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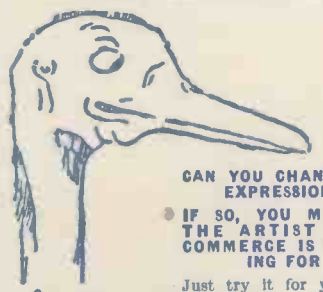

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PRACTICAL MECHANICS

Owing to the paper shortage "The Cyclist" and "Home Movies" are temporarily incorporated

Editor : F. J. CAMM

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FAIR COMMENT
By the Editor

Opportunity for Youth

THE Air Ministry announces a scheme of far-reaching import to the youth of this country. The scheme comprises the establishment of an Air Training Corps, special educational facilities, the formation of University air squadrons, and short University courses for air crew candidates. The Air Training Corps will consist of University air squadrons, squadrons and flights formed at schools, and units organised locally. It will give young men at schools and universities and those who have left, an opportunity to prepare themselves for service in the Royal Air Force or the Fleet Air Arm. Thus the scheme will greatly enlarge the field of selection for these services. Candidates of the required educational standard will be able to get a grounding in service subjects before they are tested. All boys of 16 and upward who are physically fit and desire to serve eventually in the Royal Air Force or the Fleet Air Arm will be eligible to join the Air Training Corps. Boys who are suitable for flying duties will carry out a syllabus like that of the initial training wing of the Royal Air Force, and special courses will be given to those who are suitable for mechanical and wireless trades. Grants to cover the cost of training will be made by the Air Ministry, but the Corps will depend for many of its amenities on local support. The post of Director of Pre-Entry Training at the Air Ministry has been filled by Mr. F. J. Wolfenden, headmaster of Uppingham School, who has been released by the trustees for a period of six months.

Officers Required

THE success of the scheme will depend on suitable officers coming forward to command and instruct units, and it is hoped that a sufficient number of men with previous Air Force or other service experience, and professional men in reserved occupations, including schoolmasters, will volunteer for the work. Those who are accepted will receive commissions in the R.A.F. Volunteer Reserve, and will wear R.A.F. uniform with a distinguishing badge. This Air Training Corps will be constituted as from February 1st, and units of the Cadet Corps may apply at any time to be approved by the Air Council as squadrons of the Air Training Corps. It is not the intention that the A.T.C. should supersede the organisations already engaged in giving pre-entry training for the other services.

Arrangements have been made for local education authorities to give instruction at Air Ministry expense in mathematics and English, for young men of 17½ and upward who are, in all other respects, suitable for air crew duties. After passing a selection board they will be attested into the R.A.F., but they will continue their civil occupation while they receive instruction. At the same time they will have an opportunity of undergoing the instruction in service subjects with the local Air Training Corps. It is estimated that there are in the country about 700,000 boys between the ages of 16 and 18 to whom the new scheme will be open. Many occupations are now reserved at the age of 18, and boys in these occupations might not, in many cases, be available for Air Force service. It is not, however, proposed to debar such boys from joining the Air Training Corps.

Opportunities for Engineers

THERE are other opportunities in the R.A.F. for technical officers for employment on engineering, armament and signal duties. Engineers must be holders of mechanical engineering degrees or mechanical engineering certificates, or they must be mechanical engineer members of an engineering institution and possess at least two years' practical engineering experience; or they must have served an apprenticeship followed by a number of years' experience in erecting or overhauling internal combustion engines or aeroplane structures, and possess a knowledge of engineering material.

Armament workers must be holders of engineering degrees or engineering certificates, or members of engineering institutions and possess at least two years' practical experience, particularly in connection with armament manufacture; or they must be practical engineers who have served an apprenticeship followed by a number of years of practical engineering experience, and with a knowledge of the properties of engineering materials.

Those who wish to undertake signal duties must be the holders of electrical engineering or science degrees, with experience of wireless, or holders of technical college or approved institution diplomas and two years' experience in tele-communications engineering, preferably on the radio side.

A number of posts is also available for candidates possessing a sound theoretical knowledge of elementary electricity and magnetism, of the principles of wireless telegraphic and telephonic communications and of transmitter circuits, modern wireless receiving apparatus and apparatus for the measurement of high-frequency potentials and currents. Some practical experience in addition is desirable, and specialised knowledge in one or more of the practical aspects of tele-communication would be an asset.

Commissions in the R.A.F.V.R. will be granted for the duration of hostilities to suitable applicants between the ages of 21 and 50 years possessing the requisite personal and technical qualifications. Candidates should apply, in writing, to the Air Ministry, S7(e)1, Adastral House, Kingsway, W.C.2, giving full particulars of their qualifications, training and experience.

Those who are engaged on the production of aircraft, engines, or accessories or on other important national work should not submit applications without first consulting their employers as to the possibility of their being spared for R.A.F. duty. Candidates who have previously applied are requested not to renew applications.

Colour Television for the Home

REPORTS have appeared recently of colour television demonstrations in the U.S.A. These appear to be of an experimental nature; only coloured lantern slides and coloured films have been radiated, the difficulty of sending studio scenes not having been overcome in that country. The pictures also are of a relatively low number of lines (343). The system they use appears to be on the same principle demonstrated to the press by Mr. Baird eighteen months ago.

Mr. Baird's new 600-line colour television system was recently shown in operation. A scene in an outdoor studio was transmitted to a receiving set in an adjoining house.

The transmitter is based on Mr. Baird's original spot-light system. It consists of a cathode-ray tube in front of which revolves a disc fitted with blue-green and red filters. After passing through the disc the light spot on the cathode ray tube is projected on to the scene to be transmitted by means of a lens. The person being transmitted is thus scanned by blue-green and red light beams in succession. The light from the coloured light spots traversing the scene operates three large photo electric cells.

At the receiver the transmitted pictures corresponding to blue, green and red are superimposed, as in the familiar colour printing process, to form a complete television picture in colour. Similar apparatus is used to that employed at the transmitter, the picture is first produced in black and white on a cathode-ray tube. In front of this is a colour disc similar to that at the transmitter and revolving exactly in step with it (this is achieved by controlling the motor driving the disc from an impulse incorporated in the transmitted picture). The black and white pictures, by passing through the colour disc, are coloured blue-green and red, and then projected on the screen by means of a lens. At the screen they blend to give a television picture in colours. The screen is 2ft. 6in. by 2ft. 0 in. (the largest screen ever produced for the home), and shows 600-line pictures (50 per cent more lines than used by the B.B.C.)

Photographic Reconnaissance

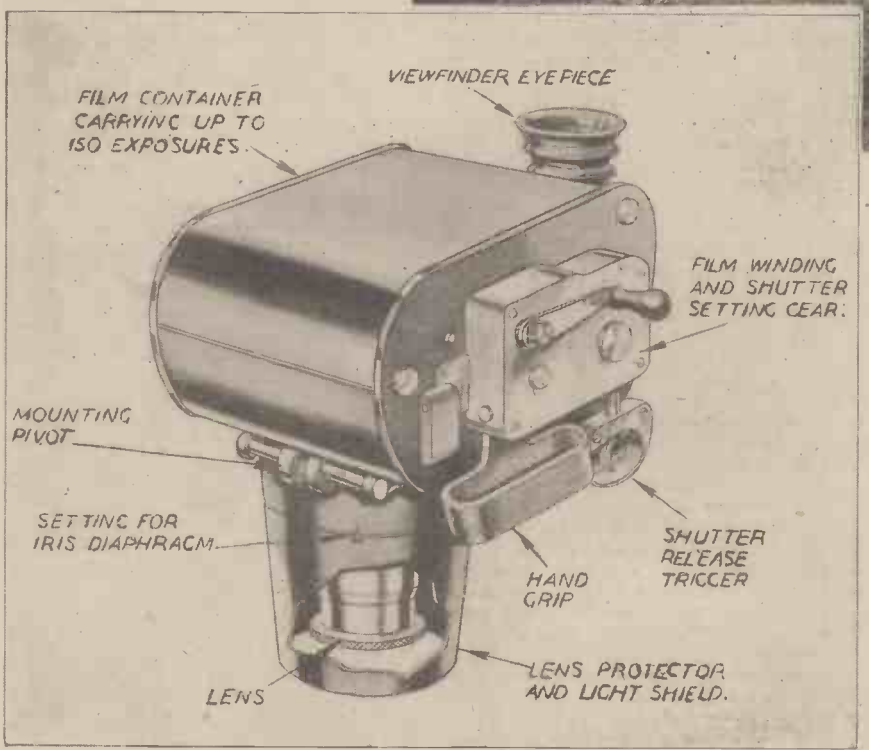
An aerial photographer at work, and (right) a typical photograph taken from the air.

AIR photography is an indispensable adjunct to air reconnaissance. Although the actual exposure of a plate or film is the first step in the production of an air photograph, it is by no means the only essential one. The various operations which precede and follow it call for a considerable degree of technical knowledge and skill, and are fraught with many different possibilities of failure.

The photographic personnel responsible for these technical operations receive their initial training at the R.A.F. School of Photography in Technical Training Command, and in order to pass the course successfully they must attain a high standard of knowledge and proficiency.

The value of an air photograph depends, first, on the amount of useful information which can be obtained from it, and, secondly, on the speed with which a finished print can be produced. The better the quality of the photograph, the easier and the more rapid and accurate is the work of the reader who extracts military information from it. But, however skilful and experienced the photographer may be, his work will be of little military value without speed in the production of the finished print.

Airmen photographers start with lectures on elementary photographic chemistry and elementary optics, and are then taught the correct use of various types of Service emulsions, Service developers, and air cameras.



Details of a hand camera as used for photographic reconnaissance work

Lens, Cones and Filters

Instruction is also given in the fitting of lens, cones and filters, exposure settings, and the loading and unloading of magazines. The subject of processing an air film is then explained, including rapid production methods, and this is followed by instruction in printing. Practical instruction is also given in the use of contact printers, enlargers and drying and glazing machines.

The course concludes with instruction in the use and maintenance of the camera gun, and of the photographic trailer, which is used as a mobile unit for the production of prints in the field.

As a result of this intensive training, the Service photographer can process a film and produce good photographs in the minimum of time. Frequently the success of a bombing raid will depend on the skill and accuracy with which a photograph of the military objective has been produced, for the longer a bombing crew can study the photographic details of the terrain in which

From The Air

The Remarkable Aerial Photographs which Appear in the Daily Press Require Special Skill and Apparatus, which is Here Described

Arranging photographs to form a mosaic.

the target lies the more effective is their sortie likely to be.

First Aerial Photograph

That aerial photography is not new is borne out by the fact that the first photograph of this type was taken by Nadar, of Paris, in 1858, who succeeded in photographing the ground from a balloon flying at a great height. How he achieved this remarkable feat, however, must appear something of a mystery nowadays, considering the crude instrument he must have used, with the added handicap of a "slow" lens, and plate of poor sensitivity. Then, again, a balloon was not an ideal craft from which to take photographs, as, at that time, they had an annoying tendency to rotate on their axis at the crucial moment.

When the American War of 1861-2 came, the art of aerial photography from a balloon had developed to such an extent that it was put to considerable practical use in the field.

With the advent of the aeroplane, photographers found their task considerably simplified for them, as the cameras and materials with which they were equipped solved most of the problems encountered by the early pioneers. The aeroplane, however, brought fresh difficulties to the aerial photographer, who now found he had to sit in an exposed and uncomfortable position in the plane with his camera balanced on his knee. And so modern aerial photography as we know it to-day has grown from these crude beginnings.

The importance of photographs in wartime when planes are on reconnaissance is obvious, as by this means we were able to photograph the whole of the Siegfried Line in the early part of the present war, and complete maps have also been made of uncharted tracts of country.

Pictorial diagram showing how each photograph overlaps a part of the view included in the previous one.

Map Making

Photographic maps are made by an aircraft flying over a given strip of country, and taking one exposure after another. When at the end of the strip, the plane turns and flies back at a predetermined distance from the side of the first strip already photographed. This procedure is repeated until the whole of the desired country has been photographed. This may seem quite a simple task to the average layman, but the difficulties and dangers encountered by the crew of the plane are considerable. In the first place the maps obtained from the photographs must be to scale, and the only way in which this may be accomplished is for the aircraft to be maintained on a straight course, fly constantly at the same height, and be kept on an even keel. Whilst taking photographs, the aeroplane is open to attack from enemy aircraft, and enemy gunfire must be ignored. That it is possible to fulfil all these requirements is proved by the fact that many valuable photographic maps have already been obtained by the R.A.F.

Developing and Printing

The aeroplane, having completed its reconnaissance over enemy territory, returns to its aerodrome and the camera is handed over for the films to be developed and printed. During the printing operation it is possible to make corrections to a certain extent caused by unavoidable inaccurate flying.

The job of the photographer who carries

An Observer taking photographs from the nose of the aircraft.

out the printing is simplified to a certain extent by instruments placed inside the aeroplane which register height, level, speed, etc., and as each exposure is made they are automatically photographed on the side of the film. In order that one photograph may become a check on the next, the photographic prints are made to overlap on the line of flight, and also at the sides of the strips.

Two compact cameras are carried by each aircraft, both of which are designed to work in most unfavourable conditions, and are virtually foolproof. One is completely automatic in operation, and the other is held in the hand, and pointed at the object to be photographed in the ordinary manner. The automatic camera carries a magazine large enough to give 125 exposures and capable of beng reloaded in the air in a few seconds.

Infra-Red Photography

One of the highlights of aerial photography is the use of infra-red methods. It is not proposed to deal with infra-red photography in this article, but a descriptive article on this subject appeared in "Practical Mechanics" dated June, 1934.

An immensely valuable application of the infra-red method is that apart from its remarkable power of revealing details at distances which ban the eye, it shows up camouflage with uncanny certainty. How it is able to do this is rather interesting. In an infra-red picture, real vegetation photographs a strange pale shade. This is due to chlorophyll, the green colouring matter of vegetation, which reflects infra-red light quite strongly. The green paint used for camouflage purposes, however, does *not* reflect infra-red to any great extent, and therefore it shows up quite distinctly in the photograph. Thus munition dumps, guns, etc., which are generally covered with painted canvas camouflage, whilst appearing quite innocent to the naked eye of the pilot, are instantly exposed by the infra-red aerial photograph. The aerial camera is also used for determining the extent of damage inflicted by bombing attacks, for in a fraction of a second it will record the extent of the damage, which would take the human observer many minutes to discover.

Night Photography

One of the latest developments in aerial camera work is night photography, where the camera is worked in conjunction with a parachute flare. The aeroplane, when approaching its intended mark, drops a "light bomb" which is automatically fired by the opening of its parachute. As the flare slowly descends, its light increases in intensity until its peak is reached which then operates a photo-electric cell attached to a camera in the plane flying above, and this in turn fires the shutter and takes a photograph of the illuminated scene below. The exposure is made at a twenty-fifth of a second with a lens aperture of f/3.5.

"Flying Dark Rooms"

Yet another interesting development in aerial photography is a machine designed for rapid reconnaissance work, known as a "flying dark room." The extensive equipment of these machines enables photographers not only to take pictures from the air but to develop and make prints from the negatives whilst the aeroplane is still in the air. Only four minutes elapse from the click of the camera to the production of a well-processed print. Another advantage of these flying studios is that the prints can be sealed in tubes and dropped direct to given objectives. Thus, photographs can be delivered without the pilot having to land for the purpose.

The Electrically-Controlled Camera

The setting of the electrically-controlled camera is governed by the amount of overlap required by each picture and also the speed of the aeroplane. The exposure is made automatically as and when required, whilst a special device comes into operation to wind the film after each exposure. Pictures can also be viewed stereoscopically, simply by taking two photographs of the same scene from different angles. The two photographs can then be viewed as one by placing them side by side and viewing them through a special optical system. In this way the contours of the ground can be made to stand out.

The neat and compact arrangement of the hand camera can be gathered by a glance at the illustration on page 164. The optical aiming sight or view-finder, can be seen at the top whilst the shutter release trigger is shown at the side to the right of the hand grip. The film container of the camera carries a spool of film capable of making 150 exposures and the film winding and shutter setting gear is shown above the hand grip.

Oblique and Vertical

Oblique and vertical are the two principal classes into which the photographs fall, the more generally used being the vertical or plan photographs. Details, however, which would appear invisible in the plan photograph, show up quite clearly in the oblique, especially if they are taken when the plane is flying at a low altitude. The altitudes at which plan photographs may be taken can be great or low, according to whether the information required is of a general or detailed nature.

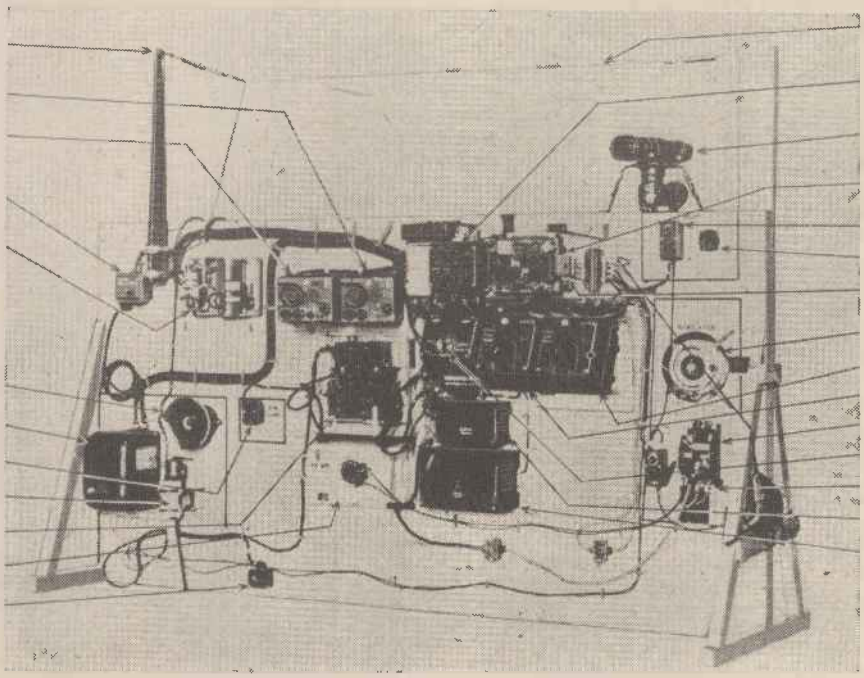
British and German Cameras Compared

I recently paid a visit to the R.A.F. Photographic Exhibition held in London, and was able to compare the R.A.F. standard F.24 aircraft camera, weighing approximately 28 lb., with interchangeable lens cones of 3½ in., 5 in., 8 in., 14 in., or 20 in. lenses, with its German counterpart, the cumbersome 12 in. by 12 in. camera with a fixed 20 in. lens, weighing approximately 168 lb. The F.24, with a separate mounting, as used for oblique photography, was also on view. I was also able to compare the standard R.A.F. camera and the German 7 in. by 7 in. camera. Other exhibits included a G.28 camera gun used for training observers in air gunnery, and a R.A.F. 16 mm. cine-camera gun—the standard type fitted to certain fighter aircraft for recording combats.

How camouflage is revealed by stereoscopic examination.

NAZI WARPLANE RADIO

Impressions of a Member of the Staff of "Practical Wireless" who Recently Examined the Equipment of several German Planes which have been Brought Down in this Country



This illustration shows the instruments used on the Heinkel bomber, mounted on a board for easy reference.

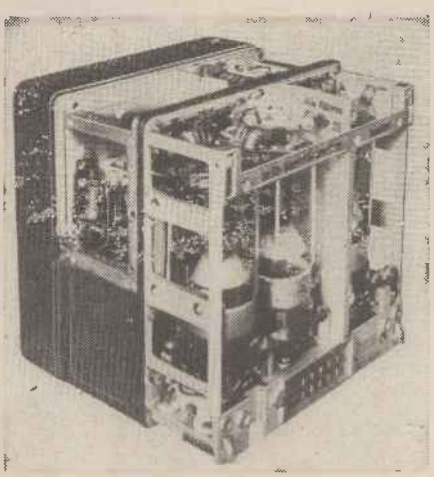
TECHNICALLY sound, but not advanced; laboriously made; very easy to service and repair; the Germans can teach us very little about warplane radio. Those are the impressions which first occurred to me when I was recently privileged to see at close range the radio outfits of a number of Nazi planes of various types which have been brought down over this country. The equipment—and planes—was on private view to a few members of the Press at a well-known experimental station of the Royal Air Force.

Before describing the radio equipment in any detail, it will be of interest to readers that there were no less than seven German planes in excellent condition at the station visited; many of them had been flown by members of the R.A.F. for experimental purposes. My first inquiry concerned the method in which some of these planes could have been brought down, for them to have sustained so little damage. Well, one of them had actually been *landed by the pilot* who was apparently under the impression that he was on French soil. Another, a yellow-nosed Messerschmitt 109, was in rather worse condition since the undercarriage had been broken away. Additionally, there were bullet holes in the propeller, wings and engine cowling; nevertheless, its condition was quite good.

Twin Receivers and Transmitters

Later, I clambered into a Heinkel 111, a Messerschmitt 110, and several other German planes which were almost "as new"; in most cases the makers' date stamp showed that the planes had been built during the past few months.

With so many items of interest, it was rather difficult to concentrate on the radio equipment alone, although that was in itself extremely interesting. It is not easy to decide at what point to start a description, for there are so many units involved, as may be gathered from an inspection of the accompanying illustration of a complete bomber outfit mounted on a board for demonstration purposes. Primarily, there are two receivers and two transmitters—short-wave and long-wave in each. The terms used in reference to the wavebands may be rather misleading until it is pointed out that the bands are from 3 to 6 megacycles and 300 to 600 kilocycles respectively. These are, of course, equivalent to wavelength ranges of 100 metres to 50 metres, and 1,000 metres to 500 metres.



A view of the transmitter with the cover off.

Laringaphones

In addition, there is an "intercom" amplifier, which is used for communication between the pilot and crew of the machine. This intercommunication is, of course, by telephony, but microphones, as they are usually understood, are not employed; instead, the crew use "laringaphones" or throat microphones. These are in pairs, fitted in the flying helmet, and press lightly against the sides of the "Adam's apple." In our own warplanes, high-grade microphones are employed universally, and these have proved to be superior to the larynx microphones, although the latter are not so bad for the guttural speech of the Germans.

D. F. and B. A.

In addition to the two transmitters and receivers, and the amplifier just mentioned, the Nazi bombers have a direction-finding receiver and a blind-approach receiver. The B.A. equipment operates on a waveband of 28.5 to 35 Mc/s and is on a modified Lorenz principle, where two beamed transmissions are used; one sends A's (. —) and the other N's (— .) and when the machine is on its correct course the two sets of code symbols "link up" to produce a steady "burr."

Power Supply

The direction-finding loop is unusual in that it more closely resembles a long, oval tuning coil and is under 6 in. in major diameter. This is mounted inside the fuselage and can be controlled by the navigator who has a large compass with which the loop control is combined. When direction-finding, the navigator's job is to turn the loop until a fixed and moving scale on the compass correspond.

Power supply is taken from a 24-volt

accumulator which, as my guide explained, is constantly overloaded in the same manner that most car batteries are overworked. Charging is by means of a generator and H.T. is supplied by a rotary converter. Besides the main items of equipment which have been referred to, there are all kinds of switching and aerial control arrangements; it is obvious that extreme care is taken to ensure correct matching between whichever aerial is in use and the receiver or transmitter, and for this reason there are several intricate matching or aerial control boxes.

The receiver with the covers off, showing the tuning control.

There are two main aerials in addition to the D. F. loop, one of these being of the trailing kind and consisting of a coil of wire on a winch, and the other the small elevated aerial mounted on top of the fuselage. For use in conjunction with the aerials there is a multiple-way switch, which also serves to bring into use long- or short-wave receiver or transmitter.

After looking over the equipment in general, both on the demonstration board and in a number of planes it was possible to examine some of the apparatus in greater detail by taking it apart. It was interesting to note that there was no shortage of German receivers and transmitters, which indicated that they had been recovered more or less intact from a large number of machines. On the bombers, the bulk of the equipment was seen to be mounted on a large and heavy bulkhead in front of which the wireless operator sits. Parts stowed away in the fuselage were the D. F. receiver, aerial-control units, generator and rotary converter.

Alloy Die-castings

Each of the units could easily be removed from the rack after turning a couple of spring-loaded catches, whilst similar quick arrangements were provided for dismantling the units. When the case had been removed it was at once evident that the units were extremely well made—in fact, they were an instrument-maker's job. Pressings and stampings which are familiar to us were replaced by beautiful magnesium-alloy die-castings. It would appear that the equipment throughout is very costly to produce—far more so than ours. Despite this, however, it is slightly less efficient than that fitted to our own planes, and which it would seem, can be made in a fraction of the time. What is more, ours has proved to be every bit as reliable—perhaps more so, since there are fewer rubbing contacts.

Interchangeable Valves

The main receivers are superhets, the other two being simple "straight" R.F. jobs. One point which is not without interest is that every valve in the superhets is of precisely the same type; all are H.F. pentodes, and can be interchanged. These valves are very compact and not unlike "acorns." They have a moulded base with side-pin contacts and a top cap. The holders are "inverted" so that the valves are pressed into place with the top cap downward; contact is made with it by means of a spring. Once a valve is in its holder it is completely enclosed and cannot be removed without a separate knob, which is screwed into a tapped hole in the centre of the base. The advantage of this is that there is never any pull on the glass envelope—the base takes the whole strain imposed by removal.

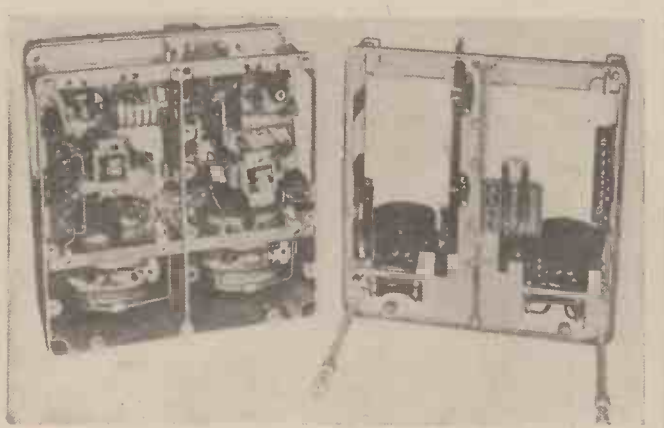
Convenient Servicing

Each unit is itself built up from separate units consisting of die-castings, so that a complete receiver or transmitter can be dismantled for service in a few seconds. The receiver tuning controls can be set to one of four "spot" positions, into which they "click," whilst the frequency at each can be checked and, if necessary set, by making use of the transmitter as a beat oscillator. The arrangement is neat and, apparently perfectly reliable. At the same time the many "gadgets" fitted are not necessarily essentials, but are of the kind that have a strong appeal to the Nazi mind.

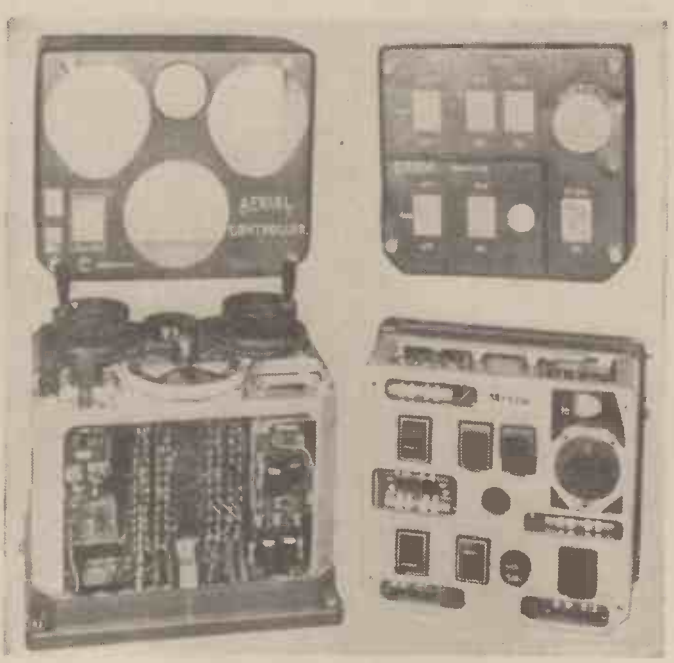
A transmitting set found in a rubber dinghy from a German bomber which crashed into the sea. It has a kite aerial, and one of the "umbrella" type. It is used to send out S O S

Total Weight 358½ lb.

In spite of the wide use of light alloys, the complete radio equipment of a German



Showing the transmitter dissected.



Aerial controller, and I/C controller

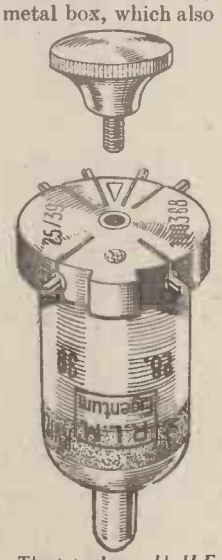
bomber weighs 358½ lb. The technicians attached to the R.A.F. and who were good enough to answer all my questions—or as many as I could think of in the time at my disposal—explained that, in their research into these German radio outfits, they have drawn the conclusion that, despite their excellence in many directions, they have apparently been designed by ground engineers rather than by technicians who have specialised in aeroplane radio. They have formed the genuine opinion, after months of careful research, that there is very little which they can learn from German radio designers.

