A Catalina of Coastal Command on Atlantic Patrol . . . .

A Short Stirling homeward bound from Europe

2

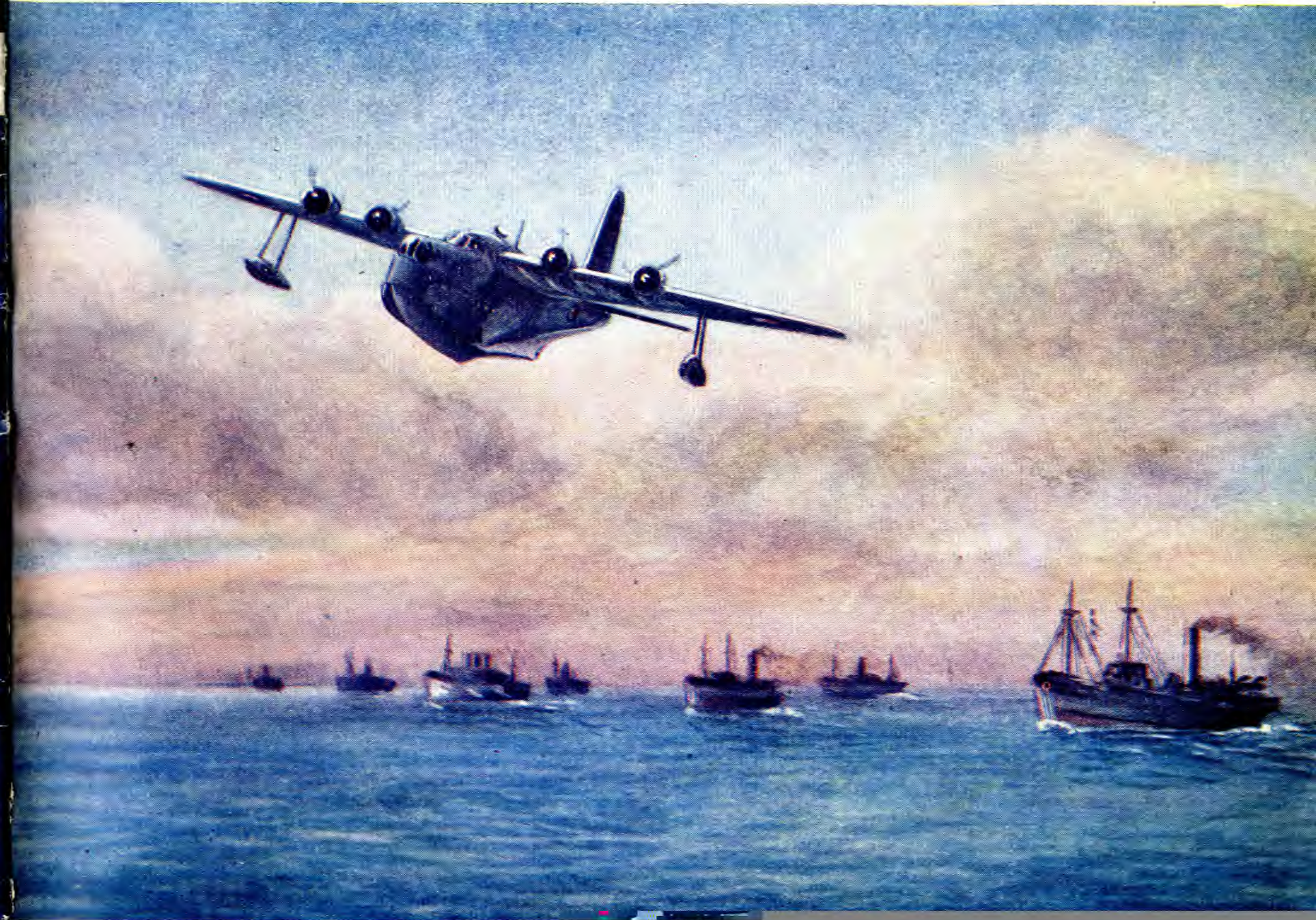
AIR TRAINING CORPS GAZETTE

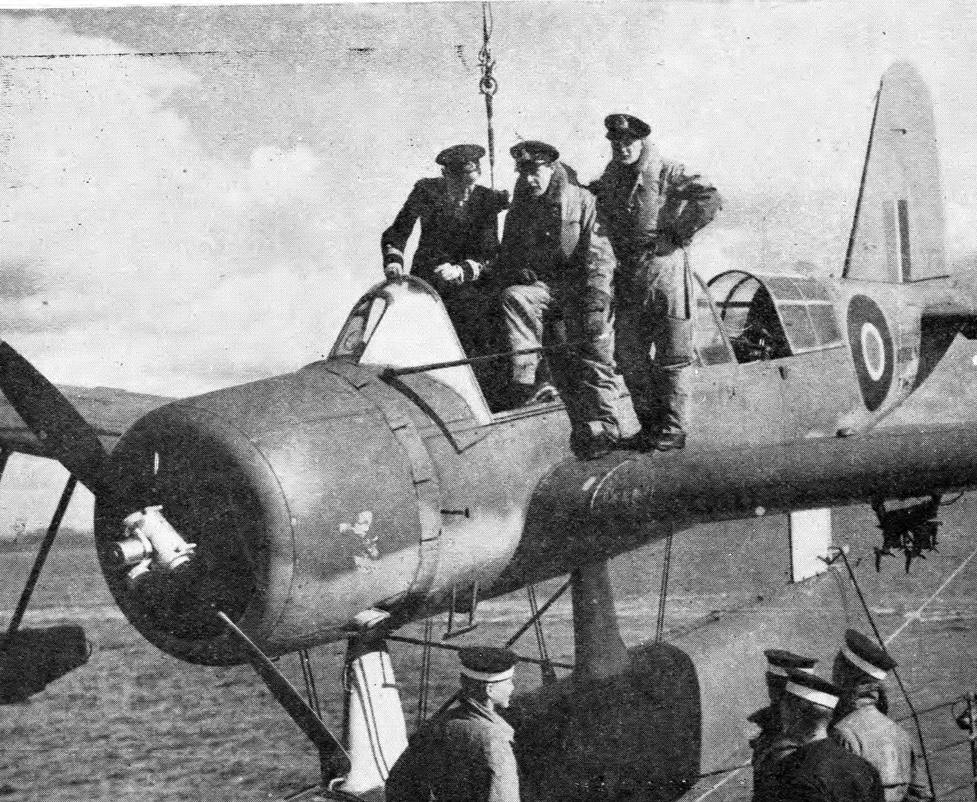
VOL. 11 No. 12 DECEMBER, 1942

Price 6d.

Over Land and Sea

The Short Stirling and the Short Sunderland





CATAPULT INSTRUCTION

A Fleet Air Arm pilot instructor tells the prospective pilot and observer what's what and points out the salient points of this aircraft, the Kingfisher, on board H.M.S. *Pegasus*. H.M.S. *Pegasus* was originally named *Ark Royal* and was employed as a seaplane carrier during the 1914-18 war. It is now used as a catapult training ship.

The aircraft is lowered for instructional purposes—instructional for both aircraft and catapult crews. Note the bomb-racks, V.P. airscrew and Royal Navy painted aft of the roundel.

"She's off." The real thing this time. Here are the catapult operators at the controlling levers. Few people can really imagine what a (*continued on page 3 of cover*)

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AIR TRAINING CORPS GAZETTE

Edited by Leonard Taylor

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The Spirit of the Air Training Corps

SOMEONE in the course of heaving belated bricks at the staff of the disbanded Headquarters of the Air Training Corps used the words "happily defunct." I am greatly in his debt.

A vast effort in matters of organisation and administration, of training, equipment and finance, was sustained by a handful of men and women, Service and civilian, who laboured without consideration all hours and with their sole aim the good of the Corps.

