simpson-Lever chain, and the early attempts of the free-wheel, rim brakes and coasters. Reminiscence is natural to elderly people, but here was a man as keen on a new bicycle as any novice, as if 80—as an age—were an experience to be utterly forgotten when it came to the modern possibilities of the very best in bicycle building. He went off to see a man I know and came back that evening full of satisfaction that he should get the things he wanted with the exercise of a little patience. "But," I asked him, "how far do you ride?" "Anything," he said, "from 10 to 40 miles a day, and my part of the country is not exactly renowned for level roads. I try to get in a ride most days if the weather is not too bad, because I know it keeps me fit, and if really stormy weather or snow stops my usual outing to see friends, I miss the exercise and am accordingly depressed." I am trying very hard not to exaggerate this story, to make you who read feel that this 15 stone man of 80 was just expressing his keenness for cycling as a way of life, as if he were talking to you, as he did to me. "I often regret," he said, "that in my young days I did no racing, for I now believe I could have been among the pioneers of the game; but at that period I was so involved in yachting that I seemed to have very little time for any other sport. As a matter of fact, I have always felt that cycling is a form of land yachting, and probably that feeling, and the fact that it has kept me so trim all these years, makes me keen on it now, and will keep me in that frame of mind for years, I hope."

The Open Air

HIS interest in yachting and the fact that his opinions on design and performance were still eagerly sought made it necessary, or at least desirable, for him to journey from his home in Radnorshire to the South Coast where the little boats flourish. It is a long journey, too long for him to ride on a bicycle and take his kit, and because he hates trains and dislikes the enclosure of a car, he wanted to buy a motor-cycle and sidecar on which to travel his long distances, for he said, "I love the open air and the feel of the wind on my brow." To me this was a shock, that a man of 80 should feel the call for a motor-cycle. "Well, you see," he said, "I only want to travel about 25 m.p.h.; my journeys will be in summer time, and if it rains I can always put up at the first place. Besides, a motor-cycle is the nearest to a bicycle, and the sidecar will take my luggage. Do you know anyone who can give me a reasonable delivery time?" Candidly I tried to put him off, but he was persistent. So I rang up a friend of mine and explained the situation, and I am afraid he did not believe my tale, and I'm not surprised. Anyhow he agreed to see the old gentleman, and my trade friend was as amazed as I with his active vitality and his insistence on having his own way. "My business is to sell motor-cycles," said my maker friend, "but I don't want to sell one to you." But that frank opinion made no difference to the attitude of the old gentleman, who insisted on his fitness (he had taken me a six-mile walk on Sunday morning) not only to ride a motor-cycle, but to take care of himself and it! I shall always admire the attitude of that manufacturing friend of mine. "Go home," he said to the old gentleman, "talk the matter over with your son and, if you still insist, drop me a line and I will send an expert with motor-cycle and sidecar to your place in Radnorshire, so that you can have a couple of days' trial before the final decision." What a delightful gesture! I asked him, when the old gentleman was wandering round the works, why he did it. "Well," he said, "he is a friend of yours, and some day, if we live long enough we shall be 80, and perhaps a little curious in our outlook; and in any case a generous sympathy is surely the right attitude towards age." And there for the moment the matter rests.