No Secrets

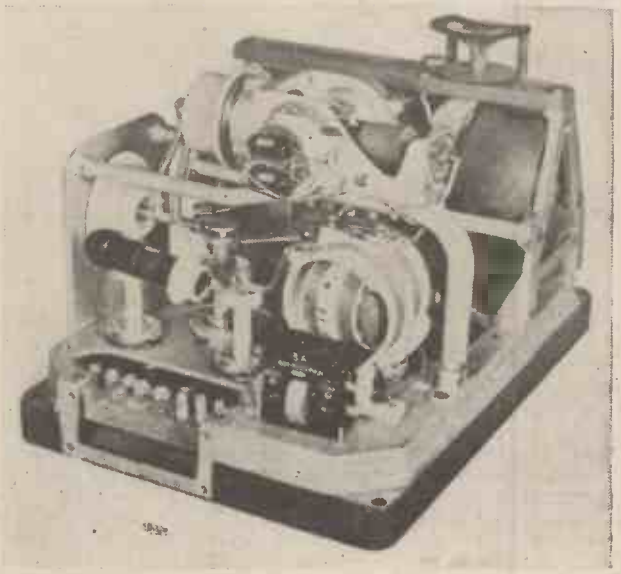
The German Luftwaffe certainly have no radio secrets which they have so far been able to withhold from the Research Department of the Ministry of Aircraft Production. This Department have prepared complete dossiers which give every possible detail of Nazi Luftwaffe radio; these extend to several thousands of words and include dozens of photographs (a few of which we are able to reproduce) and many blueprints giving circuit details, valve characteristics and constructional data right down to the last screw. I saw a sheaf of these documents, and although they bore "Secret" imprints in red letters, I was able to take a few cautious peeps at some of them. From this it is evident that they know as much about the Nazi warplane radio as they do about our own! These documents pay tribute to the vast amount of painstaking work carried out by the research engineers. Another point which was obvious from a chat with one or two of these gentlemen was that they were thoroughly engrossed in their work, and absolutely determined that "Goering's boys" should not have the slightest chance to steal a march on them.

Automatic S O S

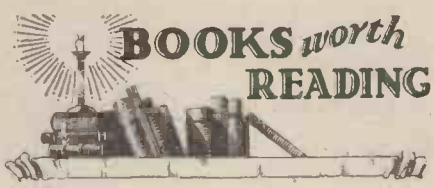
Quite apart from the standard radio equipment of the German bombers (and it might be mentioned that the fighters carry much simpler though otherwise similar radio equipment, without D.F. and B.A. systems) I was impressed in another transmitter which had been salvaged from a German machine. This was a bulky automatic S O S transmitter contained in a metal box, which also holds the necessary batteries. There is also provision for fitting a vertical "umbrella" aerial or a kite aerial. Apparently this outfit is for the use of air crews who have to take to their well-known rubber dinghies. When they erect the aerial and switch on, a motor operates a keying system so that a string of morse S O S signals is sent out. Only one of these rather awkward-looking pieces of gear has so far been found, so it is assumed that it is carried only when there is a "big wig" on board. From appearances it seems likely that the aerial would tend to upset the boat rather than save its occupants!



The interchangeable H.F. pentode, showing the moulded base, contact pins and locking screw.



Top view of the aerial tuning unit.



"Machine Design Drawing Room Problems." By C. D. Albert, M.E. Published by Chapman and Hall. 440 pages. Price 21s. net.

THIS practical book covers the complete material for a drawing-room course in general machine design, and is based on the belief in the superior value of complete comprehensive problems over those dealing with unrelated details or groups of details. It presupposes a knowledge of kinematics, mechanics, and engineering drawing. As an indication of the comprehensive character of the work, it may be mentioned that the subjects covered in its twenty-three chapters include Flanged Shaft Couplings; Strength and Stiffness of Shafts; Helical Spur Reducing Gears; Air-operated Arbor Press; Pump Problems; Balancing Problems; Engineering Materials; Worm Gearing; Tolerances and Allowances; and Screw Threads. The book is illustrated with clear-cut diagrams and photographs, and there is also a full index.

"Radio-Frequency Measurements By Bridge and Resonance Methods." By L. Hartshorn, D.Sc., A.R.C.S., D.I.C. Published by Chapman and Hall, 266 pages. Price 21s. net.

THE progress made in the realm of electrical engineering during the twentieth century has been amazing, and during the last few years the allied sciences of high frequency and electrical communications technique have moved forward with such gigantic strides that it is not very surprising that the electrical engineer whose college days are some years behind him finds it absolutely essential to devote a considerable amount of time to reading to keep his knowledge abreast of modern developments. Unfortunately, however, the comprehensive and voluminous literature covering the revolutionary advances which have been made is so scattered that the student or engineer had to waste, so to speak, much valuable time on intensive literary research. So far as Radio-Frequency Measurements are concerned, this unsatisfactory procedure no longer applies, as the author of this most comprehensive work has succeeded to the full in presenting, not an encyclopædic account of everything that has been written on the subject, but a systematic account of the basic principles and general working ideas that form the tools of the practising technician. To give an idea of the scope of the book it may be mentioned that included amongst the subjects covered in its twelve chapters are Impedance and Related Quantities; General Principles of Screening and Radio-Frequency Bridge; Generators; Standards of Capacitance; Standard Inductors; Resistance, Power Factor, Decrement by Resonance Methods; and Bridge Methods. This useful book which is illustrated with numerous diagrams also includes a full index.

"All the Photo-Tricks." By Edwin Smith. Published by The Focal Press. 276 pages. Price 10s. 6d. net.

ALL amateur photographers with a leaning towards trick photography will find this book interesting reading. The purposes of camera trickery are few and simple, and for the imaginative photographer, and others who resent the camera's too slavish dependence on common place reality, the formulas included in the book will more than amuse. Amongst the great variety of subjects dealt with are Shutter Tricks: Distortion; Shading and Spot Printing; Masking; Mirror Tricks; Doubling; Photomontage; Screens; Transparencies; and Table Top Photography. The book is profusely illustrated with half-tones, and many of the methods described in the text are also explained with the aid of line diagrams.

"The R.A.F. in Pictures." 5s. net. 97 pages. Fully illustrated. Published by Country Life, Ltd., and obtainable from Country Life, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

"THE R.A.F. In Pictures" (including aircraft of the Fleet Air Arm) has been prepared by Major Oliver Stewart, who is the Editor of *Aeronautics*, himself a pilot of great experience, which he has used in preparation of this handsome illustrated volume—a veritable pictorial pageant of our aerial fighting forces. Here you will find illustrations and easily assimilated facts about all our aircraft, and the half-tone plates alone make the book remarkable value for money. As a historical record, it is worth more than twice its price. We recommend every reader to purchase a copy, especially aircraft spotters and those interested in the R.A.F. Training and Cadet Schools. It costs 5s. 6d. by post.

TECHNICAL

Loose sand in the vicinity of a desert fort, seen in the background with its watch tower; this is "En Nofilia."

This country is very much in the news at the present time, and the difficulties encountered by our mechanised forces are described by our special correspondent who carried out a motoring tour through this desert country.

"MILES and miles of damn all" is a graphic phrase—not original, perhaps—which very aptly sums up Libya, that vast tract of country sandwiched between the Sahara and Egypt into which our troops are now penetrating. I had occasion to travel through it a few years back, and the names of places now figuring in the news recall vividly the struggles with which I and my party manhandled a car and caravan from Tripoli to Sollum.

In the days of which I speak, Mussolini's autostrada was in an embryo stage; parts were completed, but the majority of the 1,100 miles lay over desert "piste" which was either sandy or rocky by nature—if sandy it was loose and crumbly when dry and slippery as a skating rink when wet, while if rocky it was so appallingly bumpy that it was a marvel the outfit did not shake itself to pieces.

We had embarked upon the trip in the first place as a means of delivering the car and caravan by road to the Cairo Motor show, and we chose the route through Libya as an alternative to the orthodox way across Europe to Istanbul and then via Turkey in Asia and Syria. It seemed likely to be a more pleasant route, but we reckoned without the dreadful state of the "piste," and spent a good part of our time either digging ourselves out of the sand or repairing the towbar of the caravan, which broke itself in a variety of places, and was more than once patched up with the aid of mechanics of the Italian Air Force.

Oh, yes, the Italians were quite interested in our journey. We had to obtain special permission before we could enter Libya, but once having secured this, the authorities there proved reasonably co-operative, although I now realise that what we took for friendly supervision was probably more in the nature of police surveillance. For instance, the local commanders often insisted on our taking a guide they provided—we thought they were anxious we should not lose our way and suffer inconvenience, but perhaps the real reason was that we might possibly have stumbled on something we should not see. Again, if we did not arrive at the next outpost within a normal time they would send out a search party to ascertain our location.

El Pisida

We entered Libya from Tunisia at the frontier station of El Pisida, where the officials showed a most embarrassing interest in our ancestry. They wanted to know the surnames of our maternal grandparents, for example, and also our exact occupations. One member of our party worked in the service department of a motor factory, where he was a receptionist. His exact occupation was, therefore, a "service receptionist," but a ten-minute struggle to get this over in a foreign language failed hopelessly, and our friend was reduced in status to "mechanic."

After this inquisition it was nearly midnight before we reached Tripoli, and I always remember the strange feeling of entering the huge hotel there and finding we were the only guests; also that there was a Casino on the premises, open for business, but without any patrons. We got accustomed to this sort of thing after a time: Tripoli was being built up by the Italians as a tourist resort to compete with places in French North Africa like Tunis, Biskra and Algiers—but the tourist trade hadn't "caught on."

The first hundred miles into Libya from Tripoli was over decent road, and took us through Leptis Magna, where there are the remains of a most magnificent Roman city. Very creditable excavation work has here revealed an amazing relic of the days of Rome's real glory: columns of solid marble; sculpture marvellous in its delicacy and grandeur; an enormous forum; a succession of baths, walls and gateways—to say nothing of buildings—constructed of such huge blocks of marble and stone that one cannot imagine how on earth they could possibly have been placed in position with primitive tackle.

"Albergo Municipale"

Misurata was the first town of any importance after leaving Tripoli, and here we had further experience of an hotel

Typifying the surveillance of the Italian authorities over visitors to Libya; the officers are inspecting passports—a procedure which became monotonously regular during the journey through this territory. The natives on right are working on the autostrada in construction between Tobruk and Derna

PROBLEMS OF THE LIBYAN DESERT

without visitors. The "Albergo Municipale," as it was called, was an imposing edifice which would house perhaps a hundred guests, but we had the impression that we were the first for weeks. Mind you, there were lots of officers and officials about, but as for genuine civilians or visitors—none. Even the hot water in the imposing bathrooms arrived there only through the efforts of an Arab porter, who toiled upstairs with large cans of it. "No fuel," we were told, and we began to realise what an artificial place is this Libya, to which has to be brought from across the sea practically everything that is consumed in it.

More and more did we appreciate this fact as, on succeeding days, we left the civilised part of Tripolitania behind us and headed for Libya's second largest town—Benghasi. Here, perhaps, I might mention that Libya consists of two provinces: Tripolitania and Cyrenaica. Of the former,

The town of Derna is walled, and the iron gates are closely guarded.

Typical terrain in the Libyan desert.

Tripoli is, of course, the capital, while Benghasi is the only place of any real size in the eastern province. All the other towns—or perhaps I should say "place names"—one hears of and reads about are more or less nothing but military fortified zones with a sprinkling of civilian inhabitants—and these civilians are mostly all connected in some way or other with officialdom or the fighting services.

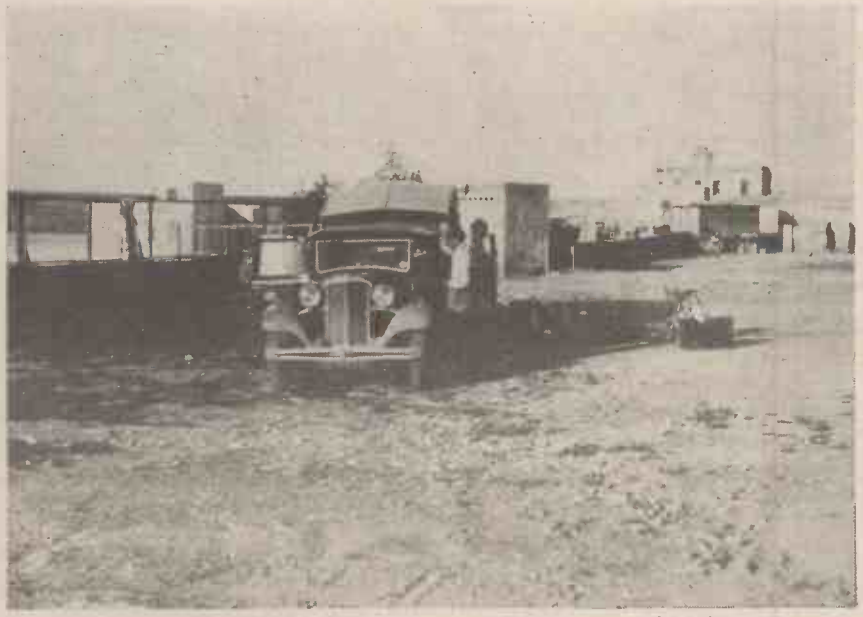
The Barren Fringe

I will quote from my diary of our journey from Misurata to Sirte, the next point of so-called civilisation on our route: "During the whole day's run of 170 miles we passed but two points of habitation—both of them desert forts. We met four vehicles during the run, and they were apparently military transport except one, a mail coach which runs to Tripoli twice a week. The countryside was barren beyond all belief—the fringe of the Libyan desert, stretching as far as the eye could reach, covered with scrubby bush save at isolated places where apparently a trace of moisture permitted a patch of verdure to grow."

At Sirte we were accommodated in the officers' mess, as there was no hotel then, although I understand that one has since been built. Sirte was almost entirely a military post, with a few civilians keeping small shops—stores and cafés—and a not inconsiderable number of Arabs. Except that Sirte was bigger and apparently more important than the other outposts we passed through, it was typical of Mussolini's Libyan colonisation. Barracks, town hall, "garda civile" building, a square for ceremonial parades, and a collection of nondescript houses used for billets, cafés, etc.—these constituted a formula for all such townships, dotted at sparse intervals along this barren sea coast.

Carpet of Flowers

After leaving Sirte, on the road to Benghasi, the "piste" or track (the strada had not then been started on in this lonely section of desert) followed the sea-coast, and I find my diary records that "the country-



Tobruk is an important seaport and has always been a place where visitors are regarded with suspicion. During an overnight stay there, the British motorists were more or less "confined" in the compound illustrated above, with sentries at the gate.

side along this narrow strip edging the sea was really beautiful, carpeted with wild flowers of every description: indeed, it resembled nothing so much as an English meadow in midsummer. Yellow, white, mauve, pink and blue flowers grew in profusion; the sun blazed down with a grilling heat, and under it our complexions —already tanned—assumed a definitely beetroot hue." (The time of year was early February.)

As we neared El Agheila, however, some 175 miles from Sirte, a marked change in the scenery occurred. Great stretches of open sandy beach were encountered, across which there was no guide save occasional wheel tracks, and navigation by compass was essential, since the sea coast could not be clearly traced owing to the presence of salt marshes covering vast areas between us and the Mediterranean proper. Luckily, the Italian authorities had given us a set of excellent maps, traced from (I imagine) their original military surveys. Without these, and our compass, we should have been in a plight, for on this stage there was no sign of human life, or landmarks of any description.

Fort of En Nofilia

Eventually we reached the desert fortlet of En Nofilia, a real "Beau Gueste" affair surrounded by barbed wire entanglements (we heard that the native Arabs were always itching to take a crack at the Italians, and from what one has since learned of the methods employed in subjugating the Libyan tribes, there is no wonder at that). We stayed the night at this fortlet, where the commandant gave us quarters in the officers' mess and, as at other places where we stopped overnight in the desert, we received extremely hospitable treatment. Incidentally, at En Nofilia there was a native camel regiment encamped.

Water Supplies

Similar conditions prevailed on the remainder of the run via El Agheila and Agedabia to Benghasi. The last-named is about 750 miles east of Tripoli, and if there is any real practical value in almost the whole of that ribbon of coastline—that is, outside of military and political strategy—it is not easy to see what it can be. Water supplies are few and far between, and are not only inadequate in quantity, but seldom safe for drinking by Europeans. There is no "hinterland" of any value. for the desert reaches right to the seashore and stretches inland for hundreds of arid miles. Compared with Libya, the Sahara is fertile!

One of the things that struck me as curious before we started out on our trip through Libya was that it seemed impossible to obtain any reliable information as to road conditions prevailing at the time. The answer, I found, lay in the fact that there is so little traffic that even the automobile clubs in Rome and Tripoli were unable to supply data. In the course of our journey we travelled for three consecutive days on the coast around the Bay of Sirte, between Sirte and Agedabia, without seeing a vehicle or even a habitation other than the desert forts. Communication between Tripoli and the eastern province of Cyrenaica appeared to be entirely maintained by sea across the Bay of Sirte—which, in point of fact, is much the shortest route.

Conditions in Cyrenaica are more civilised than those just described. For one thing, the country becomes hilly and, in places, quite fertile. Indeed, in Roman times there was much cultivation around Cirene and great quantities of wheat and corn were grown and shipped to the mother country. Water supplies are good at this place, and I always remember our overnight stay at Cirene on account of the delicious spring water that abounded there. In the vicinity of this small town, which is by way of being a local health resort, there are evidences of three distinct civilisations—those of the Byzantines, the Greeks and the Romans. As we drove away from Cirene on the road to Derna we saw ancient columns sticking out of the ground, scattered over an enormous area of the surrounding country.

Sub-Tropical Derna

Derna, our next stopping place, appeared to be of considerable importance. We reached here on a Sunday morning, and were received by quite an imposing group of officials, including the Governor of Cyrenaica, and his wife. Admittance to the town, which is completely walled round, was only gained after we had been scrutinised by sentries and reported to the military headquarters by telephone. We were taken to the Commandant, whose house impressed us very favourably: my diary records "his balcony looked out on one of the most charming vistas we have seen in Libya. The blue Mediterranean curved round the headland to the west; the white flat-roofed houses of the town glowed dazzingly in the brilliant sunlight; the tall mountain range from which we had just descended (and which we were about to re-mount) stretched away to our right. Beneath us in the garden were groves of palm trees and banana plants (Derna produces a particular type of banana, short and stubby but very succulent), and bright sub-tropical plants were in full bloom. We should have liked to stay longer in Derna."

However, we had to push on, as we were then behind schedule, and my notes record that the climb out of Derna on the road towards Tobruk was so steep and twisty that our car's bottom gear was brought into action for its first serious work on the trip. On the plateau above, there was much muddy swamp to negotiate (the strada was under construction hereabouts, but not yet available), and I have recollections of the ferocious mosquitoes which plagued us as we unbogged the car and caravan on several occasions. February is a rainy season in these parts, and the sandy clay which composes the terrain becomes boggy and intensely slippery in the wet weather. More than once we were out of control through the car failing to follow the front wheels on a turn, due to this.

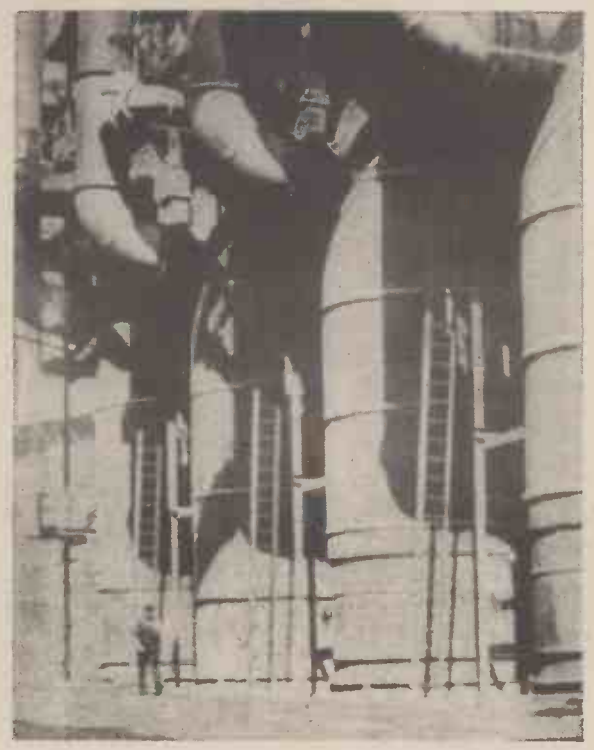
Stony ground in the eastern section of Libya—the province of Cyrenaica.

A section of Mussolini's strada in the neighbourhood of Cirene.

Tobruk

Tobruk we disliked very much. It was a depressing sort of place, and the Italians here were far less friendly than elsewhere on our journey. We were hauled off to the military commandant immediately on arrival, and then were more or less isolated in a sort of compound overnight, having to sleep in the car and caravan—which we were never too keen to do, since we had the latter packed up with baggage and supplies. Our passports were taken away, too, and only returned when we were ready for departure next morning. Tobruk gave us the impression of feverish military activity which strangers were not intended to see.

There was little of interest on the remainder of the run, through Bardia, Solloum, Sidi Barrani and Mersa Matruh to Alexandria, and then on to Cairo. Sand and gaunt rocky hills are my outstanding recollections of the last stretch of Libya and the Western Desert of Egypt; I remember thinking that fighting a war over it would be about the only thing it would be useful for!



Explosives From The Air

The Modern Process of Nitrogen Extraction from the Atmosphere, the Basis of Present-day Mass-scale Explosives Production

This illustration gives a good idea of the huge proportions of the absorption towers in a British synthetic ammonia factory.

ALL useful explosives, from gunpowder to T.N.T., contain nitrogen. This element, which makes up about 78 per cent. by volume of the earth's atmosphere, and which in its ordinary gaseous form is so seemingly inert and harmless, is, strangely enough, when chemically combined in certain compounds, able to give rise to disruptive effects of a stupendous kind. Nitrogen is a solitary element in its gaseous or atmospheric condition, not showing any great inclination to enter into association with other elements to form compounds. And even when, by devious means, nitrogen is induced to enter into chemical combination, it still retains its characteristic antipathy to association with other elements. Hence it is that many nitrogen compounds are exceedingly unstable ones, their nitrogen atoms being always ready to rush apart with explosive energy whenever the material is subjected to a sudden shock.

Here we have the inner meaning of the modern explosive. Such a material is essentially a nitrogen compound which has been produced by treating an otherwise perfectly stable material with nitric acid. Nitro-glycerine, for example, the basic constituent of cordite and dynamite, is made by treating glycerine with nitric acid, whereby the nitrogen of the nitric acid becomes associated with the glycerine, converting the latter innocuous compound into a highly unstable and violently explosive substance.

Trinitrotoluene

Similarly, when toluene, which is a benzine-like liquid obtained from the distillation of coal, is treated with nitric acid, we obtain trinitrotoluene—T.N.T. And when phenol or carbolic acid is treated with nitric acid, trinitrophenol eventually results, which material (better known as picric acid) constitutes the explosives, "lyddite," "melinite" and "shimose."

Since all these modern explosive materials must be produced by the action of nitric acid on their parent substances, and since even gunpowder contains potassium nitrate (a salt of nitric acid) as an essential ingredient, it follows that modern explosives production must necessarily be based upon an adequate supply of nitric acid. Indeed, nitric acid is as essential to the modern warfaring nation as its tanks and aeroplanes, for without an adequate supply of this source of nitrogen, there could be no explosives manufacture.

In olden times, when men fought with gunpowder, the necessary potassium nitrate or saltpetre was extracted from compost and manure heaps. It is said that Napoleon ransacked France for supplies of this nature.

Later on in the last century, after the great nitrate explosives had begun to be discovered, the nitric acid necessary for their manufacture was obtained by distilling "Chili saltpetre" with sulphuric acid. Now "Chili saltpetre" is an impure form of sodium nitrate which is obtained from vast natural deposits in Chili. Prior to the Great War of 1914-18, the Chilean Government made a good thing out of exporting its natural nitrates to Britain, France and Germany alike. When the latter war came, Germany at once found her nitrate supplies cut off by the British blockade.

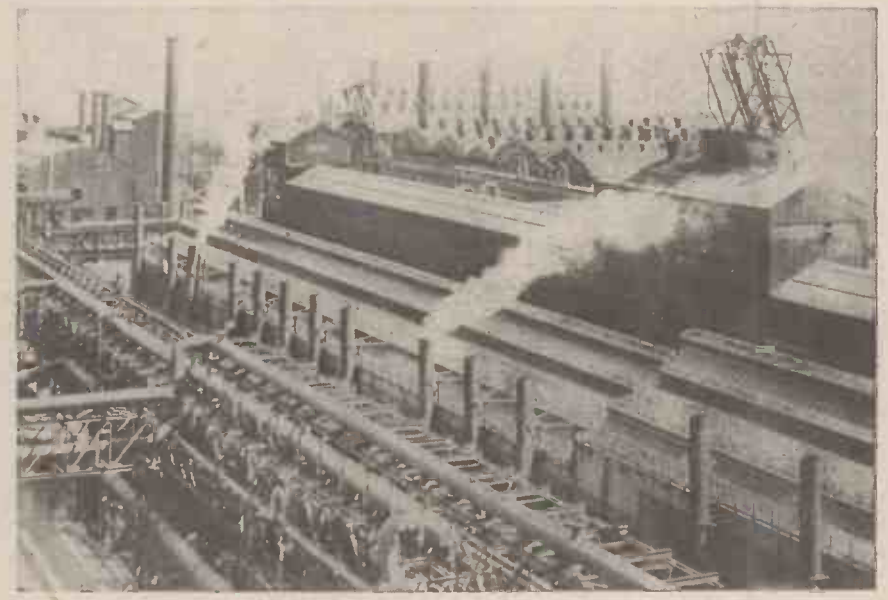
Nitrogen from the Atmosphere

The German Government, however, had previously envisaged this cessation of nitrate supplies, for a year or two before Germany so ruthlessly marched across Belgium, its chemical technicians had developed a foolproof means of extracting nitrogen from the earth's atmosphere, and of turning it into nitric acid.

After the outbreak of the Great War, Germany redoubled her efforts in this direction and successfully made herself independent of overseas supplies of the essential nitrates.

In England, a similar trend of technical development took place, and although Germany gave us the lead in the matter of synthetic nitric acid production for explosives manufacture, we very soon caught up to her. In the present war, all the belligerent Powers are independent of natural nitrates for their supplies of nitric acid for explosives manufacture, they being able to extract an unlimited supply of nitrogen from the air for this purpose by means of their large-scale synthetic plants.

Air, as we all know, is essentially a mixture of oxygen and nitrogen, containing, by volume, approximately 20 per cent. of oxygen and 78 per cent. of nitrogen. There are, in the atmosphere, something like 4,000 billion tons of free nitrogen. Every



A water-gas plant in a synthetic ammonia and nitric acid factory.

square yard of the earth's surface has about seven tons of nitrogen lying over it. Hence, as a raw material for nitric acid manufacture, nitrogen is available to all nations in almost illimitable amounts.

Previous to the introduction of the modern methods of atmospheric nitrogen extraction, it had long been known that, when an electric spark is passed through air, some of the oxygen and nitrogen combine together to form a gas known as "nitric oxide," and that this gas is capable of taking up more oxygen with the production of another gas, "nitrogen peroxide," which latter combines with water to form nitric acid.

Every time a lightning discharge plays about the atmosphere, considerable quantities of nitric acid are brought into being, this acid slowly descending to the ground and giving rise to nitrates, which act as fertilisers to the soil.

The modern extraction of nitrogen from the air is merely, in one of its forms, an imitation of Nature's creation of nitric acid by lightning discharges. In such processes a current of hot air, driven at the rate of 3,000 feet per minute by means of a centrifugal blower, is driven into a special cylindrical furnace lined with firebrick enclosed in a metal casing. In this enclosure are situated two hollow copper electrodes having cooling water circulating within them. These electrodes are placed at a distance of between a third and half an inch apart. They are situated in the centre of the field of a very powerful electro-magnet, which spreads or fans out the electric arc between the electrodes into a great roaring disc of flame some 6 feet in diameter.

Through this high-temperature flame the hot air is driven and, although the air is only in contact with the arc flame for a small fraction of a second, this interval of time is sufficient to allow of the combination of a substantial proportion of the oxygen and nitrogen of the air to form the gas nitric oxide :—

$$N + O = NO$$

(Nitrogen) (Oxygen) (Nitric Oxide)

An alternating current of 3,000-5,000 volts feeds the flame arc, and an approximate conversion of 1 per cent. of the air to nitric oxide is obtained.

The hot gases from the arc chamber are allowed to cool down somewhat, and then they are passed into a "reaction tank" of sheet iron enamelled on its inner side. Here some of the nitric oxide combines with more oxygen to form nitrogen peroxide :—

$$2NO + O_2 = 2NO_2$$

(Nitric oxide) (Oxygen) (Nitrogen peroxide)

From this reaction tank, the gases are then made to ascend a brickwork tower filled with silica and coke, down which a slow stream of water (or, in practice, dilute nitric acid) is made to flow. The nitrogen peroxide dissolves in the water, forming a mixture of nitric and nitrous acids, which solution, when further oxidised, is transformed completely into pure nitric acid.

Modifications

There are several modifications of the above process available for the production of nitric acid from the air, but the big snag about them all is that they require enormous amounts of electric power. Before the Great War, there were several large nitric acid plants of the above type operating in Norway, where water-derived electric power is abundant and cheap. The Germans made many efforts to run such plants but without lasting success, for Germany, as a whole, is not very well supplied with hydro-electric resources.

Previous to the Great War it looked as though only regions such as Norway and Canada, where water power for the production of electrical energy is abundant, would be able to operate "oxidation" installations of the above nature. However, mainly through the genius of Dr. Fritz Haber (whom Germany, after the Nazi's ascent to power, treated shamelessly and with colossal and characteristic ingratitude), the Huns in the Great War were able to make themselves independent

Small scale lightning produced by passing an electric spark between two conductors in an enclosed space. Small amounts of nitric acid are produced as a result of this action.

of outside nitrate supplies for their manufacture of nitric acid.

Haber Process

Haber's idea was to combine nitrogen and hydrogen to produce ammonia, which latter (quite apart from its use as a fertilising agent) could be oxidised to nitric acid.