Certainly mistakes were made. Not every venture can turn out profitably — but the Corps owes much to its first servants.

Headquarters A.T.C., Stanmore, may be defunct, but every member of those Headquarters can be happy, for he or she set an example from which the magnificent spirit of the Air Training Corps sprung.

I am proud to see wherever I go that that spirit survives in spite of the growing handicaps of a long war, and it is well that it should be so.

The R.A.F. relies on the Air Training Corps for a great portion of its intake; and if the fortitude and keenness of officers, instructors and cadets did not overcome the difficulties of war-time conditions we should be failing the fighting services whom we exist to serve.

Our difficulties, as our dangers, are less than theirs: we shall always, I am sure, meet them with equal spirit.

J. A. Chamier

AIR COMMODORE
INSPECTOR, AIR TRAINING CORPS

The Call-up

THE recent announcement about the call-up of the 18-year-old young men has resulted in a number of representations being made to me about the position of A.T.C. cadets.

Many who have recently registered with the "eighteens" have been wondering whether they are going to get into the Royal Air Force—the Service for which they have expressed a preference—and if so, when. Others who fear that perhaps they may not be able to make aircrew standards are wondering if their A.T.C. training is going to be wasted by possible drafting into the Army. I have therefore thought it desirable to clarify the position in so far as I am able to do so.

All cadets who are volunteers for aircrew, provided they have been passed medically fit for aircrew duties and have reached the necessary mental standard, will, in due course, be able to start their aircrew training. The R.A.F.'s need for aircrews is increasing day by day, and before this war is finished every fit young man capable of becoming a pilot, navigator, flight engineer, radio operator or air gunner will be wanted.

I know that there is a period of waiting at the present time after attestation and before being called up for full-time service. It is highly satisfactory to know that this is indeed the case, and that we have a reserve still to call upon. For remember this, that the side with the best-trained reserves will, in the end, win the battle. That is why towards the end of a long war it is so important that we should be able to put men into the air who have had a long apprenticeship and are well grounded in the duties that they will be required to undertake.

For this reason it is most important that as many as possible of you endeavour to become leading cadets. This means that you will have obtained your Proficiency Certificate, and provided that your services are satisfactory during your initial training with the Royal Air Force you are automatically ensured of an aircrew grading test.

As well as those training for aircrew duties, there are, of course, many who are preparing for ground-crew duties, or on account of eyesight or other reasons are unable to be accepted for aircrew. Again, for those who are able to reach the proficiency standard there are vacancies in skilled ground trades. Here, however, unlike the aircrew position, women and older men are frequently able to undertake many ground duties in the Royal Air Force, thus releasing younger men for more active work or combatant duty. For this reason only a limited number of recruits for ground duties can be accepted from the younger age-classes.

Those who have undergone instruction in the Air Training Corps are preferred to those who have not taken the trouble to prepare themselves for full-time service. It may well be that some who have trained for aircrew duties find themselves unable to be accepted on account of colour-blindness, or because of some other reason which, while preventing them from flying, in no way debars them from fighting. I know that many of those so placed do not want to apply for ground-crew duties with the Royal Air Force, but want to fight. Naturally, they are disappointed when they find they are unable to become aircrew and feel that perhaps their Air Training Corps work has been wasted. There need be no fear on that account, because all the work done in the Air Training Corps is particularly applicable for the Royal Corps of Signals or for the armoured divisions, and cadets may rest assured that those who have given good service with the Air Training Corps will find that they are at a definite advantage should they desire to enter either of these units of the Army.

Cadets need never fear that anything they have achieved in the Air Training Corps is in any way a waste of time. Their Certificates of Service will be attached to their airmen's papers and will follow them through their career in the Service, and then when they are discharged the fact that they have given of their spare time in the hour of their country's need will be of help to them when peace returns and they again enter industry.

W W Wakefield

DIRECTOR, AIR TRAINING CORPS

THE LOCKHEED HUDSON

By David Vine.