Thoughtless People

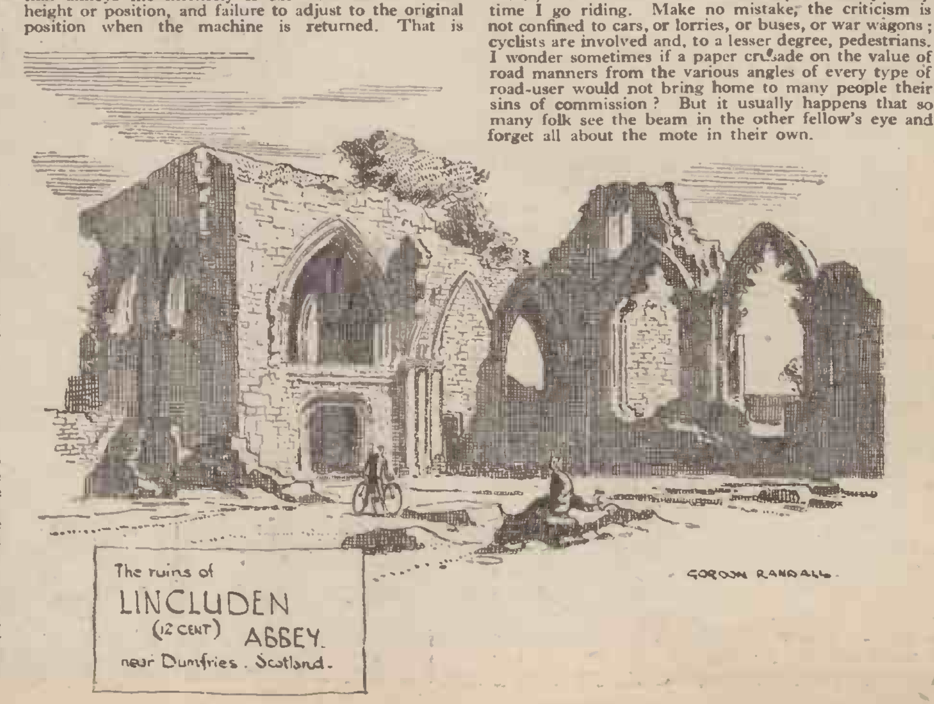
I DO wish the people who occasionally borrow my bicycles would tell me if anything goes wrong with them during the time they are in their possession. It is annoying to find a flat tyre or a bent pedal spindle just at the moment when you want to use that particular mount. Both these things happened to me recently. The puncture—it was a fat thorn—might be excused on the ground that it occurred on the way home; but the bent pedal—no, that was the result of a crash or carelessness in allowing the machine to fall heavily. No one could have ridden that machine ten yards without being aware of its disability. Another thing that annoys me intensely is the alteration of saddle height or position, and failure to adjust to the original position when the machine is returned. That is discourteous and may be dangerous; for I have a habit of jumping on a bicycle and not mounting it by the pedal, and if the saddle height has been raised without my noticing the fact, I have been, before now, in a jam, with the bicycle on top of me. I am lucky in possessing several very good bicycles—I do not mind lending one when the need is urgent or desirable—but this lack of care on the part of borrowers sometimes makes me swear that in future I will be hard-faced.

The Happy Cyclist

SUMMER has gone, and as I scribble these lines the wind is roaring down the street, sweeping the rain before it in a grey sheet. It almost seems as if those happy, sunny days of early spring, going back on their promise of a summer-to-be, were also the only real glory in the terms of weather 1945 could give us. Well, it doesn't very much matter; I've had some good riding, and though I would have preferred the elements had patterned themselves on a better example of a British summer, there have been compensations. The war is over. I shall still be doing my quota of riding, though my evening runs will be curtailed and my week-ends will contain fewer miles, for, to be candid, the roaring log fire of the farmhouse will provide a gracious rest and argument when the winter winds howl round the eaves. The thing is not to stop riding because it rains one day. Winter provides me with the opportunity of visiting many a place I side-track when the summer days beckon me farther afield, and it often astonishes me how lovely these places are when seen against the background of a winter sunset. And if you go in company, as I frequently do on these "off-season" rides, the merriness of the party makes a little holiday of the hours. That is the best of cycling, you can always find a friend if you want one, always know a place where you will be welcomed, and always arrive home with a sense of satisfaction that you have done something and that it was well worth while. The weather may not always be inviting, but the road is and all it connotes, and even on the dullest day some little adventure comes to you, some happy surprise that makes you avow again that cycling is the best game of all.

Not So Bad

WHATEVER may happen to our roads in the matter of overcrowding in the years to come, the present position is quite comfortable for the cyclist. That's my opinion, and at the moment I see no reason to alter it. Even in the summer I was never worried or annoyed by overcrowding on the big roads, and now the traffic seems to me little greater than was the case when petrol was not obtainable except under the impact of war. There are fewer army lorries, and no doubt that fact accounts for the notion that increase in civilian traffic is not nearly so great as we were given to suppose. What I should like to see is a little more courtesy practised by all road users, and especially the army driver who seems to think he still has priority to barge through and in very many cases uses his strength to frighten off other folk when the right-of-way is clearly theirs. Pity that we are still involved in the whirlpool of bad manners, which must get worse as the pace and volume of the traffic stream increases, when it should be so simple to cure this human failing and thereby, I am certain, very greatly reduce the incidence of accident. It is sad to think we can do, in a dining-room, that which it seems impossible to achieve on the road. That which we do practise in the former place is a sign of our civilisation and culture; must it be written that the good habit is but skin-deep and loses its greater human values when an individual goes road-faring? It seems to me a pitiful commentary on all of us if we cannot do better than that; yet to-day it is a fact, and one which I see and deplore nearly every time I go riding. Make no mistake, the criticism is not confined to cars, or lorries, or buses, or war wagons; cyclists are involved and, to a lesser degree, pedestrians. I wonder sometimes if a paper crusade on the value of road manners from the various angles of every type of road-user would not bring home to many people their sins of commission? But it usually happens that so many folk see the beam in the other fellow's eye and forget all about the mote in their own.