Haber obtained his hydrogen from "water gas," a mixture of carbon monoxide and hydrogen obtained by blowing superheated steam over red-hot coke. The nitrogen he obtained by liquefying air and distilling off the pure nitrogen gas. Then the nitrogen and the hydrogen gases, mixed in the proportions of one to three respectively, were compressed to about two hundred atmospheres' pressure and heated to a high temperature. In this heated and compressed condition they were passed over finely divided metallic uranium, which metal, acting as a chemical "catalyst," or active agent, caused a proportion of the nitrogen and the hydrogen to combine to form ammonia, viz. :—

$$N + 3H = NH_3$$

(Nitrogen) (Hydrogen) (Ammonia)

In the Haber process about 4 per cent. of the mixed gases are converted into ammonia, this being extracted from the stream of gases issuing from the plant by a process of cooling, whereby it is condensed to a liquid, while the unchanged nitrogen and hydrogen pass on, to be eventually returned to the reaction chamber of the installation.

In this manner synthetic ammonia is readily produced. The process is operated nowadays in England, as well as in other countries, for its commercial success is not based upon the use of extraordinary amounts of electric power.

A portion of the synthetic ammonia produced directly from the nitrogen of the air is employed for the manufacture of ammonium salts for agricultural fertiliser purposes; the remainder is converted into nitric acid.

This ammonia-nitric acid conversion is carried out by means of the so-called Ostwald process. It is based upon the fact that, when a mixture of ammonia and oxygen is passed over platinum in the form of fine wire gauze, a large proportion of the ammonia is oxidised to nitric acid.

$$NH_3 + 4O = HNO_3 + H_2O$$

(Ammonia) (Oxygen) (Nitric acid) (Water)

Secret "Catalyst"

The present-day ammonia oxidation plants, as operated in this country, and in Germany, employ a secret "catalyst" or active agent, for effecting the oxidation of the ammonia to nitric acid. Originally, however, the platinum catalyst, as previously mentioned, was employed in the form of a fine "grid" of platinum wire, which was electrically heated to a very carefully controlled temperature. Through this grid the mixture of ammonia vapour and air was rushed at a velocity of several yards a second, and although the gases only came in contact with the heated platinum for about one five-hundredth part of a second, an 85 per cent. conversion of the ammonia into nitric acid was obtained.

Nowadays, of course, due to intensified research, both on the engineering and the chemical sides of the process, a still higher conversion of ammonia into nitric acid is obtained, as is, also, a higher conversion of hydrogen and nitrogen into ammonia in the Haber process for the production of synthetic ammonia.

So long as a modern nation has the necessary means and skill to erect, operate and maintain synthetic ammonia and nitric acid plants, it will ever remain independent of outside supplies of fertilisers and explosives. For nitric acid is the one common material through whose agency all explosives are brought into being, and since nitric acid can be made from the air, it follows that, as long as this latter universal commodity is freely available, at least the nitrogen part of modern explosives can never run short in an up-to-date manufacturing nation.

The pity of it is, of course, that the wonderful process of nitrogen extraction from the air or of the "fixation of atmospheric nitrogen," as it is conventionally termed, should have to be so systematically put to the destructive usages of modern warfare. Perhaps, however, in a more enlightened age to come, fertilisers, and not nitric acid for explosives, will constitute the main output of the atmospheric nitrogen extraction processes.

MASTERS OF MECHANICS

No. 63—Ottmar Mergenthaler, Inventor of the Linotype Machine

IF any student of modern invention were to set himself the task of listing the present-day "Seven Marvels of Mechanics," the wonderful linotype machine, in its most up-to-date guise, would undoubtedly be included in that brief epitome of mechanical ingenuity.

The invention of the mechanical type-setting machine which originated some fifty years ago in the first commercial introduction of the "linotype," has made possible the great newspapers and periodicals of the modern world. The "linotype" is the most spectacular invention in the whole of the four and a half centuries of printing's history. Essentially, this machine might be considered to comprise a giant typewriter, the keyboard of which is constructed and arranged on lines similar to that of an ordinary typewriter keyboard.

At this wonderful machine a man can sit and operate the keyboard just as though he were typing an ordinary letter. Instead, however, of printing letters on paper, the linotype machine actually casts the sequence of words, figures, or whatever other characters are typed in a line of solid metal type. Hence the machine's name—"line-o'-type."

The linotype operator, sitting at the keyboard of his machine, depresses the various lettered keys in spelling out the words of the manuscript of "copy" which he is setting up in printing type. As each lettered key of the keyboard is depressed it releases a small brass matrix or mould which has a corresponding letter impressed in its face. These moulds, or matrices, are one by one brought into alignment by the action of the machine, and molten type-metal is forced into the impressions on the moulds. By this automatic operation a bar, or, as the printer terms it, a "slug," is formed which displays the letters raised on its upper edge or face.

Type Lines or "Slugs"

The various type-lines or "slugs" making up a column of print are assembled in due order for use in the power-operated printing press. After they have been printed from, and are no longer required, the mass of metal constituting these slugs, or lines of type, are re-melted for further use in the linotype machine. There is thus little wastage of type metal in linotype printing establishments, for, provided that metallic impurities are rigorously excluded from the molten metal, the linotype "slugs" may be used over and over again.

The creation of the mechanical type-setting machine resulted from no sudden effort on the part of any isolated inventor. On the contrary, inventors had worked on the idea for quite a number of years before the problem of the mechanical "composing" machine was finally solved, and many hundreds of patents had been taken out, particularly in America, for such inventions.

Most of these patents, however, proved to be useless, and until the underlying principle of the modern linotype machine was first conceived in the fertile brain of Ottmar Mergenthaler, of Baltimore, U.S.A., the projected and long-promised type-setting machine which, by eliminating the centuries-old hand methods of setting up type, was to quicken up printing production beyond all recognition, remained but a fragment of wishful thinking.

Ottmar Mergenthaler.

Ottmar Mergenthaler, creator of the linotype machine, was a German by birth, and had he lived in the present era he would doubtless have been expelled from his country with derision, for his parentage was mixed, and there was non-Aryan blood in his veins.

Mergenthaler began his life by being born on 10th May, 1854, in the diminutive village of Hachtel, in Wurtemburg. His father was the village schoolmaster, thrifty and wise. His mother was a woman of similar traits, and, from all that we can gather, it would appear that the young Ottmar began his life's systematic education at an unusually early age.

Needless to say the village school was the only educational establishment which the youthful Ottmar ever patronised, and, after his schooling, he was apprenticed to a watch and clockmaker in a nearby town.

The growing Mergenthaler liked the life of a watch and clockmaker. It appealed to his inborn mechanical instincts and, no doubt he would have remained in that honoured trade for the remainder of his career had it not been for an account of American life, and particularly of American opportunities which he received from a relative who had emigrated to Washington, and who eventually tempted him away from his native homeland.

Emigrated to U.S.A.

Ottmar Mergenthaler was but eighteen years of age when he left his Fatherland on an emigrant ship bound for the port of Boston. The relative—a step-cousin—who had recommended him to try out his luck in the New World was doing well for himself, having, from small beginnings, developed an electrical manufacturing business, which at that time was producing electric bell and signalling apparatus for the United States Government.

In this small factory, which was situated in Washington, D.C., the imigrant Ottmar, who, at that time, spoke hardly a word of English, obtained his first job on American soil. The job appealed to him and he made good headway with it, becoming, before long, his cousin's right-hand man. When the instrument-making factory removed to the city of Baltimore, Maryland, Ottmar Mergenthaler went with it, almost, it might be said, as one of its indispensable fitments.

In Baltimore, the Mergenthaler business set itself out to attract a variety of customers who were interested in instrument-making and precision engineering work. The typewriter had recently been developed and the Mergenthalers were, as one would expect, extremely interested in the new "mechanical printers." Ottmar Mergenthaler was engaged by one of his firm's customers to develop a special variety of typewriter, a task which he achieved successfully. It was whilst he was engaged in such work that his attention was drawn to the fact that there had existed in America a little group of men who for nearly twenty years had spent millions of dollars in experimenting upon the problem of the mechanical composition or setting of printers' type. Mergenthaler became interested in the subject, too, partly owing to an introduction to some of these men, and partly in view of the fact that any difficult problem in mechanical construction held out an almost irresistible appeal to his faculties.

It was in these circumstances that Ottmar Mergenthaler made up his mind to tackle seriously and systematically the problem of the much-wanted mechanical type-composition machine.

Early Experiments

First, he had the idea of producing print by means of an ordinary typewriter and of multiplying such print by lithographic processes. The scheme failed, for the chemical processes involved in lithography were far too complex to be carried out automatically.

The next notion of Mergenthaler's was to construct a typewriter-like machine which impressed characters in a strip of papier maché. From this strip, lines of type were cast in type metal and subsequently used for printing. The process was carried out into practice at that time, but it proved awkward and cumbersome, so much so that it was quickly dropped.

After the failure of his papier maché method of casting printers' type, Mergenthaler struggled with the problem for fully three years, building up machine after machine, and almost as quickly scrapping each one on account of some inherent flaw which it contained.

At last his efforts were crowned with success when, in 1883, he conceived the idea of mechanically assembling moulds or matrices and casting type-metal into them by means of the one machine, thereby forming a line of type. The device showed

so much actual promise that a new company was formed by a number of individuals who were interested in Mergenthaler's work. In this company, Mergenthaler was given a prominent interest, which factor naturally spurred him on to still greater efforts.

Final Success

Final success came to Mergenthaler with the introduction and development of his "blower" machine, so named because of its air-blast device. This became the first commercially successful linotype machine and, by means of it, on 4th July, 1886, a few columns of the *New York Tribune* were set on the machine.

Such an event formed a veritable milestone in the history of printing. The first book to be set up in print by the new linotype system of mechanical typesetting was an American publication, "The *Tribune* Book of Open-air Sports," which was issued in 1886. Linotype machines were quickly afterwards installed and used in the printing departments of the Chicago *News*, the Louisville *Courier-Journal*, The Washington *Post*, and the Providence *Journal*.

The Mergenthaler Company's factory was removed from Baltimore to Brooklyn in 1888, but soon afterwards Mergenthaler himself started an independent factory of his own in Baltimore, bringing out, in 1890, an entirely new style of Linotype machine (since known as the "Square Base" machine) which had many new features and which was completely changed in appearance. In this new machine, the air-blast was eliminated, the assembly and alignment of the type-moulds being carried out entirely mechanically.

It is from Mergenthaler's "Square Base" machine that the modern linotype has been developed. The Brooklyn *Standard-Union* newspaper received the first of the new Mergenthaler linotypes, and its example was quickly followed by another great newspaper, the New Orleans *Times-Democrat*. Within a couple of years, a number of other well-established American newspapers had installed the new Mergenthaler machines in their printing departments, and the final success of the linotype was complete.

For many years, the linotype method of mechanical type-setting was used only for newspaper work, and for the cheaper kinds of commercial printing, the "Monotype" machine (which was invented at a later date by another American mechanic) being used for book and magazine printing.

The "Monotype" machine operates by means of a keyboard mechanism perforating a paper ribbon which is used for controlling a type-casting device. Due to the fact that "Monotype" casts its type letter by letter, and that it can undertake with ease the most difficult tabular compositions, this system of mechanical typesetting for years overshadowed the old Linotype system.

Recent Improvements

In recent years, however, the Linotype system has, in virtue of the many improvements which have been made to it, achieved something of a spectacular "come-back," and it is nowadays used for the highest classes of commercial printing work as well as for setting-up of magazines and periodicals of all kinds.

Ottmar Mergenthaler did not live long to witness the steadily increasing success and the extending uses of his machine. Soon after the successful establishment of his "square base" linotype machines, his health began to decline and he retired from all active participation in attempts to improve his machines. His death occurred in 1899, but, in spite of the benefit which Mergenthaler had conferred upon the world by his system of rapid and cheap printing, his demise occasioned but little notice, even in America.

It is only in recent years that the historians of invention and discovery have begun to take stock of Mergenthaler's worth. Printing, during the last half-century, has grown to be so apparently common and effortless an art that few lay individuals ever pause to reflect upon the amazing wonders of its present-day technique.

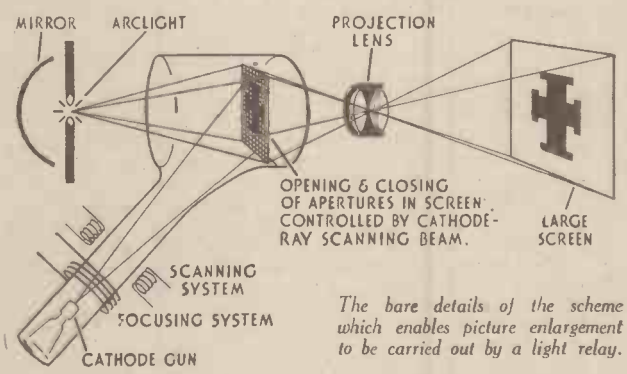
Next to old Johann Gutenberg, who is supposed to have invented printing in the 15th century, and the illustrious William Caxton, who shortly afterwards, introduced it into England and set up his press at Westminster, Ottmar Mergenthaler must ever rank as one of the "fathers" of this great art and practical science. To his mechanical and creative genius, present-day printing owes much for its origin and development. One day, perhaps, Mergenthaler may be proclaimed a "second Caxton," for, like the original Englishman of that name, he aided enormously the dissemination of information and of knowledge through that most powerful of all agencies—the printed word.

Cathode-Ray Developments

THE electronic multiplier continues to be developed for a variety of specific purposes, but in America details have been made available of this device which in the form proposed is said to be generally suitable as a generator of oscillations, amplifier, or detector. The most important feature seems to be dependent upon the shaping and disposition of the secondary emitting electrodes, and for this multiplier they are constructed in the form of two or more conical rings. The walls of these rings are made to diverge in the direction of the final collecting electrode which is generally the high potentialled anode, and to converge towards the cathode with which is associated a grid, also conical shaped. This grid has an open mesh, and is raised to a high positive potential with reference to the cathode. When the operating potentials have been applied and regulated to their correct values, the primary electrons released from the cathode surface are drawn outwards in a radial direction, and so strike against the inner wall of the initial conical ring secondary-emitting electrode. The primary electrons with the secondaries released by the impact are now attracted by the high voltage of the open mesh grid, and pass through the interstices at great speed to impact on the opposite inner wall of the second ring electrode. A further electron multiplication takes place, and this process continues until finally the amplified electron stream is drawn through an aperture at the top of the conical assembly to be collected by the final anode. Although the process of working is described, no details appear to be available to show exactly how the device can function in any one of the three purposes mentioned at the beginning of the paragraph.

Enlarging by Projection

A CONCENTRATED effort seems to be taking place abroad in order to perfect schemes, which can be regarded as quite satisfactory, for enlarging television pictures to a size comparable with that normally seen in an average up-to-date cinema. There is little doubt that this work will have many repercussions on any subsequent developments which take place in this country in the eagerly awaited post-war period. A large percentage of the present schemes incline towards the principle of replacing the fluorescent screen of the cathode-ray tube with a special form of surface which reacts to the modulated electron beam in such a way that each elemental area changes its degree of transparency or opacity in direct proportionality. The idea will be made clear by a reference to the accompanying simple diagram where the light from an arc lamp is concentrated by means of a back reflector on to this special surface, while a projection lens directs the emerging beam towards a remote screen so that the final picture is enlarged by many diameters. In one of the most up-to-date of these methods the surface which acts as a light controlled relay—shown in the diagram for simplicity as a series of apertures to correspond to the elemental areas—is built up by depositing a very large number of tiny light particles over a rippled sheet of glass. This sheet is positioned close to the screen of the electronic relay so that as a direct result of the electrostatic of the electron beam impact the tiny particles orientate edgewise to the arc lamp beam instead of remaining broadside. The actual degree of rotation will depend on the strength of the electrostatic influence.



The bare details of the scheme which enables picture enlargement to be carried out by a light relay.

A NEW SERIES

The Story of Chemical Discovery

No. 5.—The Meaning of Combustion.

Lavoisier directing an experiment in his laboratory on the respiration of a man.

THE career of Antoine Laurent Lavoisier constitutes an important high-light in the record of chemical discovery, for it was this brilliant investigator who first revealed to us the inner meaning of that age-old mystery—combustion or burning.

It was Lavoisier, too, who first satisfactorily explained the nature of respiration. He, also, it was who first clearly established the present-day principle of "Conservation of Matter," whereby we know that in any chemical or physical reaction matter is never created or destroyed. Such a principle lies at the roots of all chemical theories and is, in its way, as important a generalisation as the Atomic theory itself.

Antoine Lavoisier, although he brought no new chemical substance to light, and in spite of the fact that occasionally he made claims for discoveries which were not really his own, exerted a tremendous influence upon the rise and development of present-day chemistry. In scientific calibre he towers above his contemporaries by reason of the fact that it was he who first placed chemistry on a *quantitative* basis. Before the brief reign of Lavoisier in the chemical world, experimenters had bothered very little about the actual quantities and weights of materials with which they experimented. Lavoisier, however, brought into use the nowadays commonplace chemical balance, and by his early realisation of the importance of carrying out experiments quantitatively, or, in other words, on accurately weighed portions of material, he infused into chemical science an entirely new spirit. Chemistry, after Lavoisier's introduction of the balance, became, for the first time, an exact science, experiments in which were capable of being carried out with accuracy and precision.

His Early Activities

He was the son of a wealthy merchant in Paris and was born in that city on August 26th, 1743. From his earliest days, Lavoisier was nurtured in the lap of luxury. He was never under the necessity of having to work for his living. The best education possible was bestowed upon him by a doting parent, and when he arrived at manhood he married a young girl of but fourteen years of age whose father was also enormously wealthy, and who brought him a dowry which swelled the already considerable fortune which Lavoisier had had settled upon him by his parents. But although Antoine Lavoisier lived in the manner of an aristocrat, his own personal wants were few and simple. From an early age, he sought the company of the many eminent men of science and letters with which his father had been acquainted, and from them it would seem he had derived his first zest for a career of science and experiment.

Early Training

In his palatial house in Paris, Lavoisier equipped for himself a laboratory and during his later youth he entered on a systematic course of training in the recognised sciences of his day—physics, astronomy, chemistry and botany.

At the age of 21 Lavoisier wrote an essay on the best mode of lighting the streets of Paris. So keen was he upon his subject that it is related that he actually spent six weeks in two or three rooms from which all daylight was excluded and which were only lighted by the dim illumination of candles. In these apartments he experimented with various lamps, having, he considered, made his eyes more sensitive by continually excluding daylight from them.

The Government of France had offered a monetary prize for the best essay on the subject of street lighting, and it was Lavoisier who gained the reward.

Water to Earth Theory Refuted

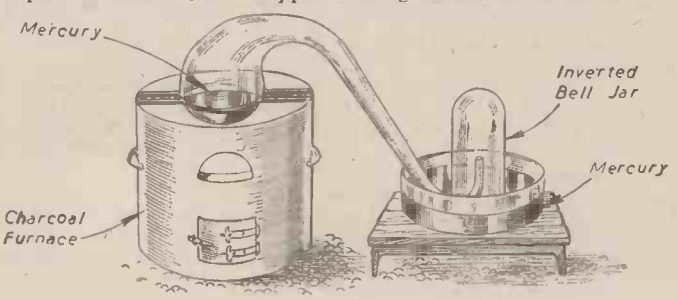
Not long after this opening incident in his scientific career as a chemist, Lavoisier was able to refute the old belief that water could be changed into earth by boiling it. Such a notion had been handed down from generation to generation of alchemists who had evaporated water by boiling it in glass vessels and had noted that a small amount of earthy deposit remained. To them, such a result offered a conclusive proof of the conversion of water into "earth." It never occurred to them that the "earth" or sediment might have been dissolved in the water or might have been dissolved out of the glass itself by the action of the hot water. Lavoisier found that, after heating water for a hundred and one days in a closed and weighed glass vessel, there was no change in weight of the vessel and its contents. Here we have almost the first successful example of Lavoisier's lifelong insistence upon experimenting with accurately weighed amounts of material.

Lavoisier then poured the contents of the vessel into an open basin and evaporated it to dryness. As a result of this experiment he obtained 20.4 grains of solid matter, but he also found that the glass vessel in which the water had been heated had decreased in weight, the actual loss amounting to 17.4 grains. The difference between this weight and the weight of the residue after the total evaporation of the water was but 3 grains, and this discrepancy Lavoisier rightly set down to experimental errors.

From the above protracted experiment, Lavoisier concluded that the earthy matter left after the evaporation of the water had been dissolved out of the soft glass of the heating vessel and that in no way had the water actually changed itself into earth.

This experiment was at a later date confirmed by the great Swedish chemist, Scheele, who demonstrated the fact that the earthy matter remaining after the evaporation of the water was identical with some of the constituents of the glass vessel.

By means of experiments such as the above Lavoisier gave the death blow to the fanciful alchemical ideas concerning the supposed change of water into earth. From



Lavoisier's famous experiment on the nature of calcination. Mercury is heated in a glass retort, the neck of which communicates with a supply of air confined in a bell jar over the mercury.

such experiments he established, as we have already noted, the present doctrine of the "Conservation of Matter" upon which chemistry, as an exact science, is based.

It was about the year 1770 that Lavoisier gave up a number of desultory experiments in physics which had previously engaged him, and devoted his sole attention to chemical research. In all these investigations, he seems to have been actively assisted by his wife who, young as she was, showed a praiseworthy tendency to turn from the ways of the decadent French aristocracy of the times and to devote herself to a serious manner of living.

Combustion

Exactly how Lavoisier's attention was first turned to the subject of burning and combustion can scarcely now be ascertained. He seems to have been first attracted by the subject of gases which had then come into prominence as a result of the investigations of Dr. Priestley and other English experimenters. Naturally, the then perplexing subject of the composition of air would claim a large proportion of his attentions and, indeed, in 1774, Lavoisier published a scientific work, "Essays, Physical and Chemical," in which he gave an historical account of all the work which had been done on the subject of air and gases since the days of the alchemists.

Two years before the publication of this book, Lavoisier appears to have hit upon the line of reasoning wherewith he finally demolished the ridiculous theory of "Phlogiston" which was at that time so greatly championed by the majority of noted chemical experimenters and, in particular, by the renowned Dr. Priestley. This theory, the reader will recall, supposed that when a thing burns it gives out a sort of fire-principle called "phlogiston" and that when metals form calces (or "oxides," as we nowadays term them) by being heated in air, this mythical phlogiston escapes from the metal, leaving the calx (or oxide) of the metal behind. According to this theory, therefore, metals were not elementary substances; they were compounds of the metallic calx and phlogiston.

In the November of 1772, Lavoisier deposited with the Academy of Sciences, of which august body he had been made a member, a sealed communication. This, which was subsequently opened on May 1st, 1773, was written in order to enable him to the right of priority of discovery, should any other investigator hit upon the same line of experiment as that on which he was then working.

One paragraph of this sealed communication shows us how Lavoisier began to demolish the doctrine of phlogiston :—

> "About eight days ago, I discovered that sulphur, in burning, far from losing, augments in weight; that is to say that from one pound of sulphur, much more than one pound of vitriolic acid is obtained. Phosphorus presents the same phenomenon. This augmentation of weight arises from a great quantity of air which becomes fixed during the combustion."

Between the years 1772 and 1774 Lavoisier conducted a number of experiments on what we should now term the oxidation of tin. He introduced a weighed quantity of pure tin into a glass retort, the neck of which was immediately sealed by fusing the glass in a blowpipe. The weight of the tin and the retort was noted, after which the tin was heated to near its melting-point and kept at that temperature for as long as its calcination (or oxidation, as we now call it) proceeded. When cool, the retort and its contents were again weighed and Lavoisier noted that, despite its prolonged heating, no change in weight of the vessel and contents was apparent. The fused end of the retort neck was now broken. Immediately air rushed into the retort with a hissing noise, a fact which proved that at least some of the air within the sealed retort had been absorbed and "fixed" by the tin.

The retort and contents were again weighed. This time an increase in weight was noted, this increase in weight, as

Antoine Laurent Lavoisier

Lavoisier rightly concluded, corresponding with the weight of that portion of the air which had been absorbed by the tin.

The calcined tin in the retort was now collected and weighed. It was found that the increase in weight of the tin was equal to the weight of the air absorbed by the tin.

Here, therefore, Lavoisier conclusively proved that when a metal is calcined it actually increases in weight as a result of the absorption of a quantity of air, a fact which, of course, was in direct opposition to the tenets of the phlogiston theory.

Dephlogisticated Air

In 1774, Dr. Priestley, the English chemist and the discoverer of oxygen (which he called "dephlogisticated air"); took a journey to Paris and there visited Lavoisier and his wife. We can imagine that Priestley's conversation centred greatly around his recent discovery of oxygen which he had obtained by heating the red calx of mercury (otherwise mercuric oxide). Lavoisier afterwards devised his now famous and often quoted experiments in which he heated a quantity of mercury to near its boiling point in a retort connected by its bent neck with air confined under a bell glass standing over mercury.

After heating the mercury for twelve days, Lavoisier noted that red particles of mercury "calx" had formed on the surface of the mercury in the retort and that the quantity of air in the bell jar had diminished from 50 to 42 cubic inches. The red calx of the mercury was now carefully collected and heated in a small retort. It was found to yield 41.5 grains of pure mercury and from 7 to 8 cubic inches of the gas which we now know as oxygen.

Lavoisier now thoroughly comprehended the inner meaning of burning and combustion. The mercury, during its heating, had absorbed an active principle from the air and had increased in weight accordingly. When this mercury calx thus formed was heated, it was found to give off a quantity of absorbed air approximating in weight to the increase in weight of the mercury after its heating. Hence, reasoned Lavoisier, things burn when they are heated in air simply because they combine with or absorb the active or combustion-making part of the air. And, naturally enough, because they absorb a portion of the air, they increase in weight by an amount which is equal to the weight of the air absorbed. Thus, at long last, is the enigma of combustion explained.

His Theory of Respiration

On the same theory Lavoisier explained the phenomenon of human and animal breathing or respiration. When we breathe in, we take into our lungs a quantity of air. The active or "combustion-making" portion of the air is retained (or, at least, in part retained) by our bodies, whilst the surplus air is exhaled, mixed with a carbon-containing gas which Lavoisier himself termed "carbonic acid gas."

The breathing of man, therefore, is nothing more nor less than a process of slow burning, of slow calcination or oxidation, the active principle of the air being absorbed by our lungs and waste air being exhaled.

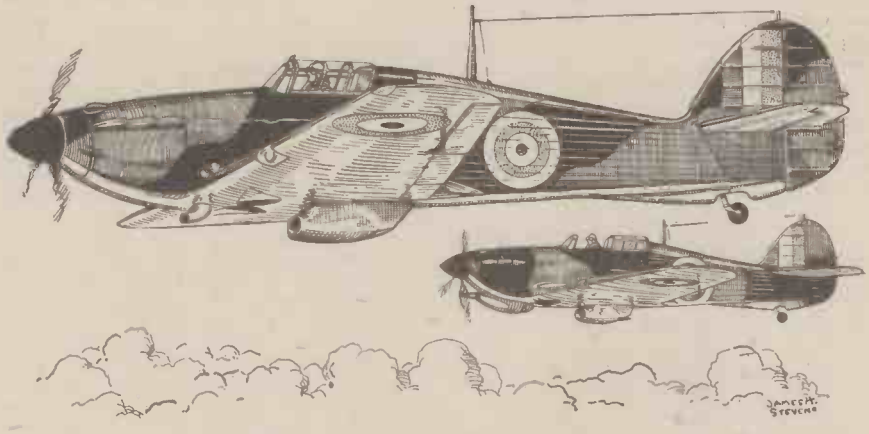
Naturally, the phlogistonists fought hard against Lavoisier and his theories, and Dr. Priestley himself, the champion of the phlogistonists, remained unconvinced to the end.

Nevertheless, Lavoisier had won the day with his new theory of combustion, burning and respiration. He termed the active or respiratory principle of the air "oxygen," which word he obtained from the Greek, *oxus*, acid, and *gennao*, I produce. Hence, Priestley's "dephlogisticated air" was to be called "oxygen" because, as Lavoisier thought, it was contained by all acids. Here, of course, Lavoisier was wrong. Oxygen is not a constituent of all acids, as instance, for example, the well-known hydrochloric acid, which is a compound of hydrogen and chlorine only. Nevertheless, the term "oxygen" has remained for the life-giving gas of the atmosphere, and few there are of us who would nowadays wish to change it.

It was Lavoisier, too, who showed that when a diamond is combusted in oxygen or air it gives rise to carbonic acid gas (carbon dioxide) in precisely the same manner as charcoal does. Hence, suggested Lavoisier, diamond and charcoal are made of the same fundamental material, a supposition which was perfectly correct.

The Revolution

Lavoisier was at the height of his brilliant experiments when the French Revolution broke out. The hatred of the masses for the ruling classes of France knew no bounds. Lavoisier, because he was of aristocrat tradition, because he had belonged to a tax-gathering organisation, and because he was accused, together with other excise officials, of mixing with the French bonded tobacco "water and other ingredients hurtful to the health of the French citizens" was tried and condemned to death.



SCALE MODEL AIRCRAFT No. 10.

The Hawker Hurricane

By J. H. Stevens, A.R.Ae.S.

The First of the Royal Air Force's Eight-Gun Single-Seater Fighters

ALTHOUGH still one of the finest fighting aeroplanes in the world, the Hurricane prototype first flew in November 1935 and the design goes back a year earlier to 1934. One of Britain's earliest military low-wing monoplanes, it caused a considerable stir on its first appearance, and many were the guesses about its probable performance until the Air Ministry permitted itself the cryptic title of "300 m.p.h. plus fighter."

The most remarkable feature of the Hurricane was the fact that the whole structure on the earlier models was fabric-covered. Another rather surprising point was that, although a low-wing monoplane, no one could ever have doubted its origin, for "Hawker" was written all over it, and nothing could have better epitomised the lines of the Hart and the Fury in the new fashion.