WITH three years of constant war service with the R.A.F. Coastal Command, the Lockheed Hudson reconnaissance bomber has built for itself an enviable record of outstanding service and merit, and is still doing so.

Developed from the well-known Lockheed "14" airliner, which it closely resembles externally, the Hudson has many internal differences and is really quite another aeroplane from its famous forebear. The outboard egg-shaped rudders are the same, and the bulbous fuselage can now house as good a load of bombs as the "14" had passenger load.

The Hudson's wing-tip slots.

The wing span of the Hudson is 65 ft. 6 in., and an aspect ratio of 7.79 gives it excellent lifting and flying qualities. The elevators are interesting, because they not only have a greater travel upwards, but also a greater area. This is made possible by a small flap (normally resting on top of the fuselage) which is raised by the upgoing elevators, and so forming one continuous control surface in the "up" position. This assists take-off considerably. The upward travel of the elevators is 14 inches and only six inches down. Surprisingly for a modern twin-rudder aircraft, both rudders have equal travel in either direction, namely, 30 degrees, so no differential rudder mechanism is fitted, as on most modern twin rudders.

Cable Control

The Hudson is interesting from its wide use of cable control, at a time when cable operation seems to be falling into neglect. The whole of the engine controls and the flying controls are cable-operated. The bomb doors are cable-operated from a single hydraulic jack, while the Fowler flaps are also cable-operated by one hydraulic jack.

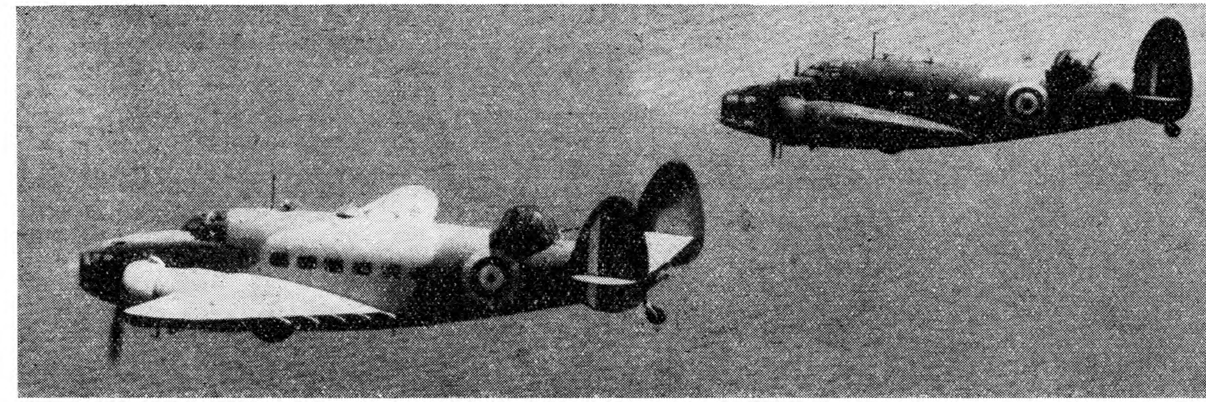
The Hudson has a single cranked control column, but provision is made for another should it be necessary. An automatic pilot is a standard fitment. De-icing is done by pulsating rubber boots along the leading edges, a method not favoured now, though it seems effective enough on the Hudson. The hydraulic system is big, and operates bomb doors, brakes, flaps and undercarriage.

In an emergency the cabin door, which contains the rubber dinghy, can be jettisoned. The rear gunner escapes through the door aperture; the pilot, navigator and radio operator through the detachable cockpit roof. There is also an extra escape through an emergency exit in the side of the fuselage opposite the cabin door.