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will really
satisfy
me now"

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CYCLORAMA

By H. W. ELEY

A well known Isle of Wight beauty spot
Godshill

The Wind and the Rain

AS I write, the rain is lashing the windows, the wind is blowing golden-brown leaves off the oak tree, and adding them to the already thick pile on the lawn. Too squally to-day to get out besom-broom and barrow, and do that necessary clearing up! And too windy, I am afraid, for cycling to be any great joy on this late October day. But we should be churlish to grumble, for, until the good weather broke, October has been the most wonderful month I recall for years; but our Indian summer seems to have gone, and out-of-doors folk are thinking of wellingtons and oilskins, and praying that leaky roofs will all be mended before the winter really sets in.

Our Oldest Windmill?

CYCLING recently in Surrey, and at Outwood, I came across what is often supposed to be England's oldest windmill, believed to have been erected in the year 1665. The deed authorising its building is still in existence, and whilst there is not a great deal of reliable data about the age of windmills, this specimen at Outwood seems to qualify for the honour of being our most ancient mill. I remember reading that the claim for the oldest mill was for some time made by the village of Chesterton, in Warwickshire, but it was discovered that the windmill there, supposed to have been built in 1632, was really built then as an observatory—only later to be transformed into a working windmill. What fascinating objects these windmills are! I wonder that more cyclists do not make pilgrimages to discover them . . . for they provide much interest and well repay study. We have two main types in England . . . the "post-mill" pattern and the "tower," or "smock," types, which are of later date. But windmills are disappearing from the landscape, and their disappearance is, I think, a loss.

Back to "Civvy Street" and Cycling

I SUPPOSE that there must be many men now being "de-mobbed" who, for long years, have been denied the joys of cycling. I talked with one such recently, and his war service had precluded him from riding a bike for over three years . . . and he was a keen rider, and longing to get a bike again and do some "exploring" of the England he had dreamed about when abroad. I was glad to be able to assure him that bikes were in more plentiful supply, although the dealers were not yet as fully stocked as they could wish. My de-mobbed friend indicated to me that whilst away he had been planning cycling tours . . . and he had a notebook full of most admirable suggestions for week-end rides and longer trips. The "Hardy" country of Dorset, with special attention paid to Egdon Heath; the Shropshire border country made famous by Mary Webb; and the quiet lanes and villages of Suffolk . . . these were some of the districts this back-to-civvy-street cyclist was planning to see, and I wished him well. There will be many riders who will be hoping to find peace and a new poise from the sights and sounds of the English countryside!

Church Cycling Clubs

SMALL clubs they may be . . . and quite unpretentious, but they are numerous, and do much to keep the cycling movement active and healthy. Those clerics who stress the importance of social life and the promotion of healthy bodies as well as healthy souls seem keen on cycling as a means of attaining these ends. There is a parson I know who has been an ardent cyclist all his life, and he started, this summer, a club in connection with his church. The other day I talked to him, and was glad to know what a fine bond of friendship has been established between his young folk by means of the church cycling club. And the runs were well planned and interesting! The church is in the Midlands, not far from Nottingham, and some of the best rides have been in the region of the Robin Hood country . . . fascinating green Sherwood, where the ghosts of Maid Marian and Little John still haunt the glades.