Unusual Construction

The original Hurricane, and a large number of the first to see service, had fabric-covered wings of very unusual design. This was because the designer, Mr. Sidney Camm, had decided that, rather than waste time evolving a new form of construction (for stressed-skin structures were very rare in this country in 1934) and trying it out on a new machine, he would produce a first-rate low-wing monoplane first, and experiment on the structure afterwards. The speed with which the Hurricane went into production, and the early delivery of the production machines (October, 1937) fully justified the decision. Later a stressed-skin system was developed, and is now used on all new Hurricanes.

The First Wing

The original wing was an ingenious adaptation of biplane practice to give the extra stiffness necessary for a cantilever monoplane. There were two spars with light-alloy sheet webs and high-tensile steel bulb-sectioned flanges. The spars were braced by a Warren truss of diagonal members of similar construction. This "foundation" was fitted with a series of closely-spaced lightly-built duralumin ribs, and a duralumin-sheet leading edge, the whole being covered with linen fabric attached by a special method to stand the stresses of 450 m.p.h. dives. The new wing panels have four light-alloy spars each, with closely-spaced ribs and lateral stringers, the whole being covered with light-alloy sheet.

Frise-type fabric-covered ailerons are used with both types of wing panel. Light-alloy split flaps are fitted under the trailing edge between the ailerons and the radiator beneath the fuselage.

Fabric-Covered Fuselage

The fuselage is built round a main structure of four tubular longerons and struts of the well-tried Hawker system used in the Fury and in the Hart family. (This was described in the article "The Hawker Henley," *Practical Mechanics*, June 1940, pp. 418-419.) This rapidly-built unit carries all the main loads, and is enclosed in a light fabric-covered wooden structure and metal cowling panels in order to give the fuselage its streamlined shape. The cockpit cover has been modified, and that illustrated is the latest version, with bullet-proof glass front screen and rear-view mirror. The pilot's back is also protected by a piece of armour plating.

The engine now in use is the Mark III Rolls-Royce Merlin, which gives 1,030 h.p. Originally two-bladed fixed-pitch airscrews were used, but now three-bladed controllable pitch de Havilland or Rotol airscrews are fitted—that shown in the general arrangement drawing is the Rotol, which is now standard, and more common. The engine is cooled by ethylene-glycol, which permits the use of a comparatively small radiator. This is mounted, together with the oil-cooler, in the duct beneath the cockpit. Recently the Hurricane has proved a thorn in the flesh of the *Regia Aeronautica* in Libya, and the fairing for the air filter, used to exclude the sands of the desert, is shown dotted in the drawings. Ejector exhausts have been fitted to all but the earliest machines.

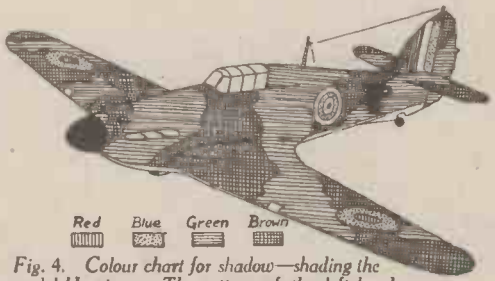
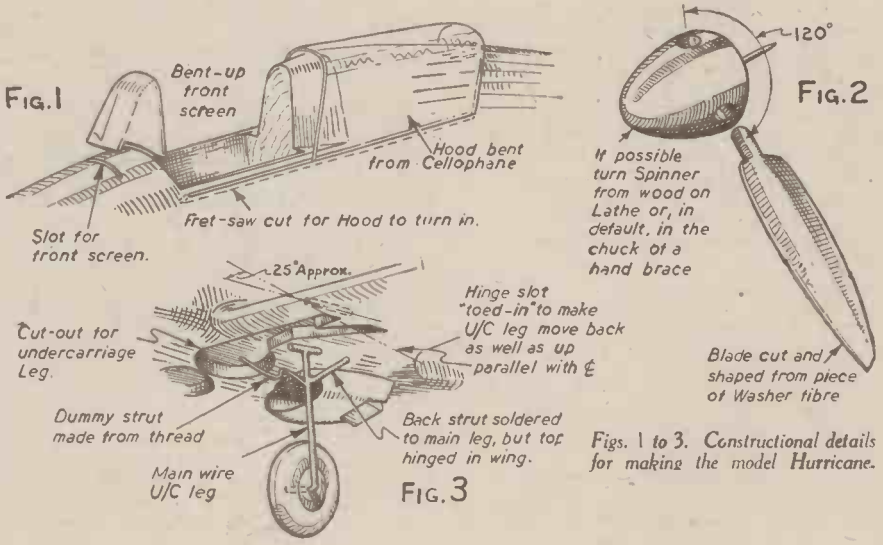


Fig. 4. Colour chart for shadow—shading the model Hurricane. The pattern of the left-hand side of the fuselage is shown in the heading sketch.



Figs. 1 to 3. Constructional details for making the model Hurricane.

Fabric-Covered Tail Unit

The tail unit is of metal construction, the tail-plane design being similar to that of the fabric-covered wing. All leading edges have metal skins. A small lower fin, made of plywood, is fitted along the bottom of the fuselage as an anti-spinning device.

The undercarriage consists of two units; each a semi-cantilever single leg with light side and back struts, fastened near the top, which assist in retraction. Low-pressure wheels with pneumatic brakes are fitted. Half the wheel openings are left uncovered after retraction.

The Guns

The eight guns which have served the Hurricane pilots so well are fitted in two batteries of four, one in each main plane outside the airscrew disc. The guns are 0.303 in. Brownings with a rate of fire of 1,200 rounds per minute. Originally the Hurricane was to have had four guns only, mounted in the fuselage and firing through the airscrew. The gun-muzzle openings are normally covered with doped fabric to assist the take-off.

It is scarcely necessary to detail the Hurricane's active service career—all that may be published is our daily news these days. It is the supreme virtue of manœuvrability, coupled with speed, which puts the machine in a class apart from anything the enemy has yet produced.

As well as being in service with our own Royal Air Force, the Hurricane has been supplied to the Belgian and Yugoslav Air Services. It is also being manufactured in Canada.

PRINCIPAL CHARACTERISTICS

Hawker Hurricane I, 1,030 h.p. Rolls-Royce Merlin III

Span	40 ft.
Length	31 ft.
Wing area	257.5 sq. ft.
*Weight empty	5,584 lb.
Weight loaded	6,600 lb.
Wing loading	25.6 lb./sq. ft.
Power loading	6.4 lb./h.p.
Speed (max.) at 18,500 ft.	335 m.p.h.
Speed at ground level	272 m.p.h.
†Service ceiling	35,000 ft.
Climb to 5,000 ft.	2.1 mins.
Climb to 10,000 ft.	4.3 mins.
Climb to 15,000 ft.	6.5 mins.
Climb to 20,000 ft.	9.3 mins.
Climb to 25,000 ft.	13.1 mins.
Max. rate of climb	2,420 ft./min. at 11,000 ft.
‡Max. range (168 m.p.h. at 5,000 ft.	830 miles
‡Normal cruising range (232 m.p.h. at 25,000 ft.)	695 miles

* Includes all fixed equipment but not pilot, parachute, ammunition or fuel.

† Height at which climb is 100 ft./min.

‡ Full range *after* running up and climbing to operational height.

The Model

The Hurricane is a simple model and requires little description. The best material is close-grained wood, preferably a soft variety such as whitewood. Birch, beech, satin-walnut or plane are also suitable. The tail unit is well made from washer fibre, as the toughness and lack of grain of this material make it durable, and easy to work.

The scale which is now most popular is that of 1 : 72, or 6 ft. to 1 in. This is a good scale, as it permits of large enough models to make the inclusion of details easy and yet allows the finished collection—if several are being made—to be stored in a reasonably small space. This scale also has the not inconsiderable advantage that such awkward accessories as wheels, and airscrews, can be easily purchased from any model shop.

The method recommended for making the cockpit cover on previous machines in this series has been that of moulding by pressing the material while hot. With the Hurricane the simple shape scarcely makes this trouble worth while, unless the only material available is very thin and lacking in stiffness—for the pressing process certainly adds considerably to the strength of the cover. Reference should be made to any of the recent articles in this series for the pressing method; the built-up cover is shown in Fig. 1.

The airscrew is another tricky unit, particularly on a small scale, and some details of a simple method are shown in Fig. 2.

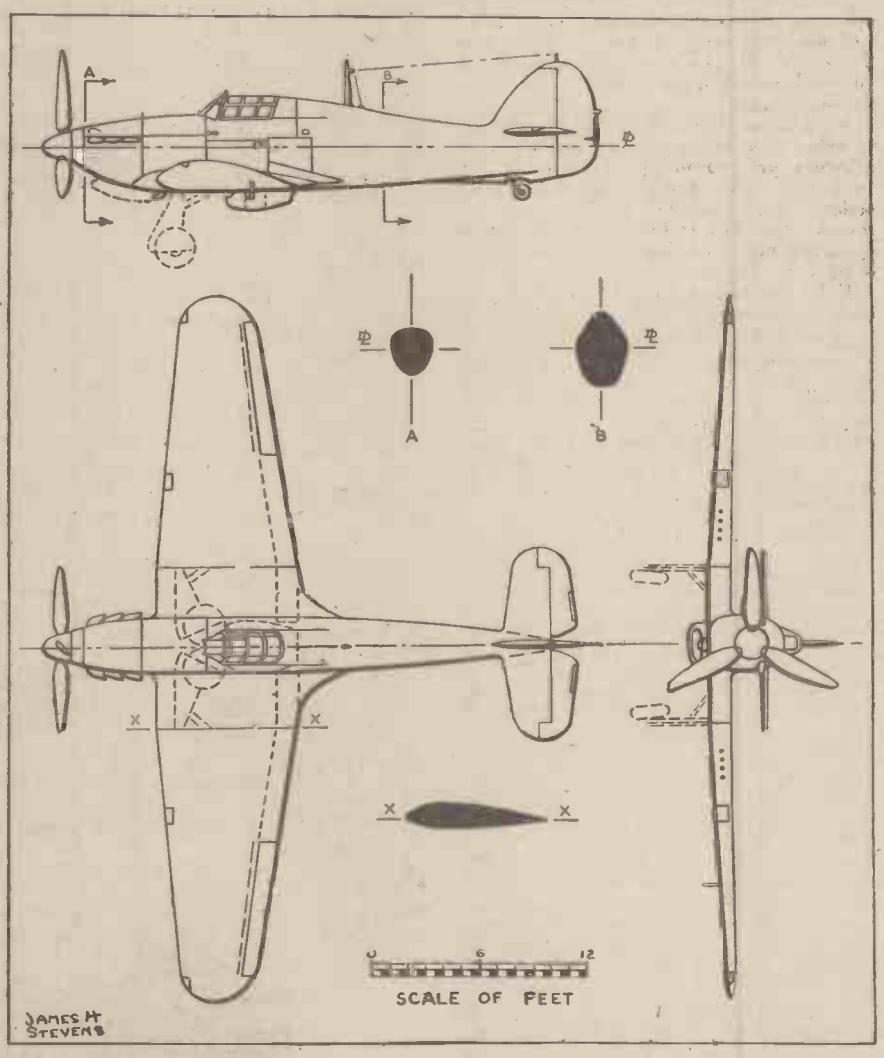
The Undercarriage

The operation of the actual undercarriage includes an ingenious, but awkward, collapsible retracting strut. In the model the most tricky part is to arrange a diagonal hinge so that the main leg swings backwards as it moves upwards. A suggestion for this is shown in Fig. 3. The inward strut can be made from a strong thread—crude as this sounds, it looks effective, and folds itself comfortably on retraction!

Painting and Colour Scheme

There are three types of paint available for models : poster paint, cellulose and oil enamel. The first gives the most faithful effect, but is easily marked and does not "take" well on metal parts; the second gives a good effect, but is difficult to use because of its quick-drying properties; the last is a little too glossy, but is very easy to use and dirty marks can be washed from it—it is this latter which I use and recommend. The most useful brushes are a No. 5 sable, and a fine liner's brush.

Since the beginning of the war the colour scheme of British fighters has been modified several times. That at present in use is indicated in Fig. 4, and is described below. The upper surfaces are "shadow-shaded" in dark green and "milk-chocolate" brown—there are two patterns in use, one being the mirror image of the other. The underside of the whole machine is pale pigeon-egg blue. The under surfaces of our fighters have had a number of colour schemes, both with and without cockades, since the beginning of the war, and shortly before going to press the pale blue, which had held sway for some months, had given place to a black port and light starboard wing, complete with cockades. The airscrew is dull black, except for yellow blade tips. The exhaust pipes are yellowish grey. The cockades on the sides of the fuselage are red-white-and-blue with a broad yellow outline. The cockades on top of the wing are red-and-blue only. There are red-white-and-blue cockades painted under the wings, but these are not always present. The stripes on the fin are red, white and blue, reading towards the tail. Grey squadron identification letters are painted on the sides of the fuselage on each side of the cockades.



Side, plan and front view of the Hawker Hurricane.

NEW SERIES

Making a Success of Your Photography

Notes on What You Should Know About Your Camera And How To Use It.

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

UNLIKE many other hobbies, photography requires a fair amount of careful thinking, or even study, if the amateur desires to achieve full satisfaction; the idea that you have only to press the button, and something else—you don't know what that "else" is—does the rest. is definitely a bad piece of advice, and only intended for the lazy individual. It does not help anyone to get good results, and it is largely responsible for the high percentage of "dud" results.

In the present and following articles on the subject it is hoped to impart information that will not only reduce the number of failures, but will make you a keen enthusiast of the most fascinating hobby it is possible to enjoy.

Overhauling the Camera

At this time of the year when the evenings are long and inclined to get wearying it is a good opportunity to take your camera out and thoroughly examine each part, and find out what its functions are and, if you do this while reading these notes, you will certainly gain some useful advice for the future.

All cameras whether of the box, folding or reflex type are so constructed that their interiors are absolutely light-proof; the back fits very exactly, and the leather bellows must be free from pinholes or cracks. The lens and other fittings on the front are fitted so that not a faint streak of light can get in.

Hold the camera to the light with the back of it open, and close to your eyes with a black cloth thrown over your head, and all that part of the camera not facing the light. Can you see any trace of light coming through the front? If this test is satisfactory try turning the camera round with its back to the light, and your eye to the lens under the black cloth; now open the lens to "Time." Is there any sign of a small speck of light? There should not be if everything is in order. These tests will prove whether the bellows, or box, are sound or faulty; if you have found even a small leakage it will probably prove to be the reason why some of your films had some shafts or spears of black markings, or the image was partly or perhaps completely obscured. These are fog marks due to the presence of light leaking into the camera, and if you can trace the spot where the leakage takes place you may be able to repair it, but if it is in a difficult place and necessitates the removal of certain parts to adjust, then the best advice is take it to a reliable dealer, and ask him to get the work done for you.

Open the camera back and have a look in the film chambers; possibly you will be surprised to see so much dust, and little pieces of paper or wood; this has occurred as the result of winding and unwinding the spools. Now put a strong torch light in the chamber formed by the bellows or box, and look especially in the corners and the folds of the bellows; it is surprising how dirt and dust will get into such a place. All this undesirable accumulation must be carefully removed, otherwise you will get more negatives with small clear spots on them, which are caused through dust and chips settling on the film before it is exposed.

Lens and Stops

On the front of the camera will be found the most important fittings, namely the lens, shutter, stops, focussing scale and the view-finder; each of these has its own particular function which will be done efficiently if the parts are kept in good order.

The lens is a very important part, its work being to collect the rays of light reflected from each portion of the picture or subject being photographed, bunch them together and pass them on to the surface of the film in sharp pin points so that a correct reproduction of the scene is received, but to do this the glasses which form the lens have had to be very accurately and scientifically adjusted; also the lens must be set at a certain distance from the film, and this distance varies according to the distance of the nearest object being photographed. If these adjustments are not correctly made then the resulting picture is blurred or what photographers term "out of focus." Always see that the distance scale, which is usually on the base board of the camera or at the side of the lens, is set to the distance of the nearest foreground object. Try the lens to see if it is screwed tightly into position, and never unscrew or remove it unless for some definite purpose, a loose lens may spoil every exposure you make.

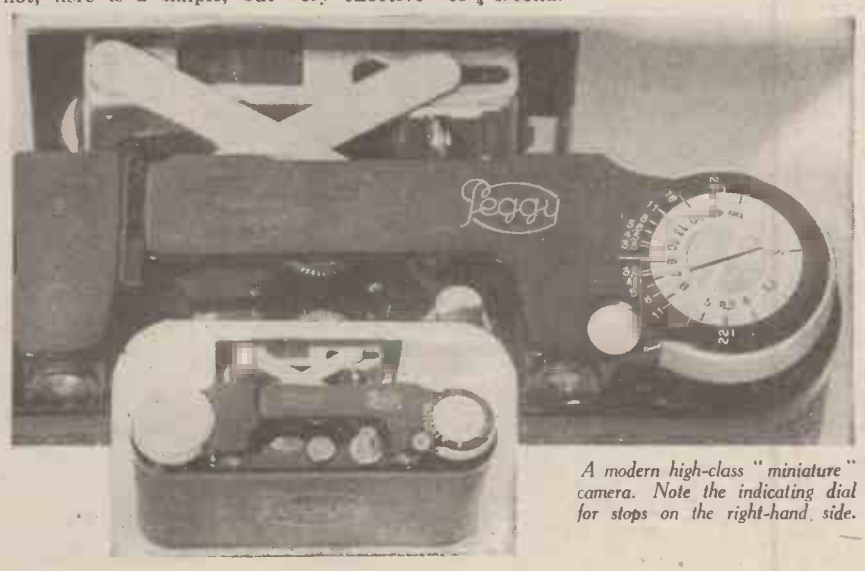
Judging Distances

Are you good at judging distances like six, twelve or twenty yards or feet? If not, here is a simple, but very effective dodge: get a piece of string, measure off 12 inches, and tie a knot; then measure another 12 inches and tie another knot, measure a third 12 inches, and then cut the string. If you always carry this in your camera case for use when required, you will not get any more blurred pictures through misjudging the distance.

If your camera is a folding one and cost, say £2 2s. or more you will find a number of little figures marked on a narrow plate just over or under the lens. There is also a small lever attached which enables you to operate a diaphragm for forming apertures of varying diameters in line with the centre of the lens. The apertures are known as stops or F numbers; they range from 6.8, 7.5, 8, 11, 16, and 22, while the more expensive cameras start and finish with other numbers giving a longer range.

You have been told that the lens gathers the rays of light and passes them to the film; it passes them through these circular apertures or holes; if the light is very strong the rays might go through too quickly and spoil the film, and so to avoid this trouble we are given the means of retarding the light action by using a smaller aperture, but to do this accurately the lens maker must make these apertures comparable, and so we find that the next smallest is only half the value of the previous one. This is how that rule works. Suppose you are taking a subject with the aperture marked F8, and it requires an exposure of ¼ second; if you altered the aperture to F11 you would have to give an exposure of 1 second, or if you stopped down to F16 then 2 seconds would be required.

Taking the scale the other way and using F7.5 the exposure would have to be reduced to ⅛ second.



A modern high-class "miniature" camera. Note the indicating dial for stops on the right-hand side.

A "Fairey" Battle plane in flight over the sea during bombing practice

Aircraft Recognition

Suggestions for Home Study—Part 3

By R. A. Saville-Sneath

IN the preceding articles twenty-four of the principal types of British aircraft were selected for study, followed by twenty-four of the most important types in service with the Luftwaffe. If we attempt to make a similar selection from the less numerous types operating with the Regia Aeronautica we find that twenty-four covers almost every machine worthy of mention.

Readers may remember that in the previous selections we have ignored biplanes. It was suggested that if and when biplanes were seen in action over Great Britain it would be an unmistakable sign of the depletion of the enemy aircraft reserves. The Germans have long realised the futility of pitting relatively slow biplanes against modern R.A.F. fighters. It remained for Mussolini to attempt this folly, with results which we all know.

The fact that the Germans permitted the experiment to be made at all suggests either their urgent need of additional numbers regardless of quality, or Goering's imperative desire to enjoy a rare joke at the Italians' expense.

It is doubtful whether many more Italian *biplanes* will face the perilous crossing of our coast, but as they represent a considerable part of the numerical strength of the Italian Air Force, the two principal land fighter types, Fiat CR 32 and CR 42, together with two of the chief types serving with the Italian Navy, Meridionali Ro. 43 and Ro. 44, are included in the following list of twenty-four aircraft selected for preliminary study:

Bergamaschi A.P. 1	BREDA 88
Breda 65	Cant. Z 501
Cant. Z 506B	MACCHI C 200
Cant. Z 1007	Piaggio P 32
CAPRONI 135B	Piaggio P 50
Caproni 310	Meridionali Ro. 43
Caproni 311	Meridionali Ro. 44
Falco 1	Savoia-Marchetti SM 73
FIAT BR 20	*Savoia-Marchetti SM* 81
Fiat CR 32	SAVOIA-MARCHETTI SM 79
Fiat CR 42	Savoia-Marchetti SM 83
FIAT G 50	*Savoia-Marchetti SM* 85

If you are studying Italian aircraft for the first time you are recommended to concentrate on the first six types, shown in capitals. When you are satisfied that you can recognise any of these without the slightest hesitation, either from photographs or silhouettes, you are ready to start on the next six important types, the names of which are printed in italics.

Whatever you do, don't devour the whole list at one meal—they will not stay put! In aircraft recognition it is far more important to know a limited number of types *thoroughly* than to have an uncertain acquaintance with a large collection.

The outstanding recognition points of the twelve principal types are briefly summarised in the following survey as a guide to individual study. Readers should have no difficulty in observing additional distinctive features which, as personal discoveries, will be so much more easily remembered.

Structural Variety

So many diverse structural types are represented in the first twelve that the simplest method of approach in the present case appears to be grouping according to the number of engines. This gives us three convenient sections consisting of (1) four *single-engine* types; (2) five *twin-engine* types; and (3) three *three-engine* types.

(1) Single-Engine Types

Fiat CR 42

This single-seat *biplane* fighter retains a family likeness to the earlier Fiat CR 32, particularly in the shape of the wings. In both types the wings are untapered, with rounded tips and no dihedral. The lower wing has very much shorter span than the upper wing. Both designs have a similar arrangement of Warren type rigid interplane bracing which is distinctive in the head-on view. Seen from below, the smaller chord of the lower wing is common to both types, but CR 32 has staggered wings, whilst those of CR 42 are without appreciable stagger. The most obvious distinction between the two models is the in-line engine of the earlier design and the radial engine of CR 42. Other points may be noticed in the fixed undercarriages of smaller and cleaner design and in the simpler lines of the tail unit.

Fiat G 50

A *low-wing monoplane* with radial engine, the G 50 is not unlike some of the current American types of single-seat fighter, although its maximum speed of just under 300 m.p.h. lags far behind modern standards. The centre section of the wings is of considerably greater thickness and chord than the outer sections. The leading edge, in the centre section, tapers very sharply but

the outer section of the wings is only slightly tapered to wide rounded tips. The tall single fin and rudder unit is rather angular, with rounded top, whilst the tailplane is almost elliptical. The fuselage is of circular section, with enclosed cockpit aft of the trailing edge and inwardly retracting undercarriage.

Breda 65

Designed for attack against ground troops or as a medium bomber, this *low-wing monoplane* corresponds roughly in function to the R.A.F. "Battle" and has about the same maximum speed. It may also be used as a single-seat fighter. The wing plan is distinctive, the leading edge being untapered whilst the trailing edge is fully tapered to rounded tips, and swept in to the fuselage in a graceful fillet. The wings have full dihedral. The Piaggio radial engine has a fluted cowling. The braced tailplane, with elevator cut away near the fuselage is placed well forward of the finely streamlined tail of the fuselage. Like that of the "Battle," the undercarriage is only partly retractable and the lower part of the wheels can be seen in either head-on or side views.

The glazed cover of the cockpit is of irregular shape and in contrast to many Italian designs, is placed well forward.

Macchi C 200

According to published figures this *low-wing monoplane* is the fastest single-seat fighter in service with the Italian Air Force, having a top speed of 314 m.p.h. Wings are evenly tapered to rounded tips, with moderate dihedral and curved fillet from trailing edge to fuselage. The radial engine has a distinctive fluted cowling. The tailplane is almost elliptical, and is mounted in the mid position slightly forward of the finely streamlined fuselage tail, the fin and rudder unit being small and rather angular. The enclosed cockpit is placed amidships in the fuselage of circular section. The undercarriage retracts inwards.

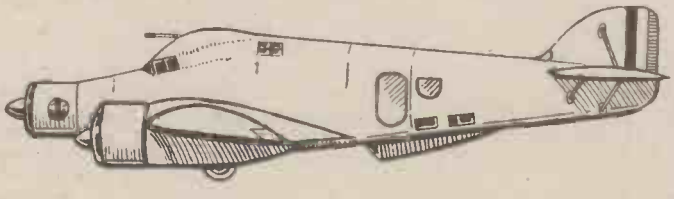
Twin Engine Types

Fiat BR 20

This *low mid-wing* twin-engine bomber is roughly comparable in performance to the "Hampden" and "Whitley IV" bombers of the R.A.F., its maximum speed being 268 m.p.h. In wing plan it rather resembles the "Hampden," having practically no taper on the leading edge, whilst the trailing edge is sharply tapered to narrow rounded tips. The centre section is unusually thick and the *upper surface* is inclined down towards the engines. This anhedral angle, together with dihedral from the engines to the tips, gives a slight effect of inverted "gull wing" in the head-on view. Fiat radial engines of 1,030 h.p. are fitted. These are mounted on their centre lines and project about half-way between the nose and the leading edge. The tail unit is unusual and although it does not sufficiently resemble that of the "Whitley" to cause any real confusion between the two, it has these points in common with the "Whitley" tail: (1) the twin fins and rudders are mounted halfway between the fuselage and the tailplane tips; (2) they are braced to the fuselage; (3) they are mounted on top of the tailplane with no part of their surface projecting underneath. On the other hand, the well-rounded shape of the fins and rudders, the distinctive tailplane and the streamlined extremity of the Fiat fuselage form a characteristic and easily remembered tail unit. One of the illustrations on page 185 shows the tail unit of BR 20 and Whitley.

In addition to the Breda gun turret which is prominent in the nose, there is a small turret on top of the fuselage just aft of the wings, and an under gun position breaks the waist-line.

In view of its cruising range of over 1,800 miles, this is an important type which may perhaps be more easily remembered by the recollection of its Hampden wing and Whitley style of tail.



A side view of the Savoia-Marchetti 79, showing the peculiar humped body.

The Cant bomber, a corpulent mid-wing triple-engined monoplane.

Breda 88

This machine is in a similar class to the Junkers 88, although structurally there are many points of difference. Like the Ju. 88, specially stripped single-seat versions of the Breda 88 established a number of International Records for speed with load, the highest of these being 344 m.p.h. for 100 kilometres. In service trim, with load, its maximum speed is probably little more than 300 m.p.h.

The Breda 88 is a "shoulder" wing variant of the high-wing type, with two 1,000 h.p. Piaggio radial engines and twin fins and rudders. The wings taper to rounded tips, with only slight taper on the leading edge, full taper on the trailing edge and slight dihedral angle. As in the case of the Ju. 88, the engines are a very prominent feature. The large nacelles are almost fully underslung and, as the engine cowlings project nearly as far forward as the nose, they give that impression of a heavily over-engined aircraft which is so characteristic of its German counterpart.

The resemblance ceases there. The simple outline of the tapered wings; the sharply pointed nose projecting a little forward of the engines; the shoulder wing position and the twin tail unit are definitely distinctive points. The fins and rudders are almost egg-shaped, like those of the Lockheed "Hudson," but they are mounted further inboard. The tailplane is elliptical, the rudders and elevator are cut away for clearance and the finely streamlined tail of the fuselage projects noticeably behind the tail control surfaces. The fins are braced to the fuselage on the underside of the tailplane only.

Two large-bore machine-guns, and two shell guns are mounted in the narrow nose of the fuselage, which is of oval section. A small glazed hood encloses the cockpit, which is placed right forward, accommodating pilot and observer. The observer is provided with a single movable machine-gun, firing aft. The undercarriage and tail wheel retract.

Caproni Ca. 135

When this *low mid-wing* twin-engine monoplane is seen from the side it has much similarity to the Lockheed "Hudson." Many Italian aircraft are rather deep in the fuselage, but this Caproni is exceptionally so, and, for this reason is very much like the converted Lockheed air-liner. The resemblance includes the wing position, the shape of the nose and its glazed panels, the full taper on leading and trailing edge, radial engines, twin fins and rudders, and the shape of these. The dihedral angle of the wings is not so marked, the fins and rudders are mounted much closer inboard and the tailplane is of considerably shorter span. In addition to the forward gun there is a retractable gun-turret immediately behind the control cabin, and a further retractable gun position under the fuselage aft of the wings. The deep fuselage is of roughly oval section, rather slab-sided forward, and large glazed panels enclose a considerable part of the underside, or waist, midway between the trailing edge and the tail unit.

Model Ca. 135 is powered by two Isotta-Fraschini liquid-cooled in-line engines of 900 h.p. Ca. 135 *bis*, the more widely used type, for which a top speed around 270 m.p.h. is claimed, is fitted with two 1,000 h.p. Piaggio radial air-cooled motors, the streamlined nacelles of which project slightly *behind* the trailing edge. This feature, unfortunately, is not so rare and valuable a recognition point with Italian machines as it is with British and German aircraft, for it may be observed in other Caproni and in Savoia designs. The undercarriage is of the semi-retractable type, and the lower part of the wheels can be distinguished protruding beneath the engine nacelles.