Slots and Flaps

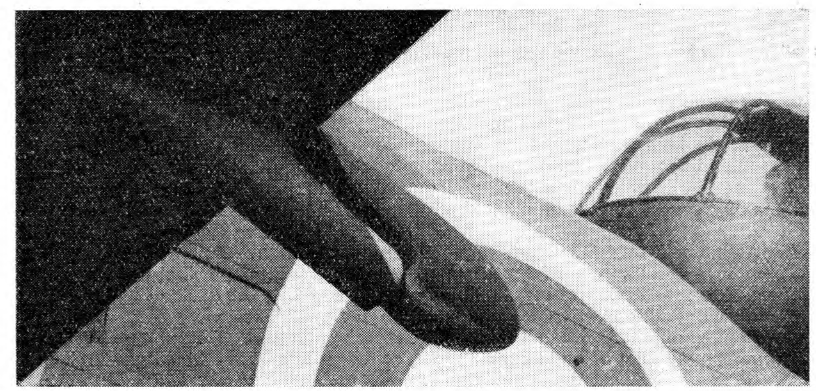
At the tips of the wings are fixed slots designed to prevent wing-tip stall, which might occur on a finely tapered wing. The slots are cut into the wing itself, and come into operation at a fixed angle of attack.

By far the most interesting part of the Lockheed Hudson, and retained on the Vega Ventura, is the Fowler flap. This is operated by a single hydraulic jack and a complicated series of pulleys and cables passing inside the bulbs seen at the trailing edges of both the Ventura and the Hudson. These flaps are of the split type, and with an area of 107¼ square feet take up nearly twenty per cent of the total wing area, a useful additional lifting surface for loaded take-offs. So the



Hudsons of Coastal Command on patrol. Since the war began these aircraft have flown millions of miles to protect shipping.

Fowler flap is not merely an air brake for steepening the gliding angle, but also an auxiliary wing which increases the normal wing area for take-off with big loads. This means that the flap has to be moved well back behind the trailing edge, a mechanical problem of extreme difficulty cleverly solved by the use of rollers running inside metal tracks and pulled by cables.



Close-up of one of the bulbs of the Fowler flaps.

The Fowler flap has three positions. The first position is at 30 degrees for increasing wing area, the second where the flap provides an air brake at about 80 degrees, and the third where the whole flap area extends behind the trailing edge at about 60 degrees. When the pilot wishes to lower the flaps, he sets the control lever to the predetermined angle, the hydraulic jack draws the cables over the pulleys (in the bulbs) and pulls the flaps along the metal tracks. The grooved metal tracks in which the flaps are moved look rather like curved railway lines. There are ten tracks in all, five to each flap, port and starboard.