Politeness Over the Counter

SOMETIMES, in the war years, politeness in shops has been conspicuous by its absence, and a would-be purchaser of some cycling accessory has met with very curt treatment from the "man behind the counter." Of course, I am not singling out the cycle dealer for criticism, for "war-nerves" and the irritation of shortage of supplies have affected the grocer, the butcher, and the fishmonger as well! But it was most pleasing the other day to be met with an almost old-world politeness when I entered a cycle shop and asked for two batteries and a cycle pump. Smiles . . . a pleasant chat . . . some interesting commentaries on the future possibilities of trading . . . these were such a welcome change from the all-too-frequent "Don't - you - know - there's-a-war-on" attitude with which, unfortunately, we became too familiar during the past few years. Politeness is a good stock-in-trade, and I hope that with the return of better facilities our dealers will find their smiles again and greet the cyclist with courtesy and consideration.

November Gold

THERE is an old saying in the chronicles of the countryside . . . "Gather November Gold when you may." Now, the "gold" refers to chrysanthemums, those gay and colourful blooms which are all the more welcome because they come to us when most of the other flowers of our gardens have died away. And as November is usually regarded as a black and surly sort of month, I like to give her credit for some colour and some virtue.

The Nature-loving Cyclist

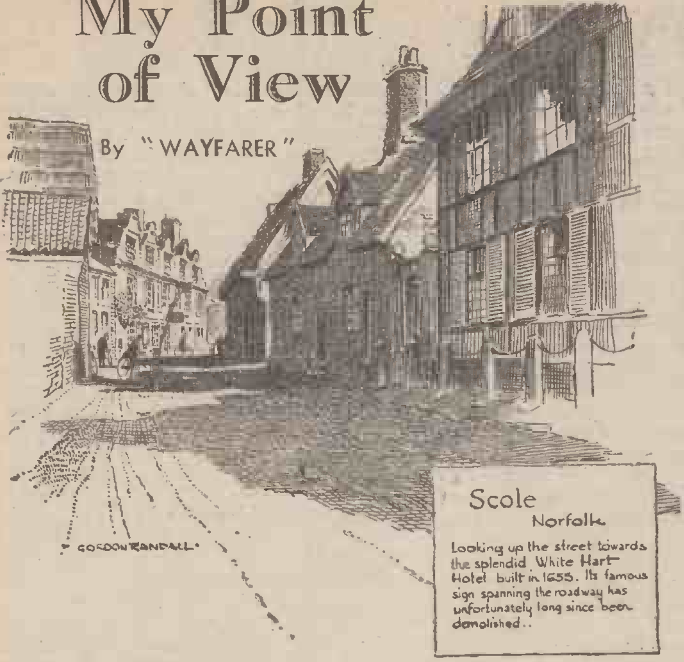
THE approach of winter, with the bareness of trees, the silence of the birds, and the reign of grey skies, need not mean the "packing up" of the nature-lover's hobbies. True, there will be no butterflies on that wide heath where, in high summer, the chalk blues used to flit from bush to bush; it will not be possible, as one wheels the bike down some tangled lane, to find a nest of buntings in the hedge; but though Mother Nature sleeps, she is very far from dead . . . and we may find the hedgehog curled up cosily among the brown leaves of the ditch; we may even, if we are very lucky, discover the lair of Brock the Badger . . . though I fancy that badgers are less and less common than a few years ago. But to the man who has taken up nature-lore as his hobby, to fit in so happily with cycling, I say . . . the winter will provide a wealth of interest, and there is no need to sigh for the charms of summer days. Make the most of the pleasant sound of rain gurgling in the ditches; enjoy the mysterious enfolding mists which creep over the fields in the early evening, and see the beauty which still lives in those bare and stark trees which guard the ridge like sentinels. And now that the dismal black-out has been lifted from our lives, ride out at night, so that you may experience the tremendous joy of coming round a bend and sighting a well-lit inn window, winking a welcome at you and suggesting good visions of a mug of ale and a quiet pipe.

The Passing of 1945!

A REMARKABLE year, ever memorable because of "V" days . . . but somehow, I think most of us will feel glad at its passing. There's always the pious hope that the New Year will be less trying, less full of troubles and trials. This was the theme of a little talk I had the other week-end with some fellow-riders in an inn just over the Hertfordshire border from Middlesex. "And maybe there'll be more tyres, more pumps, more of everything . . ." Well, I fancy there will. Anyway, here's to a good 1946 for every cyclist, with good touring and happy hours in the countryside.