Caproni Ca. 311

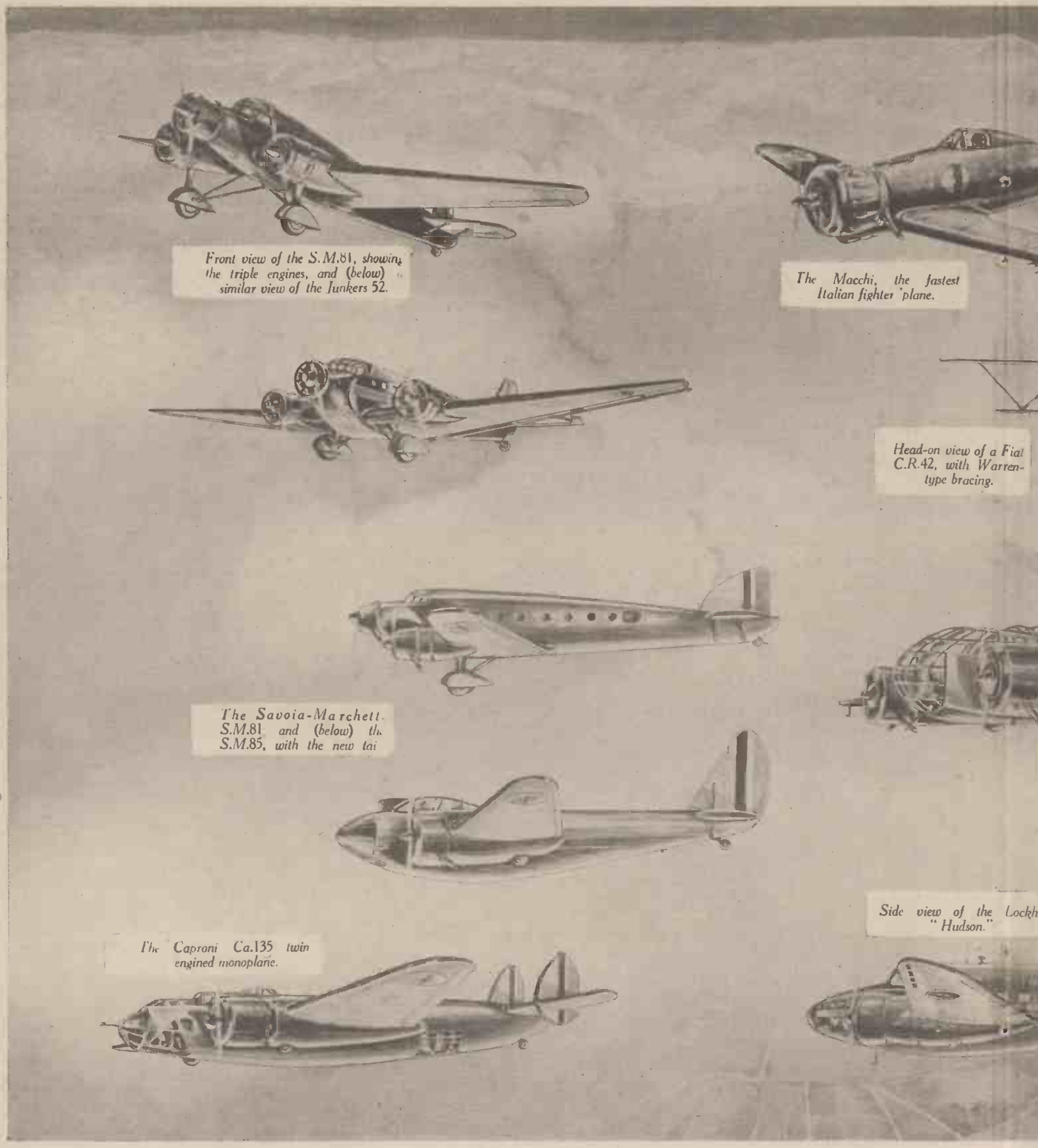
Produced by the Bergamaschi subsidiary company, this twin engine *low-wing* reconnaissance bomber bears no family likeness to the Caproni bomber just described. It is one of several types of twin-engine monoplane, all with single fin and rudder, specially developed by the Bergamaschi company for colonial service. These were comparatively light, the "Ghibli" for example, being provided with engines of only 200 h.p. and a fixed undercarriage.

Ca. 310 followed, with Piaggio radial engines of 430 h.p. and a retractable undercarriage. This model which has a top speed of around 200 m.p.h., is generally known as the "Libeccio," a name which may be freely translated as "South-westerly wind" or "Gale." It is obviously no "Hurricane."

Ca. 311 is a heavier version which retains very much the same lines but, powered with two Piaggio radial engines of 700 h.p., the top speed is now about 270 m.p.h. Its most characteristic feature is the extensive use of glazed panels. Large glazed side panels run continuously from amidships to the nose, which is fully glazed. The wings are uniformly tapered to rather

VARIOUS TYPES OF ITALIAN AND GERMAN AI

HOW TO IDENTIFY THEM BY



Front view of the S.M.81, showing the triple engines, and (below) similar view of the Junkers 52.

The Macchi, the fastest Italian fighter 'plane.

Head-on view of a Fiat C.R.42, with Warren-type bracing.

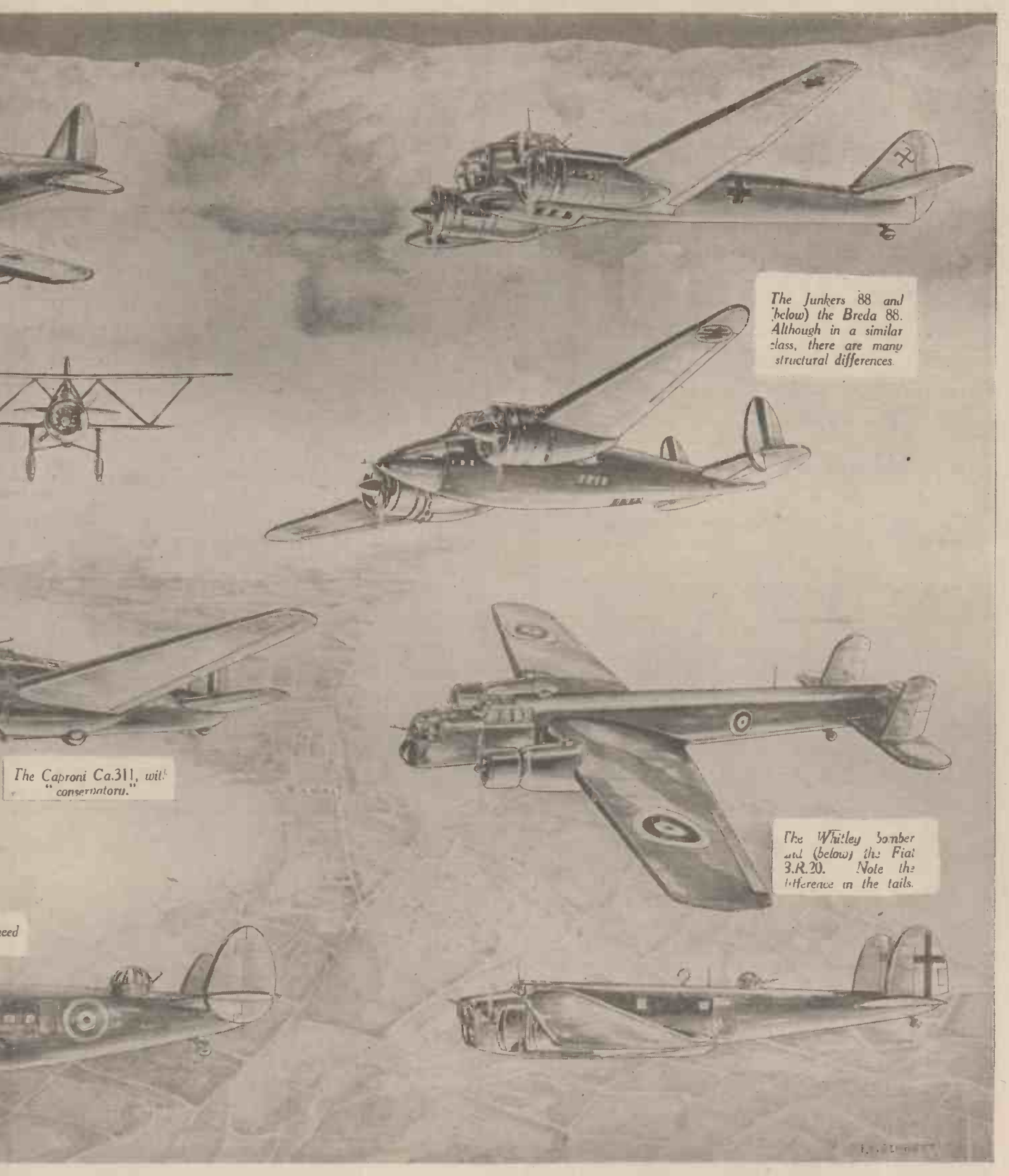
The Savoia-Marchetti S.M.81 and (below) the S.M.85, with the new tai

The Caproni Ca.135 twin engined monoplane.

Side view of the Lockh "Hudson."

RCRAFT COMPARED WITH BRITISH MACHINES

THEIR DISTINCTIVE FEATURES



The Junkers 88 and (below) the Breda 88. Although in a similar class, there are many structural differences.

The Caproni Ca.311, with "conservatoru."

The Whitley bomber and (below) the Fiat B.R.20. Note the difference in the tails.

narrow rounded tips, with full dihedral. The single tail unit is rather large, the tall rudder having a rounded top and trailing edge whilst the tailplane has the angular shape common to several Caproni designs. The fuselage is slab-sided and the glazed nose projects only a little forward of the engines—it is noticeably shorter than that of Ca. 310. A glazed gun turret is mounted about midway along the roof of the "conservatory." The engine nacelles project very slightly behind the trailing edge. Like the 135, the undercarriage is semi-retractable, and the wheels can be observed below the engine nacelles.

There is a float-plane version of Ca. 311, designated Ca. 312 *bis*.

Savoia-Marchetti SM 85

As Savoia-Marchetti have produced a long line of three-engine aircraft, this twin-engine dive-bomber—one of the latest Italian types about which little information is available is particularly interesting. It is a *mid-wing* monoplane—the wing position being slightly higher than the normal mid-wing type—with single fin and rudder. As a single-seat dive bomber it has probably been designed with little defensive armament, relying upon high speed for successful evasion—essentially a weapon of the "tip and run" type most suited to the Italian temperament. The information available suggests that the two large radial engines with which it is powered put it in the same class for speed as the Ju. 88 and the Breda 88, i.e., a top speed slightly over 300 m.p.h.

The wings are normally tapered to rounded tips, with moderate dihedral angle. The engine nacelles are mounted near their centre lines. The tail unit is a distinct departure from the usual SM tail which is so characteristic a feature of SM 73, 75, 79, 81 and 83. The angular fin is swept sharply upwards to a tall, narrow rudder. The trailing edge of the rudder sweeps down in a curve which is continuous to the underside of the fuselage. The tailplane is almost triangular, and is braced to the fin and the fuselage. There is a large cut-away in the elevator.

The fuselage is also somewhat unusual, being straight-backed, slab-sided and deep-bellied. The nose is streamlined and projects forward of the engines. It has small glazed bomb-aiming panels in the underside. The enclosed cockpit is placed right forward, about in line with the engine nacelles. The semi-retracted undercarriage wheels may be distinguished protruding from the nacelles.

Three-Engine Types

No country has concentrated more attention upon three-engine aircraft than Italy, and the series of successful civil and military three-engine monoplanes developed by Savoia-Marchetti has been largely responsible for this trend. A description of two of the most important of the Savoia military types follows.

Savoia-Marchetti SM 81

A *low-wing monoplane*, this three-engine bomber is developed from the SM 73, which it resembles so closely that the differences have to be sought in such relatively unimportant details as the arrangement of the fixed undercarriage supports, the type of "spats" fitted to the undercarriage wheels and so forth. These three-motor Savoias with radial engines and short, compact fixed undercarriage, are very similar in type to the well-known German parachute troop transport Ju. 52/3m, but they lack the angular appearance of that machine, and they possess a most distinctive recognition feature in the characteristic Savoia tail unit to which reference has already been made. This, consisting of a single fin and rudder with braced tailplane and cut-away elevator, is readily recognisable whether seen from the side or below.

The wings are tapered to moderately wide rounded tips, the taper being more marked on the leading edge and commencing outboard of the wing motors. Moderate dihedral commences from the same point. The fuselage is somewhat slab-sided, straight-backed from the control cabin to the tail unit, narrowing at the extremity to a streamline fairing which projects slightly aft of the tailplane and rudder. Two power-operated gun-turrets, which are normally retracted, are fitted, one behind the cockpit, and the other on the underside of the fuselage aft of the wings. A movable gun is arranged to fire through the side windows in the after part of the fuselage.

Alfa-Romeo engines are usually fitted, giving a maximum speed of about 210 m.p.h.

Savoia-Marchetti SM 79

This well-known three-engine *low-wing monoplane* is numerically one of the most important types of bomber in the Italian Air Force. It is similar in general appearance to the SM 73, 75 and 81, but like the SM 75, it is fitted with a retractable undercarriage. The feature which at once distinguishes SM 79 from its stable companions is the striking hump-backed appearance due to the addition, no doubt as an afterthought, of fairings to house two guns—a fixed gun firing forward and a movable gun firing aft. A third gun position breaks the line of the underside of the fuselage, midway between the wings and the tail unit and there is provision for a movable gun to fire through side windows.

The tail unit has the characteristic Savoia lines already described, except that the extremity of the fuselage does not project aft of the rudder, and the trailing edge of the elevator is straight, without appreciable cut-away. The wing-plan also differs slightly, being of smaller chord and tapering normally from the fuselage to rather narrow rounded tips. In this view the extremities of the engine nacelles can be observed aft of the trailing edge.

SM 79 was actually developed later than SM 81 and, with retractable undercarriage and more powerful engines, has a considerably better performance. With 750 h.p. Alfa-Romeo radial engines the top speed is about 270 m.p.h. Fitted with 1,000 h.p. Piaggio radial engines, the maximum speed is increased to 295 m.p.h.

Cant. Z 1007 *bis*

This unusual designation is not a designer's or constructor's name but is the customary abbreviation of "Cantieri Riuniti dell Adriatico" (United Adriatic Shipyards), a well-known firm of naval constructors which has specialised in seaplane types. It may be possible to describe some of these in a later article devoted to marine aircraft, but for the present the landplane bomber Z 1007 *bis* will be regarded as completing the twelve types selected for preliminary study.

A development of the float seaplane Z 506, which from a low-wing monoplane in the civil version became, through the addition of capacious bomb stowage holds, a corpulent *mid-wing monoplane* in the bomber version, the landplane type retains the same general lines as the military seaplane, Z 506B, a retractable undercarriage replacing fixed floats.

Superficially, with its three radial engines and single fin and rudder, it is not unlike the SM 79 just described, but whereas the latter developed a pronounced humpback, the Cant. bomber, like a city alderman, has gone to paunch. This bomb stowage hold runs from a point forward of the wide engine nacelles to well aft of the trailing edge. It is provided with forward and rearward glazed panels for the bomb aimer and rear gunner. There is a smaller bulge on the top of the fuselage, but most of this is glazed and forms a normal type of enclosed control cabin.

The wings of rather high aspect ratio are uniformly tapered to rounded tips, with full dihedral. Radial engines—1,000 h.p. Piaggios—are fitted in the present type, but Isotta-Fraschini in-line engines are an alternative power plant. The braced tailplane is elliptical and is mounted unusually high on the fin. Fin and rudder are tall and rounded. Actual figures are not available, but the performance of this bomber should correspond very closely to that of the SM 79.

NEW TYPE AIRCRAFT FOR ARMY CO-OPERATION

DEVELOPMENTS in the technique of co-operation between air and ground forces were foreshadowed in the recently formed Army Co-operation Command of the Royal Air Force. Lessons learned in France are already being made use of in the R.A.F. operations with the Greeks against the Italians. When the time comes for renewed land operations against the German army it will be found that in the sphere of army co-operation, as in 1918, Britain "has something."

Aircraft design is nowadays not so swiftly progressive as a few years ago. But it still marches on.

Single-engine Machines

Several British single-engine aircraft have been designed for dive-bombing work. Two of these have been in service for some time—the Blackburn Skua with the Fleet Air Arm, and the Hawker Henley as a target tower for the R.A.F. For general reconnaissance work with the army co-operation squadrons the standard aircraft is the Westland Lysander, a parasol-wing type with slow landing qualities. Although details cannot be given about any new British types designed for the various other aspects of army co-operation work, such as strategical reconnaissance or low-level bombing, an indication of general trends in development is afforded by certain new American types sometimes known as attack-bombers, which were being supplied to the French air force.

One of these is the Martin 167W, a two-motor medium-size aircraft designed for bombing, ground-strafing, reconnaissance and fighting. It can carry about half a ton of bombs, has a maximum speed of nearly 320 m.p.h. and a maximum range at cruising speed of over 2,000 miles. The Douglas DB-7 is another medium-bomber type having great possibilities for army work, being designed for both precision and dive or low-level bombing. It is a shoulder-wing all-metal monoplane with tricycle undercarriage, and its two P. & W. Twin Wasp motors give it an estimated top speed of around 330 m.p.h.

Our Busy Inventors

By "Dynamo"

Pocket Calculator

CALCULATING machines are now common objects of the counting house. To-day that lengthy column of figures familiarly known as a "long tot" is cast with the greatest of ease. You pull over a handle. Hey presto! the sum is done—and the result is infallible.

In the early days of these metal chartered accountants, I remember seeing a simple one which cost only £3. The trade mark embossed upon it was a viper and it was happily named the "Adder." However, in the present age, the more complicated arithmetical Robot is expensive, as far as the initial outlay is concerned. But it saves work, error, trouble and time. And the sum of these things, which no machine is needed to calculate, means money.

Related to the family of mechanical ready-reckoners, though not of complex character, is a pencil which has just made its debut. It has a movable band which is turned until the two numbers to be multiplied are matched. The answer then appears through a hole in the band. Owing to the limitation imposed by the size of the pencil, it is obvious that a multitude of calculations are not possible; but it enables one to dispense with some mental arithmetic.

Poultry Plucker

THE recent festive season, which, as usual, gave extra work to digestive organs, involved the plucking of a vast feathered flock. Mechanical methods of converting fowls into nudists are not unknown. A new machine of this description has made its advent. It consists of one or more metal drums, each about 2½ feet in diameter, the drums being bristled with rubber tube fingers, forming a cylindrical rubber brush. As this rapidly revolves, it brushes out the feathers. This apparatus is not intended as a helpmate for the average housewife; it is designed for mass production.

Floating Flavours

NOSE-APPEAL is the characteristic of certain flags which are waved by a company in Chicago. This company supplies flavouring extracts to ice-cream and food manufacturers, and furnishes its customers with what are styled "Blower Flags." Over the soda counter, announcing vanilla ice-cream flutters a flag which flavours the air with the mouth-watering aroma of vanilla. In the base is an electric fan and a vial of the vanilla whose aroma it is desired to waft. It is unnecessary to add that chocolate or any other flavour can be circulated in the atmosphere. This allows prospective purchasers to sniff an attenuated free sample of the delectable goods.

The Sands of Time

OLD Father Time, who has not so long since looped the loop of 1940, is traditionally represented carrying an hour-glass, in which the sands of time are sinking. On the sand-glass principle, a new plastic indicator registers the passing of those precious three minutes during long-distance calls. It belongs to that countless collection of pocket gadgets which, if one carried them all, would make one's suit bulge like a barrage balloon.

Boat Lights

LIGHTS with flashlight batteries are now available for canoes, rowboats, dinghies and other small craft. The light can be readily and easily clamped on to the boat. In those gloomy regions where the black-out enshrouds the land, this method of illumination will naturally be subject to modifying restrictions. But in happier realms it will form a convenient way of improvising a light on a boat.

To Foil the Fly

WINTER reigns over the land, but the summer sun will again glow. Then that perennial pest—the fly—like a Lilliputian Messerschmidt—will descend upon the British epidermis. This insect is especially an annoyance to the horse. In August it cannot be said that there are no flies on him. Now, Nature has supplied this animal with a special switch in the shape of a flowing tail, with which to "swat that fly." But for many years it has been the custom to dock the appendage. This, I am told, is a precautionary measure, as there is a danger of the tail becoming entangled with the reins.

Humane folk have used caps of net to protect the ears of the horse from being tickled by flies. I note that in the United States there has recently been patented a horse fly net. This in shape resembles the housing which caparisoned the steed in the days of chivalry.

Slick Slogans

ON this page I have had occasion to remark about the cute trade-names which appear in the United States. The American displays considerable invention in giving publicity to his wares. Here are two striking examples. Certain cigars are advertised with the slogan: "The Call of the Mild." And to direct attention to men's hosiery there is printed the picture of a silk-hatted head with one eye closed. Underneath sparkles the catch-phrase, "The Sock in the Public Eye."

Iron Lung's Proxy

NOT so long ago the iron lung was prominently in the news. Considered to be an indispensable curative agent in the treatment of infantile paralysis, its scarcity was lamented. It consists of a cabinet into which the youthful patient is inserted up to his neck. Within this cabinet there is regularly created a negative pressure in order to cause expansion of the patient's chest and abdomen, thereby drawing air into the lungs. Exhalation is effected by the normal rebound of the muscles of respiration.

It is pointed out by the inventor of an improved apparatus for producing artificial respiration that the iron lung has disadvantages. One of these is due to the patient's body being entirely enclosed in the cabinet, so that it must have an opening through which the head projects, the neck being sealed as far as air is concerned. This renders the patient helpless except when assistance is given. Another drawback the inventor considers, is the high cost of construction, which makes the iron lung available only in large hospitals.

The new device is an artificial respiration jacket, concerning which the British Patent Office have accepted an application for a patent. This jacket is wrapped round the body of the patient. It is claimed to be more convenient than the cabinet type, the patient being free to move his head, body and limbs, and therefore does not require constant attention. Means are provided to connect the jacket to a device for periodically creating positive and negative pressure in the air space formed between the jacket and the lower thorax and abdomen of the patient.

Far-Reaching Sprinkler

THE old-fashioned water-pot has a rival. It weighs only one pound and is fitted with a long handle as though it were the first cousin of a butterfly net. This enables it to reach those blossoms which blush far from the margin of the flower bed. It is equipped with a specially designed nozzle, so constructed that it slows down the motion of the water. This obviates the breaking down and washing away of the valuable top soil with the force of the hose stream.

Big Bertha's Granny

THE genius of Jules Verne, the scientific novelist of the last century, has again come into the limelight, owing to a new biography recently published. To Edward Bellamy and H. G. Wells this brilliant Frenchman possessed the gift of vision which enabled him to forecast certain inventions. One of the less known and most striking of his romances is *The Begum's Fortune*. The Begum in question, a rich Indian queen—I write from memory—left her huge fortune to two men. One was a Frenchman, the other a German. The Frenchman spent his legacy in building an ideal city. The German, who did not love the Frenchman, used his heritage to prepare a mammoth cannon—a grandmother of Big Bertha—with the object of blowing the said ideal city to bits.

On the day of the opening of the Utopian town a gigantic projectile was fired from the monster cannon. But it soared so high that it came under the attractive influence of one of the heavenly bodies. Instead of converting the ideal city into a jig-saw puzzle, it joined the merry roundabout of the solar system and is still a member of the perpetual whirligig.

A Joint Affair

AN improved pipe joint has of late been the subject of more than one application to the British Patent Office. My mind recalls what may be termed a joint tragedy. Some years ago a water company, in laying miles of pipes, adopted a joint which was claimed to be indissoluble. The joint remained true to its character for constancy, but alas! no allowance was made for expansion. As a consequence, something had to give. The joint refused to budge; so the pipe burst. The patient died of the remedy. It meant a costly resurrection of pipes, and the adoption of their successors with accommodating joints.

The Rolling English Road

A Brief Résumé of the Development of Our Highways

THEY made roads by hand in Roman Britain, so well that some are in use to-day. Now roads are made largely by machinery—to take "punishment" the like of which no Roman road-engineer ever dreamed. The natives of Britain had their roads, of course, long before the invaders came; but in no sense were these deliberately made. Neither skill nor pains nor much sense of direction entered into any of them. Choose any one, and truthfully it can be said of it :

"The wild thing went from left to right. and knew not which was which."

In that lively statement, G. K. Chesterton summed up the shortcomings and delirious wanderings of our earliest roads, whose courses were mostly impressed by the hoofs of driven cattle, and in whose footsteps the hearty, unskilled labouring forbears of our nation trod; in so much (or little) did their contribution to road-making consist. Chesterton elaborated his fanciful theme in unforgettable verses commencing :—

"Before the Roman came to Rye or out to Severn strode
The rolling English drunkard made the rolling English road.
A reeling road, a rolling road, that rambles round the shire,
And after him the parson ran, the sexton and the squire;
A merry road, a mazy road, and such as we did tread,
The night we went to Birmingham by way of Beachy Head."

Roman Roads

It has fallen to the lot of our road-engineers to straighten these out—and hundreds of other roads unskilfully, carelessly, laid down after the Romans had left. Some of our very earliest roads are traceable to-day. There is the Ridgeway, starting at Streatley on the Thames and wandering up on the Berkshire Downs; and the Icknield Way, also starting at Streatley, skirting the foot of the Chilterns, passing on through Newmarket and finally losing itself, so far as can now be determined, somewhere on the shores of the Wash.

The early track which marked a way for the makeshift, unmetalled road just wound around pond, fallen tree-trunk or boulder as though glad of any excuse to deviate. It may have straightened itself out somewhat as later it extended across flatter, barer country as an indecisive link between two villages. But the Saxons and their kind were not given to travel. Sufficient for them to have primitive tracks serving their own small community. One or two were somewhat better established, by the requirements of what was then adventurous trading, as the "tin" road along which that metal was carted from the west of England to the Kentish coast for shipment across the Channel. But there was none of that forthright driving of arrow-straight roads of solid foundation and hard-wearing surface such as we associate with the period of the Roman occupation.

For military, strategic and administrative reasons of their own, the Roman engineers gave us some magnificent highways, designed and constructed to stand up indefinitely to the pounding of their chariots and the tramp of the Legions' feet. They are Watling Street, from London to Chester; Ermine Street, London to York by way of Lincoln; Foss Way, from Exeter to Lincoln; and others. Where necessary, or advisable, they raised their roads well above land-level (for an elevated stretch of road offers good look-out facilities and lessens the chances of ambush). The highways often really were "high" ways, eight feet above the level on unshiftable foundations. Over marshland they built the roads on oak piles planted deep in the mud. Oak beams rested on the piles. Broken stone and flints and chalk three or four feet deep covered the oak beams, and on top of that was spread an honest layer of gravel, or massive stone slabs made the indestructible surface.

John Loudon MacAdam.

A typical example of a modern tarmacadam road.

Where the ground was less difficult or treacherous, foundations were still made, as called for by local conditions, and the surfacing would be of close-packed durable stones on edge. Largely this splendid work went all unappreciated by the natives, and when the Romans withdrew, at the beginning of the fifth century, we resumed the old, happy-go-lucky, even tenor of our ways. There remained no central authority to enforce the repair of the highways, and the roads in general because of this scandalous neglect actually became an impediment to travel. As the centuries wore on, the roads wore out, and it was not until the eighteenth century that any British road-engineer did anything much worth writing about. First of the famous names is that of General Wade, who after civil trouble in the Highlands in 1715 supervised the construction of military roads in remote parts there—1,100 miles of good road where none had been.

"Macadam" Roads

Then, in 1756, was born a man who gave us a word as well as founding on a firm basis the science of road-making—John Loudon MacAdam. His name became synonymous with all that was best in highway construction. His "macadam" roads stood out supreme. His strong point was commonsense allied with science. Others who preceded him had messed about feebly with their job, relying almost entirely on the traffic compacting their surfacing of any old stone. MacAdam's material was all carefully graded. He wouldn't use one broken stone exceeding six ounces in weight. This material he would have spread to the depth of 10 inches, knowing that the stones would become interlocked by their own sharp angles, and be so compacted that no moisture would seep through. He relied on a gentle camber to cause rain to be carried from the surface into ditches cut on both sides. Under his inflexible supervision, macadam roads were constructed in all parts of the country, and never would he allow the admixture of *anything* with his stones to bind them.

Turnpikes and Tolls

Hand-in-hand with his road-engineering went his relentless fight against the grossly inefficient, and mostly dishonest Turnpike Trusts. These were founded originally to supervise the maintenance of the main highways or turnpikes. To secure funds for that purpose the numerous Trusts were empowered to levy tolls, varying in amounts, on all traffic using sections of the road under their surveillance. Turnpike gates were set up at all too frequent intervals, and money-collectors installed to mulct ferociously those who had occasion to pass that way. Vast sums were accumulated in that manner, and got rid of in fashion best known to the members of the Trusts. Precious little went into the roads, and where small amounts *were* disbursed as payments to so-called surveyors, the cash was wasted. For the surveyors were chosen, it appears, chiefly for their lack of any knowledge appertaining to their posts.

People rose in their wrath and smote the toll-keepers hip and thigh and wrenched the toll-gates down.