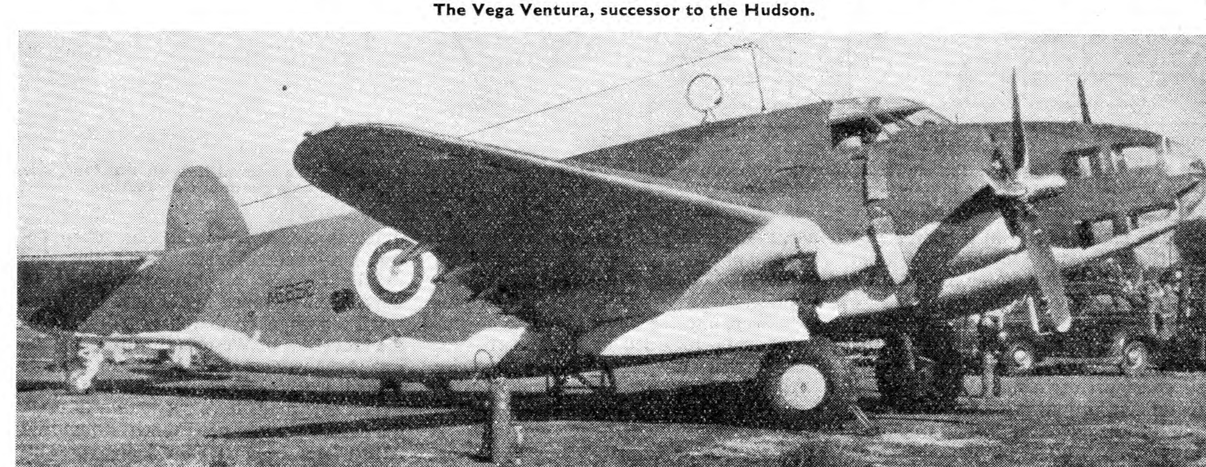
Armament

The Hudson is fitted with an electrically operated Boulton and Paul gun turret with a wide arc of fire between the two rudders. There are two Browning .303 machine-guns firing forward, and two aft from the retractable "scoop." Two Wright Cyclone engines give a total of over 2,000 h.p. The construction, though exceptionally sturdy, is the conventional stressed skin, flush riveted to formers and stringers. The wings have a front and rear spar and stamped-out ribs. The bomb compartment is spacious, as the deep fuselage indicates. The bomb doors are opened and shut by a double-acting hydraulic jack and a series of cables. In fact, the Hudson can be called a cable-operated aeroplane.

Young Brother Coming On

Soon we shall be hearing more about the Lockheed Vega Ventura, a development of the Hudson and powered with two 2,000-h.p. Pratt & Whitney Double Wasp engines. The Ventura incorporates many of the features that have made the Lockheed Hudson one of the most outstanding American aeroplanes of this war.

The Vega Ventura, successor to the Hudson.



Geography Matters

Geography is one of the bases of air strategy and essential to the pilot's work.

by **Captain Norman Macmillan,**
M.C., A.F.C.

A U.S. Navy Catalina patrol bomber cruising over the Alaskan Peninsula.

NO one can understand the conduct of the war without a considerable knowledge of geography. It is basic to all strategic thought. Many modern weapons and all vehicles of communication are designed to overcome geographical handicaps; in this respect the aeroplane has a unique significance. In airmanship specialised geographical knowledge is essential.

Global War

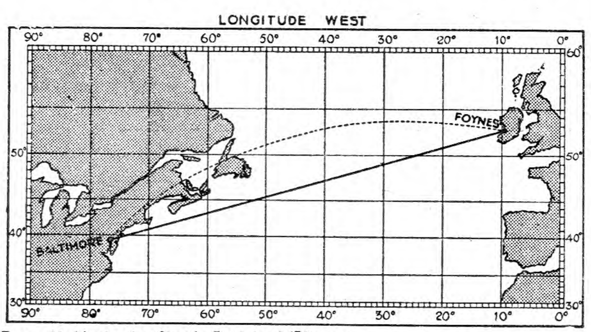
President Roosevelt has called this a "global war." The term indicates that the struggle is taking place on a curved surface. (Relative to the Lancasters of Britain, the Fortresses bombing Japanese shipping off the Solomon Islands and New Guinea fly inverted.)

To study the geographical complexity of this war a globe is better than a map; but if you must use a map, do not use a Mercator projection, with its great distortion of the areas and shapes of the land masses—get an azimuthal equal-area projection or a gnomonic projection of the world; unsuitable for general navigation, these projections give a better pictorial outline of the land masses, but remember that some distortion is inevitable when portraying by any method the plan-outline of a curved surface on a flat sheet of paper.

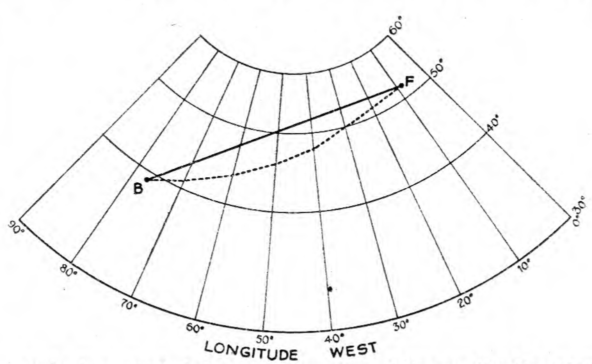
The Concise Oxford Dictionary defines geography as the "science of the earth's surface, form, physical features, natural and political divisions, climate, productions, population, etc." Not all these are important to the pilot of an aircraft. The first two he resolves into navigation and cartography. Physical features, climate and natural divisions require special study. Political divisions, productions and populations are affected by war, and so cannot properly be regarded as a standard subject. (What, for example, is the precise effect of the war upon the populations of China and the Ukraine?)