My Point of View

By "WAYFARER"



Scole
Norfolk
Looking up the street towards the splendid White Hart Hotel built in 1655. Its famous sign spanning the roadway has unfortunately long since been demolished.

Open Air Treatment

THE Chief Medical Officer of the Ministry of Health said at a press conference the other day that the authorities were taking all precautions to deal with an influenza epidemic. He urged people to get out and about and take exercise in the open air. This is most admirable advice, which I, for one, propose to continue implementing!

Answered

WRITING recently in this place about the scarcity of wheel-folk seen on the gorgeous last day of September, I asked: "Where were the cyclists?" The answer came on Remembrance Day, six weeks later. I rolled up to my usual place for Sunday lunch and was informed that 59 cycling visitors had preceded me. I was the 60th! On the following Sunday I heard that another 26 cyclists followed me, making a total of 86 for the day—a November day! The answer to my enquiry was thus highly satisfactory.

After You—Cecil!

A YOUNG office colleague overtook me at speed on the way to work the other morning, calling out, as he did so: "Excuse my back!" A quarter-of-a-mile ahead, at the bottom of a hill, I found him wrestling with an athletic chain which had jumped out of its appointed place. It seemed right and proper for me to repeat his greeting, and, as I did so, I recalled that sometimes, as on this occasion, the tortoise passes the winning-post in front of the hare!

Better Than Cure

RETURNING home at mid-afternoon on a recent Sunday from my first railway journey for some years—a 100-mile trip (each way) in order to give a lantern-talk—I made a complete change of clothing and was out on my bicycle within 15 minutes. I realised that, if something drastic were not done, I would be the victim of train-"fugginess" and would probably end up with a violent headache. So, believing that prevention is better than cure, I dashed off into the country. Before I had done six miles, the powers-that-be began to chuck down masses of water, some of which my cape, hurriedly donned, kept off me, but my sleeves were wet in no time. It didn't matter!

The rain cleared away and I reached my destination at lighting-up time, not very much the worse for wear. A glowing kitchen fire enabled me to make the toast I ultimately consumed, hot and buttered, and the company was genial and acceptable. Then, when darkness had completely shrouded the land, I lighted my lamps and set off for home, travelling by lane routes for most of the way. I had these to myself, and nary a soul did I meet until towards the end of the journey, when main roads had to be used. This was but a 40-mile trip in all, but how well worth while it was—as a measure of that prevention which is better than cure, and as an act of pleasure and recreation!

Two-legged Menace

IT would probably need an expert in the study of human nature to explain the antics of some pedestrians. For instance, how would you account for this incident? On a Sunday afternoon two of us, approaching the outskirts of a small country town, saw a woman on the left-hand side-walk, about five or six yards away. She was obviously intent on crossing the road. Very wisely, she glanced to her right, the direction from which her first traffic problem would arise. Presumably she saw us—*and she stepped into the road!* A frantic shout sent her back to safety, and we passed beyond her ken with a gratuitous word of advice. But why did she look at the two cyclists and then plunge into danger? My theory is that she saw us, but her mind did not "register." There are people like that, who look at things with unseeing eyes. However, it would be interesting to have expert opinion on the point. It seems to me to be a case for a psychiatrist.

Still "Batting"

TWO or three cycling veterans were having lunch at a table adjacent to mine on a recent Sunday and I was rather interested to overhear one of them say, quite simply, that he was 76 years of age. I knew him to be an enthusiast who, week-end by week-end, is to be found along the road, making the best of a grand pastime, and it was certainly comforting for one still on the sunny side of three-score-and-ten to hear of a fellow-cyclist well on the other side of the psalmist's arbitrary demarcation line still actively participating in the best of games—a game which, as I have often asserted, is for both sexes, every age, and all sorts and conditions of men (and women), as well as for the whole year, for day and night, and for practically every sort of weather. Yes! an active cyclist at age 76. How many thousands of people give up cycling long before they reach half that tale of years, on the ground that it is "hard work"? I wonder!

Alertness Required

SOMETIMES, when working my way through a network of deserted lanes of which I happen to be very fond, I wake up from a brief dream and wonder where I am, exactly. The tangle of lanes which the white light of my lamp illumines Sunday after Sunday, which, as a rule, is entirely devoid of traffic, whether wheeled or of the foot-slogging class, and which carries me for a great part of my way home, is rather tortuous and involved, with many a twist and many a turn, and there come moments when I am temporarily "at sea." It does not take long for me to figure out that this bend to the right and that twist to the left were duly taken, and to remember the landmarks which help to indicate my course. Thus I come back to earth again, and, while at no time relaxing my vigilance, I find a renewed delight in this progress through almost unused byways.