(*To be continued*)

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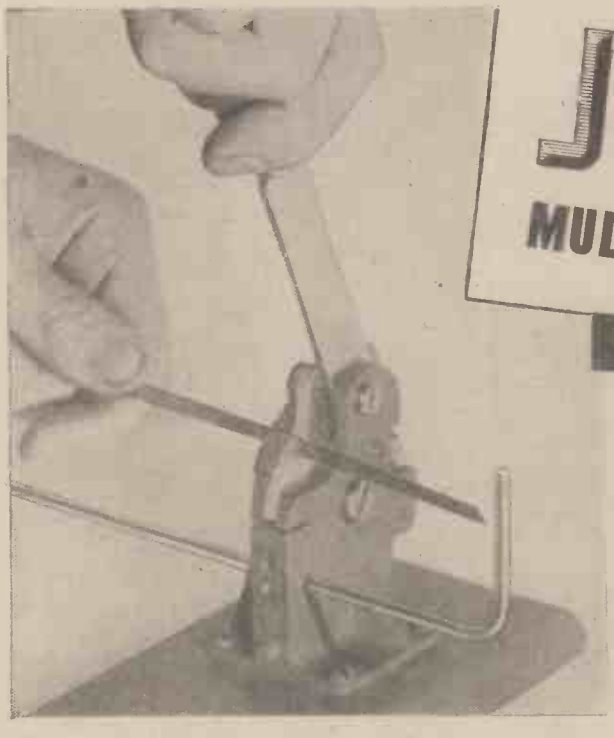

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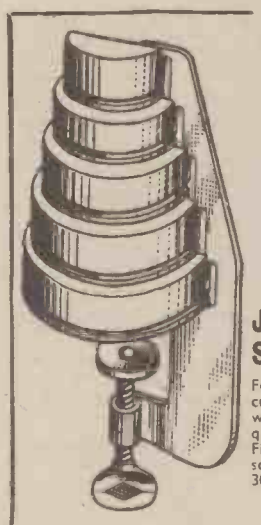

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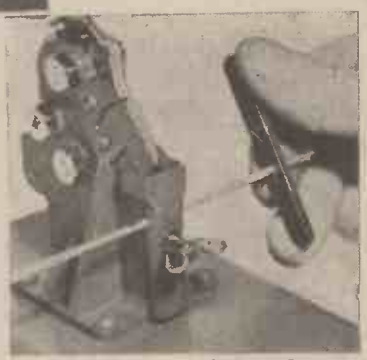

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CONJURING

Secrets of a Variety of Rings of

Fig. 1. About to cover the borrowed ring with the left hand and release the dummy one shown hidden by the right hand

By Norman Hunter
(The Well-known Conjurer of "Maskelyne's Mysteries")

Further Articles on the Secrets of Conjuring will appear Regularly and Exclusively in this journal

ONE of the first things a conjurer wants to do when he borrows a ring for a trick, is to change it secretly for a dummy ring. Once this has been done, he is free to damage, destroy and finally vanish the supposed borrowed ring; while he or an assistant occupy the time placing the genuine ring in some piece of apparatus ready for its dramatic reappearance.

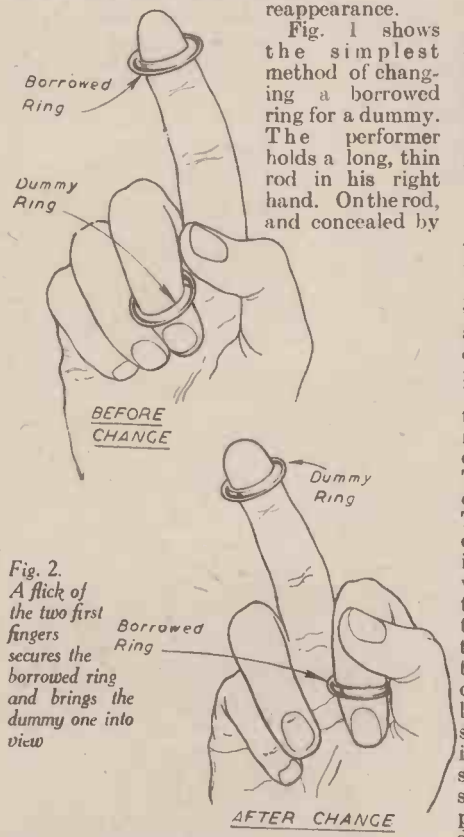


Fig. 2. A flick of the two first fingers secures the borrowed ring and brings the dummy one into view

Fig. 1 shows the simplest method of changing a borrowed ring for a dummy. The performer holds a long, thin rod in his right hand. On the rod, and concealed by the hand, is the dummy ring. He asks the owner of the ring he is borrowing to put it on the end of the rod. In returning to the platform, the conjurer takes the free end of the rod in his left hand, as shown in Fig. 1, covering the borrowed ring. He then releases the opposite end of the rod, revealing the dummy ring. To the audience he appears simply to have changed the rod over from one hand to another. He now openly drops the visible ring on to a plate off the end of the rod. Apparently his hands have not touched the ring at all, yet the dummy is now on view, and the real ring is in his hand, ready to be disposed of according to the requirements of the trick.

Fig. 2 shows another version of the same idea. In this case the borrowed ring is received on the tip of the forefinger. The other fingers are bent down into the palm, and on the tip of the second finger is the dummy ring. Turning to the stage, the conjurer apparently drops the borrowed ring off the tip of his finger into a tumbler. Under cover of the movement, it is a simple matter for him to bend the first finger down and extend the second finger. Thus the dummy is dropped into the glass and the genuine ring remains palmed.

The Pistol Trick

One way of disposing of the dummy ring is to drop it into a pistol fitted with a tube. The pistol is fired at some article such as a nest of boxes, where the real ring is later to be found, and the dummy simply remains in the tube, as shown in Fig. 3.

Another method is to hammer the dummy ring out flat on a piece of iron, usually to the alarm of the lender, who thinks her ring is being destroyed. The flattened ring is then dropped into a small pan, spirit is poured over it and ignited. The lid is put on the pan to put out the flames, and when the lid is removed out flies a dove, with the genuine ring tied round its neck with ribbon.

Knowing that the damaged ring is a dummy you will realise that an assistant off stage is, during the hammering process, busy fastening the real ring round the dove's neck. The pan used is a trick one, composed of three parts, as shown in Fig. 4. There is the pan proper, into which the dummy ring is dropped. The lid, which is brought on by the assistant, is fitted with a metal lining that attaches outside the lid and fits tightly into the pan when the lid is put on. The dove, with the ring tied to it, is slipped into this lining and the lid put on just before being brought on the stage. There are air holes in the lid just under the handle, so that the bird suffers no discomfort, and in any case it is only imprisoned in the lid for a few seconds. When the conjurer has lit the spirit in the pan, he takes the loaded lid, puts it on the pan and pressses it firmly down. Removing the lid now leaves the lining in the pan and permits the dove to escape. The lining, of course, hides the beaten-out ring. There is sufficient space between the bottom of the lining and the bottom of the pan for the ring.

Using Livestock

The same trick can be performed with several rings, which can be changed on the rod in the same way as that described for changing one ring. In place of a dove, the rings may appear tied round the neck of a small rabbit or, if the conjurer prefers not to use livestock, a teddy bear or golly-wog can be used. If several rings are borrowed, each can come to light tied round the neck of a different toy. This trick provides scope for topicality by the use of a stuffed figure from the latest Walt Disney film, or any other topical character that may be obtainable.

Fig. 5 shows a very unexpected way of reproducing a vanished ring. The jewellery having been disposed of in any way the conjurer chooses, a plate of eggs is brought forward and one selected. The chosen egg is put into an eggcup and cracked. Fishing inside the egg with a buttonhook the conjurer brings out the borrowed ring, which is then cleaned and returned.

The eggcup is prepared so that the ring is held vertically on edge. The chosen egg is secretly tapped on one end to crack the shell. It is then placed in the cup with the cracked end down, and the ring is thus forced into the egg, from which it is extracted as described. Figs. 6 and 7 show two egg cups; the first is a special egg cup sold by conjuring shops, having

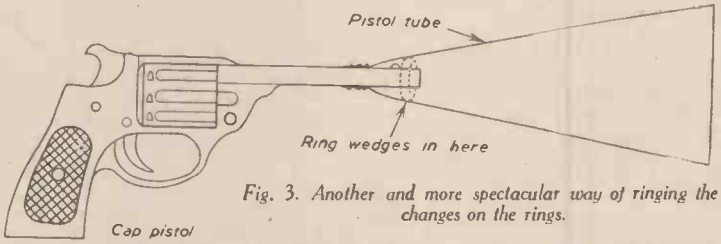


Fig. 3. Another and more spectacular way of ringing the changes on the rings.

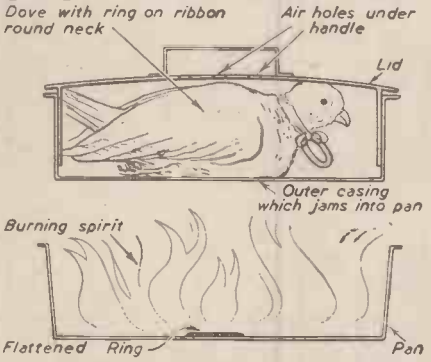


Fig. 4. The trick pan from which, in a most amazing manner a dove is produced together with the borrowed ring

WITH RINGS

Puzzling Tricks with Different Kinds

a groove to hold the ring. The second cup is an ordinary egg cup with a little piece of putty or modelling wax at the bottom, into which the ring is temporarily fixed.

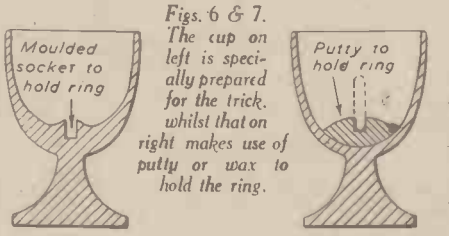
When doing this trick it is important to see that all the eggs offered for selection are on the small side, to ensure that they will go right down into the egg cup, otherwise, if a large egg were used, it might not reach far enough into the cup to enclose the ring.

Fig. 5. The egg about to be placed in the egg cup already holding the ring. Which pierces the shell and and is then withdrawn from the visible end.

With this trick the ring in the egg cup can be the genuine article, placed there before the cup is brought on, or it may be a dummy in which case the egg cup can be in view all the time. In the latter case, when the ring is removed from the egg, it is changed secretly for the genuine ring under cover of wiping it with a cloth, the real ring being concealed in the folds.

Stick and Scarf Trick

An easy and effective trick with a borrowed ring is shown in Fig. 8. A long stick is shown and two members of the audience are asked to hold the ends while a borrowed ring covered with a scarf is held over the centre of the stick. Although the ends are being held, when the scarf is



Figs. 6 & 7. The cup on left is specially prepared for the trick, whilst that on right makes use of putty or wax to hold the ring.

flicked away the actual borrowed ring is seen to be threaded on to the stick.

The stick is first shown and the conjurer tucks it under his arm while he borrows the ring. This is apparently wrapped in a big silk scarf but is really palmed and a dummy ring, sewn into one corner of the scarf, is brought to the centre and held as shown in Fig. 8. The right hand now takes the stick and in doing so passes the real ring on to it, the hand concealing the ring from view. Two spectators are now asked to hold the ends of the rod, and the scarf with the dummy ring gripped through it is draped over the rod. The right hand can now be taken away as the scarf hides the real ring. Fig. 8 will explain the whole situation.

The trick is now over as far as the conjurer is concerned, although to the audience it is only just beginning. Dropping the dummy ring and flicking away the scarf, the performer reveals the genuine ring threaded on the stick. The scarf is shaken out and thrown aside, the ring is returned and the rod can be examined.

Trick Cabinets

Devices for vanishing borrowed rings are shown in Figs. 9 to 12.

Fig. 9 is a cabinet with a drawer in the upper part. The cabinet stands on the palm of the hand, the ring is put into the drawer which is closed. Nothing happens until the drawer is pressed right home. This action releases the bottom of the drawer which drops on a hinge and allows the ring to fall into the hand. The cabinet is then stood on a table and the ring disposed of according to the needs of the trick. When the drawer is again pulled out, the hinged bottom is forced into position again by the action of taking the drawer out.

The cabinet in Fig. 10 looks very similar but its construction is entirely different. This cabinet contains two drawers, placed bottom to bottom. A sliding panel on the front of the cabinet works loosely up and down. When the cabinet is put down the panel hides the lower drawer. A ring having been put into the visible top drawer, the cabinet has only to be turned upside down in transferring it to another table

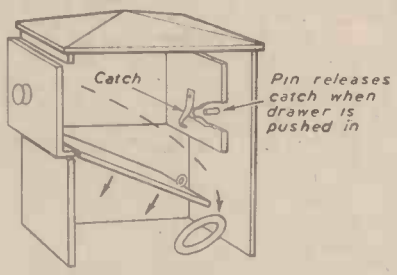


Fig. 9. Shows the simple construction of one form of trick drawer used for disposal of ring.

when the empty drawer comes into view and the ring remains hidden in the now concealed drawer, ready to be extracted by an assistant behind the scenes. With this apparatus it will be noted that the vanishing of the ring must be shown before the assistant can get possession of it, whereas with the cabinet shown in Fig. 9 the performer has the ring in his hand at once and can dispose of it ready for re-production before revealing its disappearance. The cabinet in Fig. 10 is, however, very useful for vanishing a dummy ring or for changing it into some other object. Another use for it is as follows :

A ring having been vanished and passed off to an assistant, it is put into one drawer of the cabinet, the cabinet inverted and brought on with the empty drawer visible. The conjurer now asks the owner of the

Fig. 8. An effective yet simple trick, once the actions shown in this illustration have been mastered.

ring to write an advertisement for her lost ring. The slip of paper she writes is put into the empty drawer, the cabinet is secretly turned over, and the missing property is found in place of the advertisement for it.

An entirely different principle is employed in the box illustrated in Fig. 11. This has a sliding lid, something like a pencil box. The ring is dropped in and by tilting the box as the lid is closed, the ring is allowed to fall out into the hand. This movement alone would probably be suspected by the audience, but the box contains an added secret which completely disarms suspicion. The bottom of the box has a hollow space in which a small weight works to and fro on a pivot. Normally the weight is held immovable by pressure of a spring. By pressing with the fingers against the bottom of the box, the weight is released and if the box is then shaken the weight rattles to and fro, sounding exactly as if the ring were inside the box. The ring having been disposed of, the box is rattled again, then suddenly pressure is relaxed, the rattling stops, and the box is opened and shown empty.

Fig. 12 is a simple type of slide to vanish a ring or change it to something else. It consists of a hollow casing in which a slab of wood can move up and down. There is a hole in the casing and two hollows in the slab. Either of the hollows in the slab can be brought under the hole in the casing. The apparatus is worked by means of a long pin in an outer case into which the slide is placed. The pin, passing through a hole in the casing, pushes the slab along until

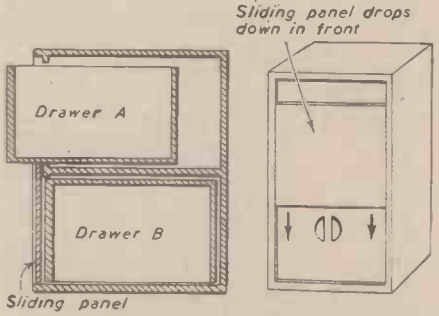


Fig. 10. A double-drawer cabinet giving greater scope than that shown in Fig. 9.

the second hollow takes the place of the first. The diagram will explain the detail of the construction.

The method of changing one ring for another by means of a rod, as illustrated in Fig. 1, can also be used for an effective trick in which a number of loose links are made apparently to weld themselves into

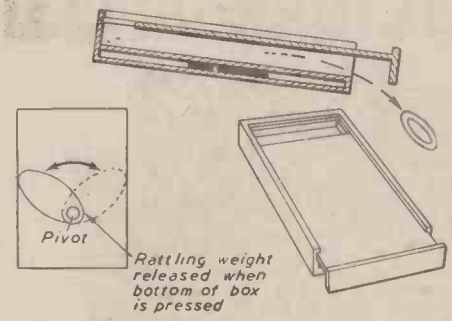


Fig 11. A very misleading effect is produced by a rattling weight fitted to this type of vanishing box.

a chain. All that is required is a short piece of chain and a number of similar loose links. The loose links can be got by cutting every alternate link from a piece of chain, which will leave a supply of whole loose links. A thin rod must be used, on to which the chain is threaded and concealed in the hand. The loose links are given to a member of the audience, with the request to thread them on to the rod. The performer then returns to the stage and pours the links into a glass bowl. Actually, he executes the change on the way back and the chain is dropped into the bowl, to be produced at the end of the trick.

Chinese Linking Rings

One of the most popular of all ring tricks is performed, not with finger rings, but with polished metal rings six to eight inches in diameter. The trick is usually known as the Chinese Linking Rings.

A number of rings are shown to be separate and a couple are tossed out for inspection. The conjurer then proceeds to link and unlink the rings, form designs with them, pass one through another, and so on. Yet the audience is quite convinced that each ring is solid and separate and with no joins or gaps in it.

The secret lies partly in the manipulation of the rings and partly in their construction.

The set usually employed consists of two solid and separate rings, a set of two rings permanently linked together, a set of three similarly joined and a "key" ring. This is a single ring with a gap of about an eighth of an inch, through which other rings may be passed.

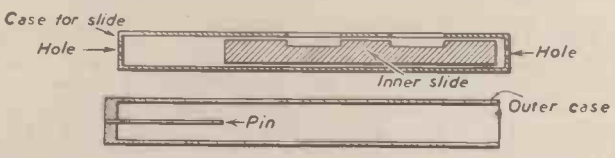


Fig. 12. A simple type of slide suitable for vanishing or changing small objects

The set is arranged in the left hand, as shown in Fig. 13. Commencing from the outside first, come the two loose rings, then the set of two linked rings, after them the set of three rings, and finally the key ring. The first move is to show the rings separate. To do this, they are allowed to drop rapidly one after the other from the left hand into the right, which is held a few inches below. The fact that some of the rings are linked together will not prevent them from dropping this short distance, exactly as if they were separate. The bunch of rings is then taken back in the left hand, as before, and the first two rings bounced on the stage to prove their solidity, and given or thrown out to members of the audience for inspection.

The conjurer now asks for one of the rings to be returned to him. Holding it in his right hand, he thrusts it into his left hand and at the same time permits one of the set of two linked rings to fall. To the audience it looks as if he has linked the just-examined ring through one of the others. See Fig. 14. I have omitted the remaining rings for the sake of clearness. The set of two rings is now removed by grasping the lower one and drawing the rings away, the single loose ring being held back by the fingers of the left hand. The set of two linked rings is now given for examination.

Next, taking the single ring that is ready in the left hand, the conjurer again bounces it on the stage to prove its solidity, and by repeating the last move, apparently links it to the next ring. Actually, he

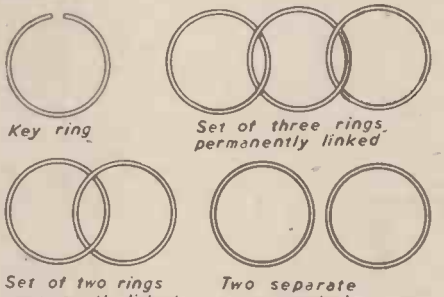


Fig. 13. The complete set of rings usually employed. Note the key ring and the two separate solid rings.

releases one of the set of three. He then asks for the return of the remaining single ring, and in exactly the same manner apparently adds it to the two linked rings. Actually, the set of three is now drawn out while the two loose rings remain in his left hand, along with the key. The set of three is passed for inspection.

At this point the member of the audience holding the two linked rings is asked if he can unlink them. Of course he says that he cannot. Another spectator is invited on to the stage and given the two solid rings, with the request that he shall try to link them. Naturally, he fails to do so. The conjurer then takes one of them and links it to the key ring, spinning the solid ring rapidly, while holding the key ring with the thumb covering the gap.

By now the audience will be fully convinced that all the rings are solid and some effective manoeuvres can be gone through linking and unlinking the key ring with one of the solid ones. The two rings can be apparently melted one into the other and apart again; in fact, it is advisable throughout the trick to suggest this melting of the rings through one another rather than to use any display of force. The second solid ring can then be taken from the spectator and a chain of three formed, the key being in the middle. As long as the rings are kept on the move, it is impossible for even the spectator on the stage to detect the gap, as the polished surface of the rings effectively camouflages the opening.

Various Designs with Trick Rings

The manipulation of the rings can now continue according to the fancy of the conjurer, the various sets and single rings being linked into designs by means of the key. Some examples are given in Fig. 15. (A) is a watch chain and is held

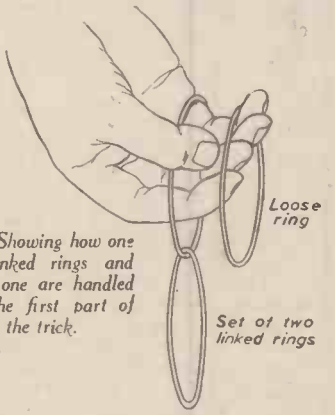


Fig. 14. Showing how one set of linked rings and one loose one are handled during the first part of the trick.

across the waistcoat. The cross (B) is made with the key at the point where the two arms of the design meet, the top ring being held in the mouth. The design at (C) is the two- and three-set linked with the key. (D) is a stirrup, the key being attached to the set of three after passing one end ring through the other end ring as far as it will go.

The concluding move consists of gathering all the rings in a bunch so that they hang from the key ring; the key is then held with both hands above the head, gap downwards. The sides of the ring are pressed apart, thus causing the gap to open sufficiently to allow all the rings to fall in a shower to the stage, where they will bounce and jangle about exactly as if they had all become quite separate again. This noisy and spectacular climax makes an excellent finish to the trick and always produces applause.

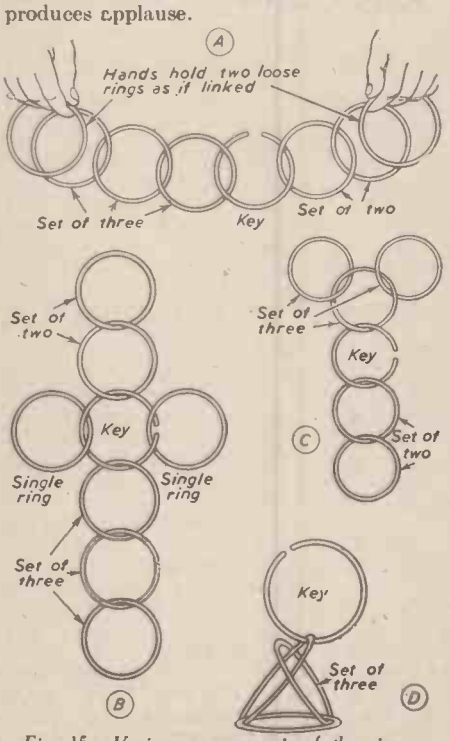
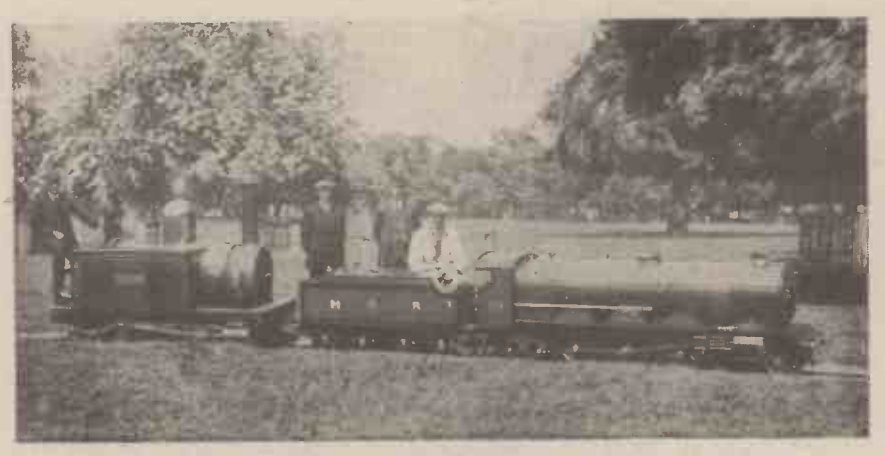


Fig. 15. Various arrangements of the rings. Each move is fully described in the text.

"MOTILUS" PEEPS INTO THE MODEL WORLD

A brief review of some interesting models from the great war of 1914-18, up to the present time.



Comparison in 15-inch gauge design—the goods tank locomotive "Katie," and the express passenger locomotive "Colossus"—a picture taken on the Duke of Westminster's railway at Eaton Hall, where the trials of the "Colossus" were carried out.

WHEN turning out some old photographs recently I came across a model railway picture taken in 1916, which I feel sure will interest readers as it shows the progress in 15-inch gauge locomotive design. The two locomotives depicted are the Goods Locomotive "Katie," which was built by the late Sir Arthur Heywood, Bart, of Duffield Park railway fame, and the express Passenger Locomotive "Colossus," first 15-inch gauge Pacific type locomotive ever constructed in this country, and the property of Captain J. E. P. Howey of Staughton Manor, St. Neots, Hunts. This locomotive has 4¾ in. by 6¾ in. cylinders, 150 lbs. pressure, an overall length of just over 18 feet, and a weight in working order of 3 tons. It was designed by Henry Greenly, and built by Bassett-Lowke Ltd., of Northampton.

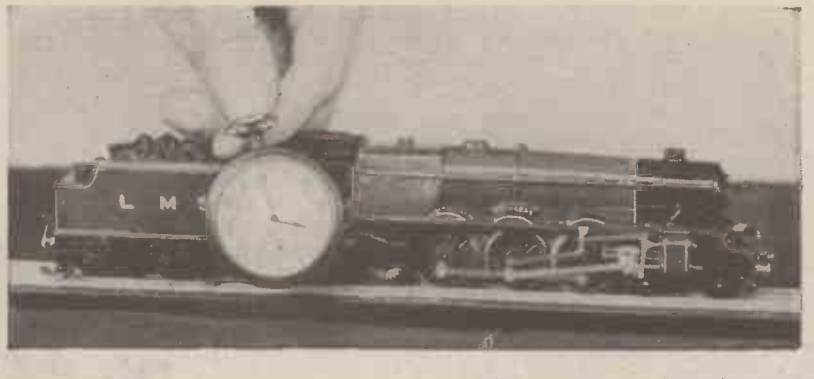
Captain Howey is sitting in the cab and behind is Mr. F. Green who was principally responsible for the construction of the locomotive. The picture was taken on the Duke of Westminster's railway at Eaton Hall, where the trials of the "Colossus" were carried out. The tests on this notable engine on the Eaton Hall line resulted in a load of 5½ tons being taken up a 1 in 82 gradient at 21½ miles an hour, and a top speed of 35 miles an hour with the engine running light. The "Colossus" was afterwards purchased for use on the Ravenglass and Eskdale Railway in Cumberland.

Model Tangye-type Engine

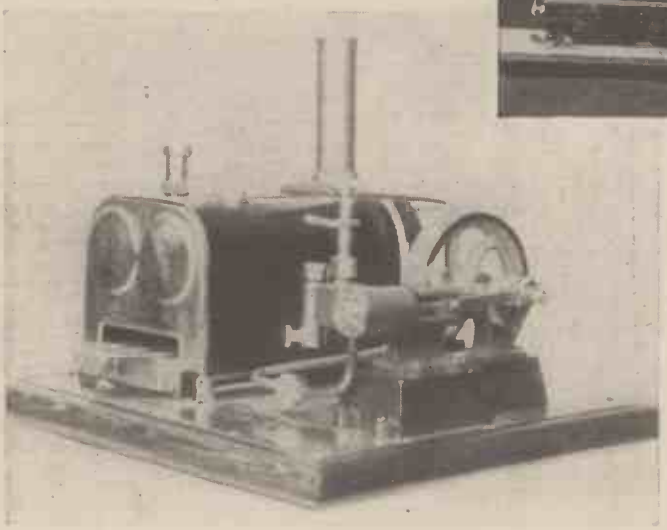
Stationary engines always seem to have an appeal during the wintry months, and the tendency now seems to depart from the usual nickel plate and elaborate finish so often seen with the toy type vertical engine and boiler (mostly emanating from the continent) in favour of the more strongly built all-British production. Here is an outfit comprising a Tangye horizontal type engine and a twin-drum brass boiler fired by methylated spirit. For driving small dynamos, a set of working models, or for general demonstration where steam power is required, a set of this type is the ideal thing, and it will stand up to really hard and continuous wear.

A Tiny "Trix" Locomotive

"How big is a Trix locomotive?" someone asked me the other day. One can state a length but somehow that does not really convey much. Here is a 4-6-2 L.M.S. Pacific "Princess" class "00" gauge T.T.R. locomotive photographed beside an ordinary pocket watch. Chiefly owing to the fact that the production of Trix equipment is a question of high grade precision tools, it is not possible in wartime to introduce new lines, but standard equipment can still be had. Although the Purchase Tax has increased the price some 20 per cent. in those goods where pre-purchase tax stocks are not available, the Twin Train Railway is still one of the best values in "00" gauge outfits, quite apart from its unique feature of running two trains on one track under separate control, and the electrically controlled points which are exclusive to this "00" production.



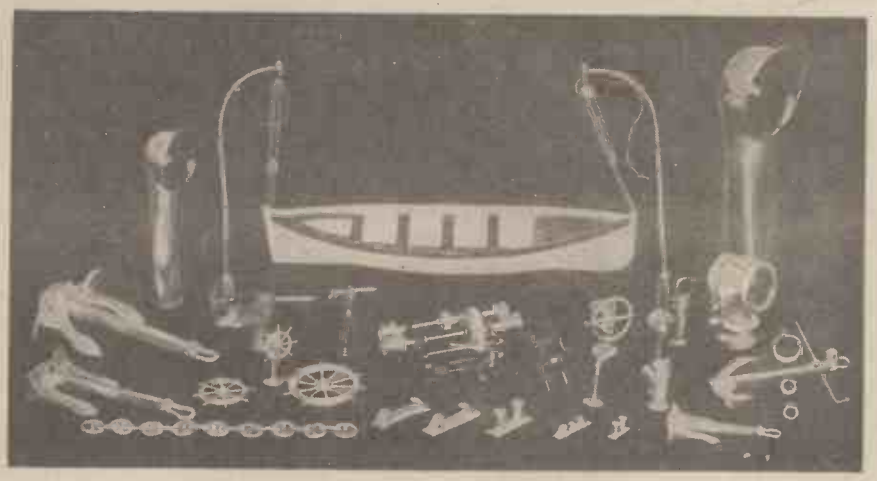
(Above) The T.T.R. 4-6-2 L.M.S. Pacific "Princess" class "OO" gauge locomotive compared in size with an ordinary pocket watch.



(Left) A well made model steam plant comprising a Tangye horizontal-type engine and twin-drum brass boiler fired by methylated spirit

Fittings For Ships Models

Ship fittings often have a great fascination even for those who are not ship-lovers, and here is an array of fittings made for using with exhibition models of various scales. The making of these fittings is a metal craftsman's job, for the quantities required, though large in total are small in "repeats." Not only are ship models made to various scales, but every ship has its characteristic and individual fittings. Very few indeed are standardised. Most fittings are made from rod or sheet

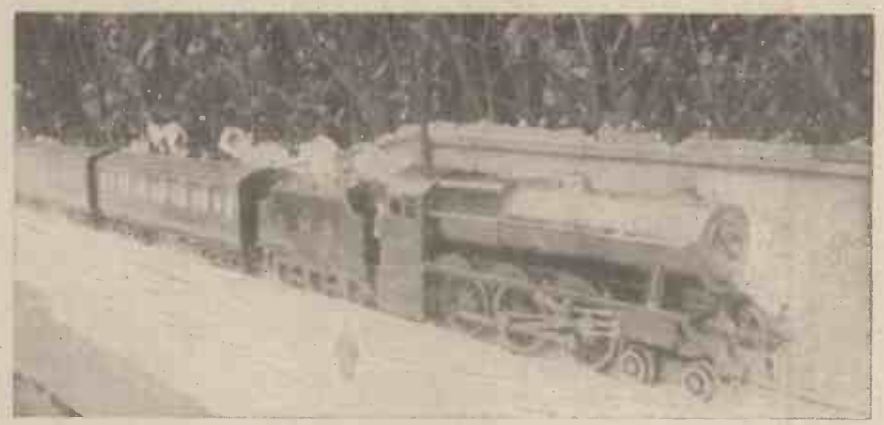


A collection of scale model ship fittings.

metal, and for others small patterns are constructed from which castings are made, and the finished fittings are worked up from the rough. In the early days of ship modelling fittings were always finished in gold or silver plate. Now shipping companies are asking for models that are exactly like the real thing. The fittings are still made with the same painstaking accuracy of form, and then they are either chemically coloured to represent the metal of the real ship, or enamelled in the lifelike colour. This finish in the opinion of some people takes away from the sparkling pristine smartness of a finished model, but it has the vital asset of being realistic, and "realism in models" like "fitness for purposes," used in reference to every day things, is a slogan that has been growing steadily in the past ten years.

A Realistic "0" Gauge Model Steam Loco.

"Running to Schedule in all Weathers," would, I think, be a fair title for the accompanying illustration. The engine will no doubt be recognised as a gauge "0" steam "Super Enterprise," but its owner, Mr. C. B. Smith of Lincoln, has fitted it up with a modified version of Walschaert's valve gear. He made this up from odd bits and pieces, which were quite tricky to rig up, but in his own words look "quite businesslike when running." Mr. Smith also removed the whistle from the cab and fitted it horizontally behind the dummy safety valves. It is now connected to the original whistle valve by a short copper pipe and union connection. Though the engine is not under steam in the picture it looks very well when steaming with the steam blowing off at the whistle. For this purpose the owner fitted a small brass deflector on the whistle outlet, as otherwise the steam would go off at an angle—a matter he had not foreseen when making the alteration. Other additions were lamp irons, brake pipe and dummy exhaust pipes to smoke box, and the additional realism of a tender fitted up with real coal. This locomotive has now run very nearly 100 actual miles—a matter of scale miles in gauge "0"—and this is actually a remarkable feat for the pistons of this engine!



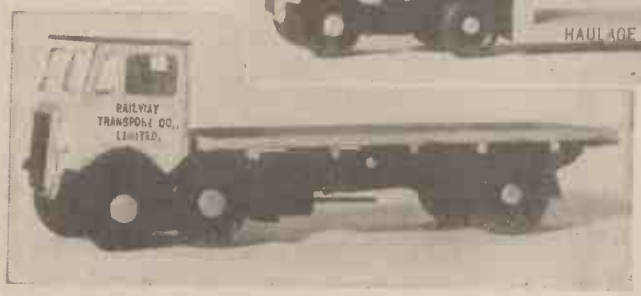
A gauge "O" steam locomotive "Super Enterprise" on the track of Mr. C. B. Smith of Lincoln.

Scale Model Lorries

At the present time the model railway owner, and especially the "00" gauge enthusiast has ample opportunities to improve the lineside appearance of his railway, and under this heading come Road Vehicles. When looking in Bassett-Lowke's shop in High Holborn the other day I came across a very nice new range of 3½ m.m. scale model lorries. These vehicles are described as the most exact and detailed models on the market. Designed by craftsmen and hand-made they are produced specially for the model railway engineer, and with their smart paintwork in three colours, aluminium painted hub-caps, lettered cab sides and true scale dimensions they are excellent little models. They are known as the "Wilson" range, and the two examples illustrated are a scale model 6-wheel bogie well wagon with 20-ft. chassis, and a 10-ton scale model lorry with flat body and twin steering wheels. The first mentioned is priced at 9s. retail, and the motor portion of the vehicle is on a swivel: the second model costs 5s. All are fitted with rubber tyres. In addition to the finished vehicles complete sets of parts are available. In a specimen set of instructions it is indicated that the model-maker requires only a sharp knife, sandpaper, a tube of adhesive, and a few rubber bands. A typical list of parts is given here as a matter of interest: 1, Channel section wood chassis; 2, Celluloid for cab windows; 3, Four cut-out cab sections; 4, Wheels (8); 5, Rubber tyres (11); 6, Shaped wooden body; 7, Radiator and headlamps; 8, Stripwood, card and wire for petrol tank, hangar, silencer and exhaust pipe, mudguard supports, mudguards, cab roof and floor.

To make up a kit of parts like this is ideal "home work" in the long black-out evenings, and when completed, the scale model lorry is well worth the time expended.

(Right) A scale model 6-wheel bogie well wagon with with 20-ft. chassis.



(Left) A 10-ton scale model lorry with flat body and twin steering wheels.

A New Engine

THE REV. W. J. BORER, Nebraska, has for four years been labouring to achieve what may revolutionise auto-motive power—a combustion engine with power far in excess of anything yet manufactured. The Rev. Borer and his associate, Mr. E. George, seek to make their engine adaptable to aeroplanes, tanks and motor-boats to eliminate vibration and reduce wear on cylinder walls. Its feature is that it has no connecting rods, but a drive arm of secret design. Five horse power can be developed at 4,000 revolutions per minute in their present 20 in., 36 lb. model.

The inventors believe that in an area 24 in. in diameter, between 600 and 700 horse power may be developed and that a 30 cylinder model will develop power far in excess of anything yet manufactured. Nothing larger than an 18 cylinder model has been put on the market.

QUERIES and ENQUIRIES

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

An X-ray Fluoroscope

I RECENTLY completed a Wimshurst machine, which gives me a spark of 5 to 6 inches. I am desirous of making some X-ray experiments. The X-ray tube I have already obtained, and would now like to make a fluoroscope. Could you please tell me a simple way of making same?—C. F. Burlison (Bradford).

WE feel bound to say that the only really satisfactory fluorescent materials for preparing an X-ray fluoroscope are magnesium platinocyanide and barium platinocyanide, both of which are obtainable in small quantities from Messrs. John Matthay & Co., Ltd., Hatton Garden, London, E.C., but which are very expensive.

You might try, also, fluorescent zinc silicate, which could be obtained fairly cheaply from Messrs. Harrington Bros., Ltd., Oliver's Yard, City Road, London, E.C.1, and it is just possible that this firm might be able to supply you with one or two other cheap fluorescent materials suitable for fluoroscope preparation. Having obtained your fluorescent material, powder it well and incorporate it in a little celluloid varnish or clear spirit varnish (obtainable from any large paint stores) so that a mixture the consistency of paint is obtained. Spread this on a clean glass sheet and allow it to dry. When dry, bind the sheet up with another sheet of clear glass and your fluoroscope will be ready for service. When not in use, it should always be kept in the dark. Greater details on the making of a fluorescent screen can be found in most textbooks describing X-ray apparatus.

Engine Lubricant

COULD you please tell me if any form of engine lubricant can be obtained from tar or pitch, and if so, how is this accomplished? In a book I have at hand, I read that the Greeks and Romans extracted pitch, tar, resin and turpentine from trees from the forests of Europe. Would you please inform me how tar and pitch is obtained from wood, and which is the most suitable British timber? Also, could a smooth protective substance be made by mixing resin and lime, which could be applied to steel to protect it against salt water?—D. Peat (Glasgow).

THERE is no form of engine lubricant obtained from tar or pitch, since these materials are sticky, and are devoid of all lubricating properties.

Tar and pitch may readily be obtained from wood of any variety by placing the wood chippings in a glass retort, or a metal vessel provided with a delivery tube, and by heating the chippings strongly. Gases will be evolved, and from the end of the delivery tube will drop a brownish liquid which will separate into two layers, an upper one consisting of methyl alcohol, water and acetic acid, and a lower one consisting of wood-tar. This wood-tar is a complex mixture of various materials. When it is carefully distilled, the lighter constituents boil off, leaving a heavy, viscous material—pitch.

Pine is about the best wood for this purpose.

Resin and lime do not make a good mixture, and, as such, would not be suitable for application to metalwork of any description.

The best material for this purpose is ordinary bitumen, which can be applied in the molten state, or, better still, can be dissolved in benzene or naphtha and painted over the metal work in one or more coats. This will completely protect the metalwork from the action of salt water.

Waterproofing Fishing Lines

CAN you advise me how to make a water-proofing oil for flax fishing lines? Also, what is the effect of putting 83 cycle supplies across 50 cycle bus-bars, or motors?—W. Singleton (Blackpool).

IN order to water-proof your lines, the best plan would be to purchase a pound of aluminium stearate from Messrs. A. Boake, Roberts & Co., Ltd., Stratford, London, E, and to dissolve this in petrol, paraffin or naphtha. Soak the lines in this solution, or draw them slowly through it

several times, afterwards hanging them up to dry. The lines, of course, must be quite water-free before you commence the treatment. They will then be quite waterproof and will remain so for a very long time.

Your experiment of imposing an 83 cycle current on a 50 cycle one would merely give you an irregular pulsating current quite useless for practical purposes.

Glazing Rough Tiles

I HAVE a smooth face cement surface of tiles which I want to glaze to withstand heat, hot water, etc. Can you please give me details of any method of doing this?—L. R. Ackland (Plymouth).

ALL durable glazes and enamels for cement or tile work are applied to the cement or other surface by means of a muffle furnace. This, of course, is impossible in your case, since we presume that the surface which you wish to glaze is a portion of a room or a building.

We fear, therefore, that you will not be able to obtain the durable glaze you desire, since it would appear that you are seeking a glazing substance which can merely be brushed on to the cement surface, and left to dry and harden. If there is any such durable material known (which we doubt), an enquiry to the Technical Department of the Associated Portland Cement Manufacturers, Ltd., Tothill Street, London, S.W.1, would bring you the requisite information. You can, of course, "glaze" a cement surface by applying varnish to it, but such a "glaze" would not be heat proof or permanently water resistant.

Silica Gel

I SHOULD be grateful if you could explain to me the works method of manufacturing silica gel from sodium silicate? I am particularly interested in the "gel" that is used for freeing air from moisture for blast furnaces.—N. Hindle (Peshawar, India).

WHAT you refer to as silica gel is an amorphous form of silica (silicon dioxide—SiO_2). It is prepared on small and large scales by treating a fairly strong solution of sodium silicate (waterglass) with a moderately dilute mineral acid, such as hydrochloric acid.

A gelatinous mass of silica is precipitated and it is appreciably soluble in water. It will not, however, pass through a dialysing filter. The silica, therefore, is filtered off, and dried for several hours at 100°C. After several hours drying at this temperature, the product will still retain tenaciously about 13 per cent. of water. It is afterwards dried for several hours at 200°C (not more), the eventual result being a product which contains about 5½ per cent. of retained water. This material, which is a hydrated silicon dioxide of uncertain composition, is the one to which you refer when you mention its use as a dehydrating agent.

Making Firelighters

COULD you inform me as to nature of the materials used in firelighters? I believe sawdust and creosote are two of the materials. Would there be any danger of fire in making the firelighters?—E. H. Brown (Broughton).

THE firelighter material to which you refer consists of coarse sawdust impregnated with crude creosote oil in which a small proportion of crude naphthalene has been dissolved.

You can make up a suitable impregnating solution for firelighter-making by dissolving 5 to 10 parts of crude naphthalene in ordinary crude creosote oil. This is carefully poured over the sawdust until it saturates it, whereupon the saturated sawdust is bound up with wood chippings, the whole being lightly compressed in order to make the firelighter. You can obtain the materials mentioned above from your local firm—Messrs. Lord's Tarworks, Eccles New Road, Weaste, Salford. Creosote oil and naphthalene are both inflammable, but there will be no danger from fire in making the firelighters so long as you do not bring a naked light near to the materials. We must remark, however, that creosote is known to be a cancer-producing agent, and that long contact with creosote over a number of years sometimes produces a skin cancer. Bearing this in mind, therefore, you should handle creosote as little as you can.

Flash Powder and Flashlight Bulbs

CAN you please give me information on the following subjects?

(1) How can I make or procure a substitute for celluloid: something more inflammable, which burns in a flash when ignited. (For photographic flash sheets)?

(2) Formula for smokeless flash powder.

(3) What is the nature of the metal foil used in electrically fired photographic flash bulbs?

(4) Would this foil ignite without the aid of the oxygen in the bulb (i.e., in the open air), and where could I obtain this foil?—Hugh Norman (Belfast).

(1) Gun cotton is more inflammable than celluloid and, when ignited, it burns with exceeding rapidity. A still quicker burning material may be made by soaking thin rice paper (or thin tissue paper) for 24 hours in a mixture of 2 parts of concentrated sulphuric acid and 1 part of concentrated nitric acid. After immersion in these mixed acids, wash the paper in several changes of warm water and allow it to dry. This material, when ignited, will flare up and burn almost instantaneously. To obtain the quickest burning, the paper must be as pure and as thin as possible.

(2) There is no really smokeless flashpowder. One burning with the minimum of fumes may be made up as follows: Scatter 3 parts of fine magnesium powder on to a sheet of newspaper. Then scatter over it separately 6 parts of powdered potassium chlorate and 1 part of powdered antimony sulphide. All these ingredients must be very finely powdered and *perfectly* dry beforehand, and they should be stirred and mingled together *very gently* by means of a feather, the resulting powder being stored in small quantities in dry bottles. We feel bound to add that flashpowder making is really a dangerous operation, since the powder is often liable to ignite on the gentlest friction. If, therefore, you only require such powder on one or two occasions, it is far better to purchase it from your local photographic supply dealer.

(3) The metal in the electrically-ignited flashlight bulbs is aluminium foil of extreme thinness. The foil would ignite without the aid of oxygen (provided, of course, that there were ordinary air in the bulb) but it would not burn with the vivid intensity and rapidity which it does when ignited in an atmosphere of oxygen. The aluminium foil is usually manufactured abroad, but you might be able to obtain supplies from Aluminium, Ltd., Bush House, Aldwych, London, W.C.2, or from Invicta Foil Co., Ltd., Norway Wharf, Commercial Road East, London, E.14.

THE Cyclist
Editor : F. J. CAMM

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Comments of the Month

By F. J. C.

The Rise in Road Accidents

IT is not often that we find ourselves in disagreement with the C.T.C., which for the past sixty years has efficiently and zealously guarded the interests of cyclists, guided the Government on legislation, corrected misinterpretations of the law, encouraged cycle touring, advised manufacturers, and in many other ways safeguarded the pastime. The C.T.C. did, indeed, lay one of the foundation stones of the industry and the pastime. It has always been our pleasant duty to support the C.T.C. because we have sincerely felt their policy to be sound, their arguments unanswerable, and their attitude always conciliatory because they appreciate the viewpoint of other road-users.

We now, however, disagree with the views expressed in a letter circulated last month under the joint signatures of Mr. G. Herbert Stancer, the Secretary of the Cyclists' Touring Club, and Mr. T. C. Foley, the Secretary of the Pedestrians' Association. In the first place we feel that the C.T.C. did not need the support of the Pedestrians' Association for its views. If it did need support we suggest that it would have been better for the letter to have been sent by the National Committee on Cycling and signed by all its constituent bodies. Of all bodies concerned with road users, it is our view that the Pedestrians' Association is the least necessary, and cyclists do not need the support of pedestrians, for we are all pedestrians as well as road-users. A man who does not own a cycle, motor-cycle, or car, ceases to be a pedestrian when he boards a tram or bus.

This is the letter which was circulated to the Press :—

> It is very discouraging that, side by side with a campaign for road safety, the number of road accidents each month should be steadily mounting. The experience gives no grounds for believing that an intensified propagandn campaign, as announced by the Parliamentary Secretary to the Ministry of Transport, is likely to reduce the toll.
>
> The standard of motor driving was never so low as it is to-day, and the discontinuation of driving tests has removed an important public safeguard. Although there are fewer cars on the roads, a large proportion of them are driven recklessly and at excessive speeds, both in the black-out and in daylight, in town and in country. No amount of preaching at the public is going to help, as it is simply beyond their capacity to cope with these conditions without accident.
>
> What is needed is action—a resumption and intensification by the police of the prosecution of road offenders, and the imposition by magistrates of really deterrent penalties, particularly the suspension of the licence.

We are not in accord with these views, which we consider likely to damage the cyclists' cause, in that they may lead those in authority to presume that cyclists are adopting an unreasonable point of view. We have driven every night since the war started through the black-out, and on most occasions we have been accompanied by well-known cyclists who can support our point of view. We have not witnessed any abnormal amount of bad driving, far less, in fact than took place in peace-time. The number of drivers who jump the lights, as alleged by the police, is very small indeed, and even in those cases which have come within our personal observation, the lights have only been jumped at crossings where it was quite safe for the drivers to do so, for they had a clear view in all directions and there was no other traffic at the junctions.

The Standard of Driving Skill

THE letter quoted states that the standard of motor driving was never so low. On what evidence does the C.T.C. and the Pedestrians' Association make such a sweeping assertion, and are they judges of the matter? It is, of course, fantastic to suggest that with fewer vehicles on the road, skill has dropped. The letter implies that all the skilled drivers of motor vehicles have put their cars in storage for the duration of the war, and only the reckless ones remain. This, of course, is absurd, and unsupportable. The letter also says that although there are fewer cars on the roads, a large proportion of them are driven recklessly and at excessive speed. Again we ask, on what evidence does the C.T.C. and the Pedestrians' Association assert this, and what investigation have they conducted? Any? The grim facts have to be faced that in the interests of home security, the Government has imposed the black-out, and thereby created a war risk. Pedestrians, as well as cyclists, still presume that conditions are the same for drivers of cars as in peace, and from our own knowledge we assert that a large proportion of the accidents could be avoided if pedestrians exerted greater care. The black-out imposes its own limit on speed, and we do not agree therefore that a large proportion of cars are driven at excessive speeds during the black-out. A few may be during the day-time, and it would be interesting if the Government analysed the accident statistics, so that we may be informed as to the types of vehicle involved in accidents, and particularly the number of military vehicles and lorries. In this connection it is worth recalling that four summonses against a civilian lorry driver were withdrawn by the police at Norwich on the grounds that the lorry was part of a military convoy. We must remember that military traffic claims that it is entitled to drive at speeds up to 50 miles an hour.

Cyclists to be Watched

IT is significant that the Commissioner of Police for the Metropolis has issued an instruction to all Metropolitan policemen to watch all cyclists to ensure that the black-out lighting rules are observed. We would therefore advise all cyclists to put their house in order in this respect, for we have observed (and can provide evidence of such observations) cyclists riding without a rear light on many occasions. A prolific cause of accidents are the road islands, some of which are unlit, whilst some have white lights and some red. In connection with this matter, the R.A.C. and the National Cyclists Union have struck a bargain. The N.C.U. approached the R.A.C. and asked it to use its influence with motorists to give to cyclists greater consideration when overtaking. The R.A.C. agreed to make this appeal, and asked the N.C.U. in return to draw the attention of cyclists to the danger to themselves and other road-users caused by not displaying front and rear lights during the hours of darkness, and most particularly in the early evening and the last hour of the black-out in the morning. The N.C.U. agreed to this proposal, and we applaud their action, which we think is preferable to a policy of always blaming it on the other man.

Tyre Shortage in Germany

IT is reported that the rubber shortage in Germany has brought forth a Nazi decree against German cyclists, stipulating that they may not carry passengers on the steps of their bicycles. If true, this is particularly quaint, for the amount of additional wear caused by an occasional lift of this character is negligible. The carrying of passengers on bicycles equipped with a single step—that relic of the old days when middle-aged people mounted their machines from it—has a more serious disadvantage in that it tends to buckle the wheel and twist the frame. Ideally, there should be a step on each side. It could be argued that in giving a passenger a lift on the step of a bicycle the passenger is saving shoe-leather, of which there seems to be an equal shortage in Germany; or that he is saving the wear on passenger-carrying vehicles.

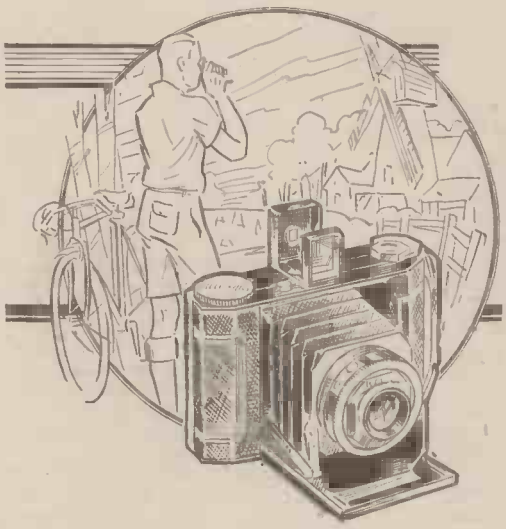
No Curfew for Motorists

LT. COL. MOORE-BRABAZON, the Minister of Transport, was recently asked in the House of Commons to consider the imposition of a curfew on private motor vehicles, with a view to lessening the accidents to pedestrians during black-out hours. As was naturally anticipated, the Minister of Transport refused to make any such order, for it would be as sensible to ban motoring during the day-time because pedestrians are killed in the day-time. It would be far better for cyclists and other road-users if jay-walking were made a penal offence.

Accident Statistics

THE monthly return of deaths caused by road accidents in Great Britain shows an increase over the figures for the corresponding month—November, 1939. During the fifteen months of war, 11,424 persons have been killed in road accidents, which compares with 8,283 for the fifteen months preceding the war. Most of the fatal accidents occur during black-out hours, and over half of the victims are pedestrians. There is a moral here, and it is not indicated in the letter quoted in the first column.

Paragrams



Actress Awheel

DIANA WYNYARD, the famous actress, makes most of her spare time to seek seclusion awheel. "When I get into the country," she states, "I always take out my cycle and do some riding about the lanes." Like Mary Ellis, Diana Wynyard is an expert cyclist now.

Handlebar Baskets

THERE are probably more handlebar baskets now in use than ever before. Visitors to either Cambridge or Oxford have always commented on the tremendous number of cycles, each equipped with basket, seen in the busy streets. Now that mor utility cyclists than ever before are on the roads there has been a great demand for baskets.

Bicycle for Pope

WHEN Bartali, the Italian road champion, was received in audience by the Pope, he offered his Holiness a cycle. This was accepted and handed to a missionary.

Cycling in Paris

WAR conditions have made the cycle in Paris more popular than ever. At a mannequin display one of the most attractive presentations was a special cycling ensemble.

Treat for Highgate C.C.

SIR CHARLES McREA has again promised members of the Highgate C.C., of which he is president, that when he becomes Lord Mayor of London he will arrange for the club's annual dinner to be held in the Mansion House.

Twenty Years' Service

CHARLIE BURNETT has been hon. social secretary of the University Cycling Club (one of the most flourishing of eastern road clubs) for over 20 years.

Torpedoed

A FORMER active racing member of the Dukinfield C.C., Sub-Lieut. S. Jones, R.N., has been in more than one naval engagement and was in the water for three hours when the ship on which he was serving was torpedoed.

Carrying On

ALTHOUGH it may be less elaborate than in previous years, the annual Cummock Rally, organised by the West of Scotland Cyclists' Defence Committee, will certainly be held in 1941. Robert Marshall, secretary of the committee, will organise it.

B.S.A.'s for West Africa

A STRONGLY-MADE roadster bicycle specially designed to meet the needs of cyclists in Nigeria and the Gold Coast, is being despatched to West Africa in large numbers by B.S.A. Cycles, Ltd., as part of their present intensive export drive in more than forty different countries.

Built primarily for strength and reliability under arduous conditions rather than for speed, the West African Roadster is equipped with B.S.A. detachable oilbath gearcase, D-section mudguards, extra large leather saddle, and a combined rear carrier and stand, as seen in the illustration on this page.

Many of the natives use the carrier for the transport of produce, a typical load being four tins of Palm Oil (the liquid variety) each containing four gallons.

Clubmen in the News

JACK SIBBITT, 14 times N.C.U. champion, has been made a Life Member of his club, the Manchester Wheelers. Stanley Miles, well-known and appreciated member of the Century Road Club, is now with H.M. Forces in Egypt. Both W. Thompson and L. Innes, holders of the End to End tandem record, are serving with the Crown forces. Innes is with the R.A.F. Fred Green, founder member of the Southgate C.C. in 1882, has died. J. Cecil Paget, North Road C.C., has moved from his haunts at St. Neots to South Devon. He was formerly Mine Host of an inn at Woodbridge, Suffolk. Habitués of the Great North Road will miss him. The many friends of Jack Middleton, former holder of the Liverpool-London cycle record, will be amused to hear that he is in the army and training to be a cook! After being reported "missing" for many months, news has been received that W. J. Billings, well-known time-trial member of King's Lynn C.C., is a prisoner of war. President of Stafford Velo Club, Capt. S. A. Bower has been awarded the Croix de Guerre following the operations in Norway.

Scunthorpe's Cycling Steelworkers

STEPS are being taken to arrange for Scunthorpe steelworkers—hundreds of whom cycle to and from work in the darkness—to adjust their shifts so that the number of cyclists on the roads at the end of the shifts is reduced. The long stream of cycle lights, it is felt, might help an enemy raider, and although it has been suggested that the riders should dismount and put out their lights on the sounding of the alert it is felt that this is hardly practicable.

Forty Years—Then Caught

A 63-YEAR-OLD Lincolnshire man—a cyclist for 40 years—who was charged at Skegness with riding at night with an improperly screened front lamp stated that after being stopped by one constable and told he would be reported he was seen by another constable who just said "Good-night" and made no comment about his lights.

West African natives with their B.S.A. roadster, carrying a load of palm oil on an "outsize" carrier.

Sort of Accidentally

"GUILTY by accident," was the plea made by a Grimsby cyclist who was charged at the Borough Police Court with having lights on his machine that were too bright for these dull days.

Scott Called-up

WILL SCOTT, Scotland's best short-distance cyclist, has been unexpectedly called-up, and is now serving in England with the Royal Engineers. Aged twenty and a member of the Crawick Wheelers, Scott is a Dumfriesshire miner. He started serious competitive cycling in 1938, and in the two following seasons won almost every time trial in which he competed.

Scott holds the Scottish 25, 30 and 50 records, and had meant to try a 100 during the coming season. His admirers believe that it is within his powers to bring the Scots 25 record under the hour for the first time. Quiet and modest, Scott has often led his team-mates to victory, and they remain to carry on the fame of the Crawick club. They include his brother David, who is eighteen years of age, and J. Tudhope and D. Adams.

More Scots Promotion

SEVERAL further Scots cycling bodies have decided to promote open events during 1941. They include the Mid-Scotland Time Trials Association, Shotts Wheelers, Glasgow Nightingale C.C., Glasgow Wheelers, and the Douglas C.C. These, together with the clubs which have previously intimated their decision to continue promotions, assure West of Scotland and Mid-Scotland cyclists of a programme next season.

"McGougan Case" Again

THE biggest controversy in Scots cycling circles since the massed-start debate of three years ago concerns the now-famous "McGougan Case," which has grown from a simple matter of censure to a divergence of opinion between the two biggest bodies in Scottish road sport.

It arose out of a case of alleged pacing by J. McGougan, West of Scotland Clarion, in his club's open event late in 1939. The West of Scotland Time Trials Association passed a vote of censure on McGougan, but did not suspend him. This vote was the subject of protest by a majority of the Clarion committee, which decided to refer the matter to the Scottish Amateur Cycling Association.

The Clarion protest was upheld by the latter body, despite objections by the West of Scotland Time Trials Association, which claimed full right of censure under the wartime regulations of the S.A.C.A. Later, the W.S.T.T.A. referred the S.A.C.A. decision back, and unless a settlement can be found, there may be serious repercussions in the organisation of Scots road sport.

The matter was to be further discussed at the annual meeting of the W.S.T.T.A., which was due to be held by the time this issue appears.

Clubrooms in Scotland

WHILE such clubs as the Glasgow Wheelers and the Johnstone Wheelers have lost their clubrooms by requisitioning, the Douglas C.C. is keeping its first-rate rooms at Stepps, near Glasgow, in the hands of members.

The recent annual presentation of the Douglas was held in the rooms, and attracted eighty members and friends. "Lion" of the evening was K. M. Cochrane, club champion and breaker of the club 25 and 30 records during 1940.

Glasgow Clarion cyclists, too, have decided to keep their clubrooms going, despite troubles caused by the war, and are inviting further support from the twenty Clarion sections in and around Glasgow.