Since the foregoing words were written, I have actually gone wrong in the lane-maze referred to, I quickly observed from the scenery which was slipping past me (although "you can't see anything in the dark!") that I had made a false step. This was rectified, not by going back (which "isn't done"), but by riding along two sides of a triangle.

Good for Trade

"IT'S a so-and-so shame," I said, "doing your own house decorations and thus robbing a deserving trade of work and throwing men on the dole." My friends looked at me in amazement, and then saw that I was indulging in a bit of leg-pulling. But when I added that my opinions, even if flippantly voiced, were backed up in practice, they realised that there was something in what I said. For it so happens that my habit is not to repair my own punctures, nor to make any adjustments to my bicycle, unless compelled to do so. My attitude is not by any means 100 per cent. altruistic. The fact is that, while I will ride bicycles until I am black in the face, I hate the mechanical aspect of cycling. I also hate getting my hands dirty—and spending precious time on jobs which other people, for a consideration, do so much better. So I'm all for supporting the trade, first satisfying myself that the folks to whom I give jobs are capable of doing them.

The Hungry Knock

WHEN cyclists are threatened with or possessed by that grim trouble known to us as the hungry knock, what should they avoid thinking of? Food. What, in actual fact, do they think of? Food. What do they need to put them right? Food. Simple questions—and simple answers! As I cycled through Llanberis several weeks ago, I tried a small selection of the rest-houses with the object of securing tea, and was turned down. It did not seem to me to matter, because the village is infested with tea-places, and I felt confident that no real difficulty could exist. But I reached the far end of the habitations and was still remote from tea. "Never mind," I said, talking to myself, "there's a rest-house a bit farther on. It will be all right there." That phantom establishment, however, had disappeared—if it ever existed. So now the old problem had to be faced: go on, or return? In accordance with my almost invariable policy, I decided to go on, knowing perfectly well that the fearsome Pass of Llanberis would have to be topped before there was any possibility of my eating and drinking.

What did I think of as I climbed, a shade wearily, up the pass, all my internal organs knocking against each other? I have already told you—food! I tried to divert my thoughts, but they weren't having any. They insisted on concentrating on food, to my increasing discomfort. I would have liked to think of several other things, in order to keep my mind off my greatest need, but my mental processes insisted on having their own way—though I did just recall that, if the Pen-y-pass Hotel rejected me, it was only (only!) seven miles to the next house of call! At long last I staggered into the lonely pub., and rather fearfully "popped the question." Thanks be to Heaven, I could have tea. There was a 20-minute wait, but that did not matter, now that I knew food and drink were on the way. And so I survived the horrid ordeal of the hungry knock, which is so easily cured—if you have the wherewithal to cure it! Of course, it is a good thing for cyclists to carry an "iron ration" for use on such an occasion as this.

Blarney's The Word

ON the eve of setting forth for a recent holiday, I was talking things over with some friends, to whom I disclosed the awkward fact that I had not succeeded in booking anywhere for the first night. "Whatever will you do?" asked the lady, and, before I could reply, the question was answered by her husband, a parson, who ejaculated: "Blarney!" I imagined him to be suggesting what I would do in the circumstances, but actually he was outlining his own course of action, and he went on to speak of a recent motor-car trip. One evening he and his wife arrived at a certain hotel, only to be told that no accommodation was available. "But I *always* stay here," said his reverence. "You'll remember that the last time I came I was with my daughter, and we were on push-bikes. (It may be mentioned that the "always" and "the last time" represent one and the same occasion!) So, after a little more persuasive conversation—that is to say, blarney—it was found possible for my friend and his wife to be accommodated.

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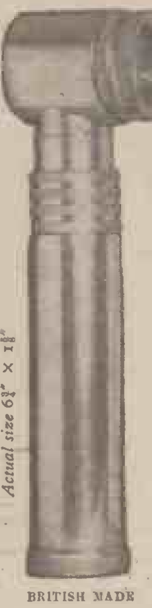

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Practical Mechanics. January, 1946.

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