Scheme to Prevent Clashes

THE time trials associations covering the West of Scotland, Mid-Scotland, and Greenock; are to prepare their lists of 1941 time trials jointly to prevent events clashing with others in adjacent districts.

Success of Outdoor Lectures

BIGGEST success of the second wartime winter in Scotland is the series of gatherings held by the Scottish Youth Hostels' Association in the Glasgow High School, Elmbank Street, Glasgow.

Held every Monday evening, these lantern lectures by cyclists and walkers attract between two and three hundred outdoors enthusiasts weekly. Admission is free, but collections have raised substantial amounts.

Threat to Beauty Spot

LEAD-MINING operations in the Rheidol Valley, not far from Devil's Bridge, near Aberystwyth, are causing concern. This area is very popular with touring cyclists.

Observations are being taken of the effects of the mining, with a view to preventing pollution. Only in recent years has the River Rheidol recovered from previous pollution caused by mining.

Oldest Hostel Tourist

MISS SMITH, believed to be the oldest consistent hostel tourist in Scotland, died recently at Ayr, after a short illness, at the age of 74.

Three years ago she undertook a strenuous cycling tour of the North-West Highlands by bicycle, using youth hostels. She was also an official of the Scottish Youth Hostels' Association.

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Tube 2/7. Cover **7/2**

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Tube 1/10. Cover **4/5**

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Tube 2/4. Cover **6/1**

SENTINEL High quality at a wonderfully low price! Amazing value only possible through the experience and skill of Firestone Tyre Engineers, combined with the facilities of the World's most Modern Tyre Factory. Sizes 28 x 1½ and 26 x 1½, Black only. 26 x 1⅜ and 26 x 1¼, Red or Black.

Tube 1/7. Cover **3/6**

Purchase Tax additional to all listed prices.

FIRESTONE TYRE & RUBBER CO., LTD., GREAT WEST RD., BRENTFORD, MIDDX.

C. A. ("Bath Road") Smith (left) handing over the Bath Road "100" cup, which he won outright in 1891-2, to the president of the Bath Road Club—J. Burden Barnes—at their 53rd Annual "Dinner" (this year a luncheon) at the Monico on Dec. 14th.

AROUND THE WHEELWORLD—By Icarus

R.T.T.C. Unofficial Meeting

THE Secretary of the R.T.T.C. invited the delegates and secretaries of the London District Councils of the R.T.T.C. to attend an informal meeting at the C.T.C. offices on Sunday, January 5th. The object of the meeting, which was unofficial, was to ascertain what programme of road sport was contemplated in London during this year. The Secretary stated that he would report the result of the meeting to the National Committee, which met on January 12th. I fear that the Secretary did not learn much more than has already been announced by speakers at annual luncheons and dinners. Few clubs had held their A.G.M. by January 5th, and thus were only able to express their hopes and intentions. However, most of the speakers did assert that they intended to run a full programme. Mr. J. C. Beauchamp stated that there was every possibility of the Bath Road Club staging its classic "100" and Jubilee "50" events this year. The meeting seemed somewhat aimless, and I left with the impression that the R.T.T.C. secretary should have invited other districts to get together on the same date, so that the information could have been garnered on a national scale. The Secretary explained that there were no rules under which he could call a national meeting of delegates. One speaker referring to the fact that this was the second occasion on which such an unofficial meeting had been called, advised the Secretary to seek powers to call official meetings. As it was, he thought a parochial aspect was given to the R.T.T.C., which exists as a national body, and the holding of these informal meetings to which only London delegates are invited is likely to cause resentment in the provinces.

Panel Of Watch Testers

THE National Committee of the R.T.T.C., at their meeting of January 12th, considered that every effort should be made to maintain the standard of timekeeping. The B.H.I. have, it is thought, discontinued their tests during the past few months, and thus timekeepers are in a difficulty in getting their watches approved. The General Purposes Committee has been empowered to appoint on the recommendation of the District Committees, a panel of testers for watches under Rule 30, which is enforced at the discretion of local councils. The examination of the watches is to be made in accordance with existing rules and specification. The testers must give a certificate in an approved form and manner, and all testers must agree to a common fee which shall be a condition of their appointment. The R.T.T.C. test is a simple one, which could be undertaken by any without watch knowledge, and it is no index of a reliable watch. The limits are far too wide and the test could actually be passed by a watch costing 2s. 6d. The specification for the watch laid down ("17 jewels," "over-coil hair-spring") should be associated with a closer rate than 30 seconds a day.

R.T.T.C. News

THE National Committee's annual report and financial statement is to be sent to each affiliated club, together with a form for the payment of the annual subscription of 2s. 6d.

W. W. Greaves has been reinstated as an amateur as from January 12th, 1941. A dates list for 1941, with week-ends keyed, is to be published.

N.C.U. News

IN spite of the war, the N.C.U. membership renewals have come in at a greater rate than at this time last year. During 1940, about 250 legal cases have been dealt with by the Union, and over £8,000 been recovered as compensation for members. The Union has received the sum of £6 15s. 10d. from the Loyals Cycling Club of the Loyal Regiment, Malaya. It was stated that this was the profit made on recent meetings at Malaya.

The Lighting Order

THE following statement has now been made to the Manufacturers' Union by the Ministry of Home Security: "With reference to your letters of November 27th and December 2nd, Chief Officers of Police have been informed that a cycle rear lamp having an aperture of slightly less than 1 in. in diameter may be regarded as complying with the regulations, provided that it satisfies the requirements relating to the distance at which the light is visible."

Honour for Hans Renold

CONGRATULATIONS to Hans Renold, the founder and director of the Renold and Coventry Chain Co., Ltd., on being made an Honorary Doctor of Science by the Manchester University, in recognition of his many engineering achievements, including the invention of the bush roller chain. Mr. Renold was the first manufacturer in Manchester to use electricity for power purposes, taking a supply from the Manchester Corporation. Forty-four years ago Dr. Renold instituted a 48-hour week, which at that time was looked upon as unprecedented in history. Dr. Hans Renold, now in his 89th year, is still active, and pays regular visits to the works of which he was the founder.

Dr. Hans Renold, who was recently made an Honorary Doctor of Science by the Manchester University.

It is now sixty years since Mr. Renold bought the business in Salford which was the foundation of the Renold organisation. In 1930 Hans Renold Limited merged with The Coventry Chain Company Limited, and is now known as The Renold and Coventry Chain Company Limited—the largest chain manufacturers in the world.

It was in 1879, when in his early twenties, that Hans Renold bought, for £300, a small Salford business, from one, Slatter, the inventor of the bowl type of chain. The chains then manufactured were balance, monkey and common roller chains. When Hans Renold took over the business he continued to manufacture these chains, which were used for textile machinery, but it was the development of the "Safety" bicycle in Great Britain that gave the real start to the chain business and laid the foundation of the "Renold" organisation.

The patenting of the bush roller type of chain in 1880 by Hans Renold was an epoch-making event, not only in the history of the company, but in the development of that great British industry, the Cycle Trade, for when J. K. Starley produced his now famous "Safety" cycle, he was unable to make it a complete success for lack of a durable chain. It was to meet this need that the Renold bush roller chain was developed, and may be regarded as one of the two or three great inventions that made the modern cycle a possibility.

The Road Transport (Defence) Advisory Committee

THIS Committee was formed in 1938 for the purpose of reviewing the detailed plans which had been provisionally worked out by the Ministry for the control of the transport of goods by road in time of war, and to review the position at intervals.

Its main task was thus largely discharged before the outbreak of war, although it has been consulted by the Minister from time to time since.

The recent setting up of the Road Haulage Consultative Committee, a step in which the Minister was influenced by the representations of the Road Transport Defence Advisory Committee, has transferred to the former body, which is directly linked with the various Associations of operators, the greater proportion of the questions upon which the Minister may, from time to time, find it desirable to seek advice, and in consequence the necessity for consultation with the Road Transport Defence Advisory Committee will be less likely to arise in the future.

The members of the Road Transport Defence Advisory Committee, however, have agreed to continue to hold themselves at the disposal of the Minister, so that their assistance may still be available to him should any questions arise upon which he desires to consult them.

Trouser Clips Tax-Free

AS the result of representations made by the Manufacturers' Union, trouser clips are now tax-free. Formerly they had been subject to the tax.

53rd Bath Road Annual "Dinner"

THE 53rd annual "dinner" of the Bath Road Club took the form of a luncheon this year at the Monico, on December 14, when 60 members and guests were present. The usual Bath Road spirit pervaded the luncheon which, in spite of the hour and the times, lost none of its usual conviviality and good fellowship. President J. Burden-Barnes, O.B.E., was in the chair. The toast of the Club was proposed by Mr. A. V. Jenner, of the Charlotteville C.C., who said that the 53rd year of the Club's history was not perhaps the most successful, due to the difficult times. He congratulated the Club on its Jubilee "50," which he thought was a model for all those who aspire to run open events. There is every possibility that the Jubilee "50" and the Bath Road "100" will be run this year. It is up to the older clubs to keep alive the traditions of the game and it is to clubs such as the Bath Road that the sport looks for guidance and leadership. Mr. J. C. Beauchamp replied on behalf of the Club, and paid tribute to the older members, many of whom were present. The Visitors and Press were proposed by Mr. G. Webster, with a witty reply ragging each of the members, by Mr. W. J. Mills. The toast of the Chairman was proposed by Mr. F. J. Camm. It was an historic occasion, for C. A. (Bath Road) Smith was the guest of honour, and made the presentation illustrated at the top of this page. Mr. Smith, in an interesting speech, recalled some of the early Bath Road "100's," particularly that of 1891, when he had such a tussle to beat S. F. Edge.

WAYSIDE THOUGHTS

By F. J. URRY

Still No Praise

THERE is as yet no movement by the Government to tell the people the value of the bicycle as a means of convenient travel. I often wonder why, and am forced to the conclusion that authority does not like the bicycle, or alternatively, since it considers cycling *infra dig*, does not feel any confidence in recommending it for use by other people.

Yet consider the convenience of a bicycle in these days of traffic disorganisation, and look at the matter from no other aspect, and you must admit its value. Look, too, at the people who use it; they do not wait in queues, or waste their limited leisure in uncomfortable places. My daily journey to town, a distance of six and a half miles, does not vary three minutes in time, no matter what the conditions; and I start when I must and leave when I can, having no time table to control my movements. To me, the bicycle is more convenient than a car because of its mobility, its cheapness, and more than anything else, its excellent activity. But, you will say, how can I ride a bicycle with any feeling of security in the present traffic conditions; I should be frightened. I think there is a lot of truth in that outlook, and I can sympathise with it. Yet the fact remains that for over 50 years, I have been part of the daily traffic stream, and never entertain a qualm for my safe arrival at the office or home again—wet weather or fine, daylight or black-out. That is use, and the wisdom of having grown up amid the changing traffic conditions. And you can do the same and become equally, or more proficient. I do not suggest you should buy a bicycle and plunge into the traffic stream without a modest training; but you can make your purchase, spend a few hours each week amid the quiet streets and the countryside, feeling your way into the traffic, until, in a very short time you have gained the confidence that takes you gaily on your journey and solves the traffic problem as far as you are concerned. You have to learn to drive a car; it is a good deal easier to learn to ride a bicycle with safety, and far less expensive and much more convenient.

The Possibility

I think I told you that during last fall, I ordered, on behalf of friends, a number of high-class bicycles. Mainly they were for men who have read the possibility of petrol supplies becoming tighter, and so were returning to active cycling for the purpose of conserving their independence of travel. I cannot say I have seen them using these machines daily, but I have been on one or two week-end jaunts with several of the owners who cheerfully admit the pastime is much more enjoyable than they had imagined it could be after years of exclusive motoring. That, at any rate, is a concession that may yet become a great convenience, for rightly or wrongly, I believe this year will witness a still further reduction in the possibilities of motoring. I base that notion on the fact that military people cannot obtain the quantity of petrol, even for duty travel, they imagine they require. A relative of mine serving as a doctor in a field ambulance writes to inform me he has bought a bicycle to make his rounds of camp, because the higher authorities have cut his petrol supply to the basic ration. It is a straw to show the direction of the wind, and taken with the losses of shipping, and the ever-increasing service calls for fuel, it is not difficult to form an opinion on the possibilities of the future. Lucky are they who have a good bicycle in service, and I've no doubt my friends will yet thank fate they have been wise enough to make provision. One of these same friends has just called in to see me because his four-speed hub gear was not properly functioning. All the matter was the split change gear spindle running through the axle had not screwed right home, thus limiting the movement of the clutches. This particular machine cost him £16 10s. before the Purchase Tax was in operation, but it is a perfect specimen of the cycle builders' art, with stainless steel rims, rubber black enamel finish, and the very best of accessories. If you can afford it, such a purchase is the cheapest form of cycling as well as providing perfection in machinery and therefore ease of riding.

The Tandem

IN these notes I have said little about the tandem, probably because no tandem crew, particularly the leader, should venture the double-seater until they are expert cyclists, and even then the styles of the two riders must be nearly related if comfort is to ensue. Yet for two folk of a like mind and ankle action, there is no more delightful form of cycling. That does not mean that tandem riding halves the effort of propulsion, but it does mean the ideal companionships awheel, always providing the crew "micks." As a matter of fact, a tandem is easier to ride, and faster by at least two miles an hour for similar single effort along level roads or down hill. It is the slopes up and the acclivities that test the tandem couple, for if their pedalling action is not complementary, the double-seater becomes a dragging burden. The tandem is a bad hill-climber because of its long wheel-base; but perfect pedalling action very largely discounts that fault. I have been tandeming for over forty years, and much of my early touring was undertaken with my wife as partner, and that lady still affirms they were the finest holidays ever, particularly in those times when the motor car was rarely met along the road. The next generation in girls—my daughter—now often occupies the rear seat, and in the late fall of last year, we spent three wet but happy days in Wales, and have promised ourselves many more such outings—but fine ones, we hope—when the times are more propitious. My tandem, now in its thirteenth year of service is moderately geared with 68 in. normal, 75 in. high, and 51 in. low through the medium of a Cyclo gear, has two lmb brakes and an auxiliary rim brake on the rear wheel, and still looks well because of its rubber black enamel finish. It cost me nearly £20 thirteen years ago, has worn out five pairs of covers, a set of pedals, a free wheel and both saddles, while the cog wheels on the gears were removed when new chains became necessary. I may have spent £10 on it in renewal, but as a travel investment it has been a wonderfully cheap line.

Cold Feet

I AM among those folk who suffer from cold feet on the slightest provocation, and actually it is the only handicap to winter cycling that I carry. In normal English winter weather I can keep my extremities fairly warm by tramping with vigorous foot-flaps up the hills; but when the frost is fierce, this arduous form of exercise only has a temporary effect. I think I have tried most of the remedies my many corresponding friends have advised, but up to the moment none of them has proved very effective. A pair of dark grey spats made by my friend, Sydney N. Vanheem, are the best protection from the bitter blast I know, but even these fail when the weather is tight with frost. Last winter I tried to buy a pair of shoes made on the "bootie" principle, with warm linings, but I was unsuccessful in discovering footwear of that type suitable to the ease of pedalling action; so I am still searching for the remedy for cold feet. Over-size shoes and two pairs of stockings, specially recommended socks, brown paper packing, even grease—I have tried them all and still my feet refuse to remain a comfortable part of my anatomy when the winter is really cold. Curiously enough I do not get this trouble when walking or following the daily round of work; it is only when I go for a long jaunt on a bicycle, and because I like such journeyings, I am naturally keen to eliminate; or at least reduce, the trouble.

Troubles of the Times

MANY of my cycling friends, espacially those who, like me, make daily journeys to work and home again, are complaining of the frequency of puncture troubles due to broken glass. I have every sympathy with the victims, occasionally being among the number, but candidly I do not see much sense in criticising our highway authorities, considering the present circumstances. We just have to grin and bear it for the time being, carry a full repair outfit, arm ourselves with a good pump, and make the best of it. Twice during the last few weeks I have managed to reach home after puncture with a couple of vigorous inflations, and have then been able to deal with the perforation at leisure, and in comfort. But on several occasions I have been stopped by cyclists for the loan of my pump, and it has struck me as supremely unwise to take the road in these times, without the full equipment to meet and overcome the irritation of puncture. I have also seen this advice given, that the service of more heavily built tyres is likely to prove a protection against this trouble. It may be true, I do not know because I will not handicap myself or a good bicycle with the fitment of slow tyres. I can only tell you that on my daily journeys for a year, over thirteen miles of town and suburban roads, the number of punctures has been four, all small daggers of glass, generally picked up from the interstices of granite setts, where they lie in wait, business end uppermost, for any type of cycle cover, heavyweight or otherwise. As a matter of fact, I believe the tread of the good-class lightweight cover is as puncture resisting as the heaviest tyre made.

Bicycling as a Hobby

AN interesting volume entitled, "Bicycling as a Hobby," by Roland C. Geist, has just been published by Harper & Brothers, of New York. The American price is two dollars, and it is obtainable in this country from the London agents of Harper & Brothers. It contains 163 pages, and the chapters include: How to Select a Bicycle; The Parts of a Bicycle and Bicycling Terms; The Adjustment, Care, and Repair of Your Bicycle; What to Wear for Cycling; How to Ride a Bicycle; How to Organise a Cycling Club; Where to Ride in the United States; Planning a European Cycle Tour; Preparing for Racing; Planning Cycle Parades, Century Runs, and Carnivals; What a Cyclist Should Know About the Law; The Rules of Safe Riding; First Aid for Cyclists, Cycling, and Camping; The Evolution of the Bicycle; Bibliography; Formula and Gear Tables for Bicycles; Partial List of Bicycle Clubs in the United States. The book is well indexed.

My Point of View

BY "WAYFARER"

"Loved Long Since"

CARDINAL NEWMAN, in the most famous of his hymns, speaks of things which one has "loved long since and lost awhile." There are many such, nowadays, in the case of touring cyclists. Always in the winter, of course, the distant places are beyond our reach, but the war has had the effect of pushing them, or some of them, still further away. They are indeed "lost awhile," and we can only dream—and dream with joy—of those spots which we have "loved long since" . . . that house which looks down on the clamorous river at Beddgelert, that cottage which stands on the edge of the New Forest, that hotel which gazes out on to the Island of Mull, that gay dwelling at the end of a steep lane near the northern coast of Ireland. How true it is, especially in these days, that we cyclists are in much better case than the average man! We have our memories, *and* our maps, and the combination will help us to recreate past joys: it will lead us back to the distant ribbon of road which winds over the hills: it will give us the far horizons where delight ever abounds: it will help us to feel "the wind on the heath" and to participate in the delirium of our glorious pastime. Yes: we have our memories, *and* our maps, and the places that we have "loved long since and lost awhile" can still be ours, in imagination, for the asking—as, please Heaven, they will be ours physically and actually when the present spot of bother is over and done with.

I am reminded by the foregoing that a few days ago, in an unexpectedly idle moment, I took up a copy of "Bradshaw" and began browsing through it. There is quite a lot to learn from this famous railway guide, but what I was interested in was the manner in which I would reach certain distant places to which my bicycle has taken me, if I happened not to be a cyclist. (Of course, the real answer is that few of those distant places would ever come within the knowledge of the average man unless he had a bicycle to take him to them.) How, for instance, would I get to Mallaig? how would I journey to Kyle of Lochalsh? by what route would I travel to Dingle—to Burntisland—to Burton-port—to Ballyliffin? "Bradshaw" was silent—or almost silent—as to some of these places, certain railways having died, but it was vocal on the subject of, say, Mallaig, and I travelled delightedly, in imagination, through Glen Falloch and across Glencoe and by the side of the famous "Road to the Isles," my fancied trip covering some of the ground over which I cycled on the last tour undertaken before the shadow of war came into our lives. This "Bradshaw" browsing was a pleasant diversion, which brought back a host of happy memories, and made me long for the good days that are yet to be.

"Blitz" Corner

RECENTLY, while I was at home having tea, there came an urgent call to me to go, with a minimum of delay, to a house in the country, just 10 miles away, and to be prepared to stay the night. For a cyclist there was only one way of doing the journey, and it was not long before I had changed into my glad rags (these include "shorts") and had poured a few things in my saddle-bag. Then I set forth on one of my always-ready bicycles, the desire to get out of the city before the evening concert commenced accelerating my movements. The "Blitz" beat me, for I was still on the wrong side of the boundary when the wailers sounded and the guns commenced to roar. Air raids, of course, know no civic or county limitations, but I must confess to a growing feeling of comfort and confidence as the suburbs slipped behind me and I thrust more deeply into the countryside. It was only a corner of the "Blitz" through which I had to pass, and, in the relative peace of the wide open spaces beyond the habitations of man, I was able—after riding up one or two banks which normally bring me out of the saddle—to ease my pace and to look behind me at the free display of fireworks. How good it was—thanks to the bicycle—to get right away from the "Blitz" on that particular occasion! It remains to be added that I had a delightful ride back to town on the following morning.

Postscript

A NARROW lane, a gate, a path. The clamorous world which we all know too well, and which is disposed to get on our nerves, is left behind. The solitude intensifies; the peace deepens. The path climbs onwards, now passing through other gates, now descending to cross an elementary stone bridge, now well-nigh losing itself in sedges and water-courses. A soundless world! Nay, not quite! The silence is complete but for the rustle of the wind through the grass—but for the musical tinkle of an infant river—but for the sudden call of a bird—but for the plaintive cry of a sheep. Here is the apex of the water-shed, the mountain-ridge—and a long-distance view. Then the descent, sometimes ridden, sometimes walked. More gates, more bridges, more climbing, more strenuous exercise. Then the final fall to what we speak of as "Civilisation"—to the 'ard 'igh road which will carry us to the further places of our desire. For 2½ hours we have not seen a soul; for 2½ hours we have enjoyed detachment from the workaday world—a detachment which is so healing, and so comforting. This world of ours is a congested world, full of din—of strivings and problems and difficulties and disappointments. But there, on that mountain path, we get away from the things that hurt body and soul. It is by means of the little old bicycle that we achieve the solitude we have just enjoyed.

Notes of a Highwayman

By Leonard Ellis

American Mecca

ON a peninsula formed by a wide bend on the river Teme, and just below its junction with the beautiful but less famous Corve, stands Ludlow. The town is one of those always singled out by American tourists, and in this respect it shares the honours with Stratford-on-Avon, Chester, Shrewsbury and York. Ludlow is a curious old place, but like many others it is one that pays for thorough exploration, and it should not be forgotten that some of the most charming views are those of the castle, town and church when seen from a little distance. The old castle was founded late in the eleventh century by Roger de Lacy, later passing into the hands of Roger Mortimer, the Earl of March, and so to his descendant, Edward IV. Many royal favours have been bestowed upon the town: Edward IV gave it two representatives in Parliament and confirmed its charters, and Edward V was born and crowned here. At one time, Prince Arthur, son of Henry VII, lived in the castle. During the reign of George II the lead roofs were stripped and the building was allowed to fall into decay. Like Chester and Shrewsbury, one of the delights of the town itself is the abundance of beautiful half-timbered buildings, and foremost among these is the world-famous Feathers Inn, said to have been built for one of the Lords of the Marches. The facade is so elaborate that one wonders sometimes if the adornment is not over-done. The origin of the Feathers is not exactly known, but it is supposed to have some connection with Henry, Prince of Wales, hence the feathers. Other fine buildings are the Angel, the Readers House, and the Castle Lodge, and some very fine panelling is to be found at the Bull Inn. Very little of the old town walls still stand, but one gateway and part of the walls are still to be seen. Ludlow figured in much of the turbulent war around the borderland and on account of its strong position always offered great resistance; it was, in fact, the last of the Shropshire strongholds to give way to the parliamentary forces. Some of the loveliest of the Teme scenery lies around Ludlow, and there are several interesting bridges, one such being the solid-looking Ludford Bridge, connecting Ludlow with its neighbour or suburb, Ludford.

Devon Rivalry

THE inhabitants of Kingswear are supposed to look down on Dartmouth and claim that their history goes back a much longer way. Whether this is true or not, Dartmouth, in addition to being a most interesting place, certainly has a notable history. It is not finally decided whether Brutus the Trojan landed here or at Totnes, and it is possible that we shall never know. It is said that Rufus sailed from here in 1099 en route for Normandy, and there is no doubt that Dartmouth was then a place of considerable importance. From here, during the Crusades, part of Cœur de Lion's following set out for Palestine from the port. In view of to-day's happenings, it is well to remember that in the reign of Richard II our Admiralty seemed unable to prevent the threatened French invasion. Men and ships from Dartmouth and Portsmouth took the law into their own hands, sailed down the Seine, destroyed the French fleet, and returned home in triumph laden with booty. Dartmouth is rapidly becoming modernised, but there is enough of the old town remaining to make it a worthy object of any tour in the district. Probably one of the best-known features is the Butter-walk, a curious arcade of shops with an immense overhanging story of quaint gables supported on massive pillars. These old Elizabethan houses are more than 300 years old. There is a castle at Dartmouth, and another at Kingswear across the river, the two seeming to stand as sentinels guarding the narrow entrance to the Dart. One of the scenic gems of the district is the beautiful river stretch, and a trip that should on no account be missed is the boat journey to Totnes and back. It cannot properly be seen by any other method.

Ludlow Bridge across the Teme, Ludlow.

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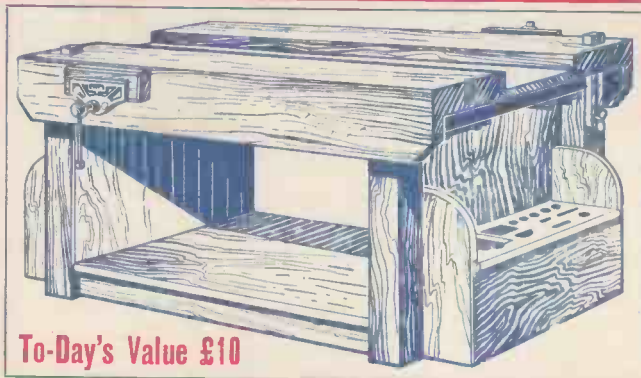

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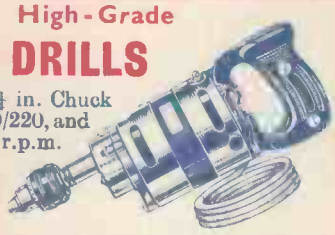

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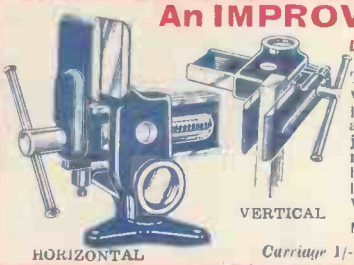

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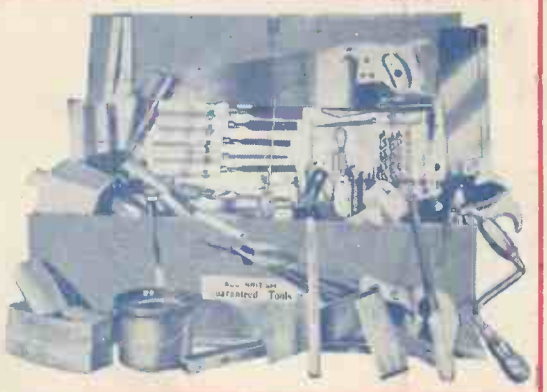
Contents: 1 Skew-back Handsaw, 22 in.; 1 Tenon Saw, 12 in.; 1 Set 3-blade Compass Saws; 1 Pad Saw and Handle; 1 Smoothing Plane, 2 in. double iron; 1 Joiner's Hammer, No. 2; 1 Claw Hammer, No. 1; Joiner's Mallet, 5 in.; All-Steel Hatchet, No. 1; 1 Cased Oilstone, 8 in.; 1 Joiner's Square, 6 in.; 1 Sliding Bevel; 1 Spirit Level, 6 in.; 1 Spokeshave, 2½ in.; 1 Marking Gauge; 1 Cabinet Turnscrew, each 4 in., 6 in.; 1 pair Pincers, 6 in.; 1 Handled Chisel, each ¼ in., ½ in., ¾ in., 1 in.; Handled Gouge, ½ in.; 1 Joiner's Plain Brace, 9 in.; 1 Centre Bit, each ¼ in., ½ in., ¾ in.; 1 Special Auger Bit, each ½ in., ⅝ in., ¾ in., ⅞ in., 1 in.; 1 Boxwood Rule, 2 ft.; a pair Combination Pliers; 1 Putty Knife; 1 Paint Scraper; 1 Mitre Block, 9 in.; 2 Gimlets: 2 Bradawls; 1 Glue Pot; 1 Cold Chisel, 6 in. by ½ in.; 1 Tack Hammer; 1 6-in. Half-round File and Handle; 1 4-in. Saw File and Handle; 1 Centre Punch; 1 Nail Punch; 1 Packet of 12 Sheffield Twist Drills; 1 Pencil. *Carriage (outside our free delivery area) 3/- extra, England and Wales.*



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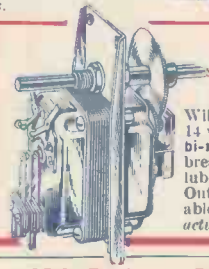

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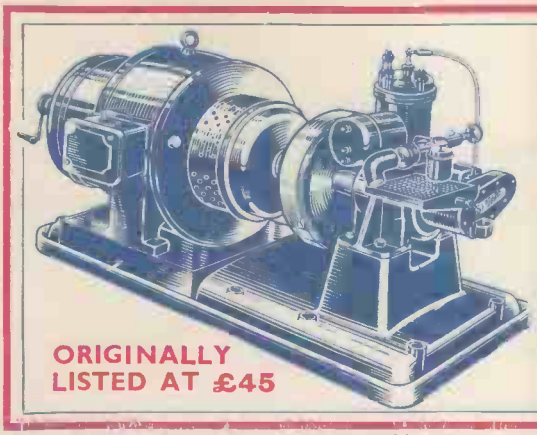

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