The Works of Man

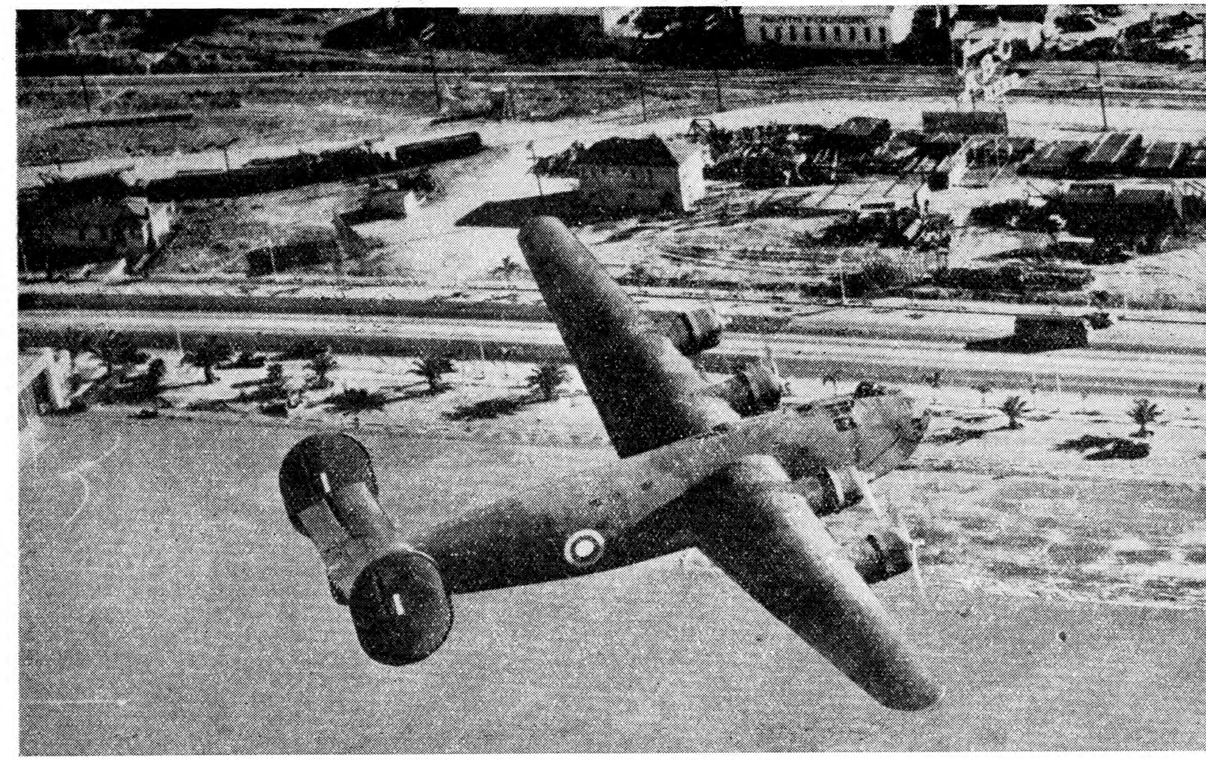
The definition just quoted ignores one aspect of geography which is of great importance in airmanship. I refer to the works of man—cities, industrial areas, factories, docks, railways, roads, canals, navigable rivers (as distinct from non-navigable streams), bridges, irrigation works. These are things which man has produced, improved, diverted or superimposed upon the physical features of the earth, and they are striking landmarks to all aircrews. They are subject to change, especially in war. Think of the diversion of the Yellow River, which now follows a different course from the one taken before the Japanese attack upon China, due to the Chinese breaking the dykes to impede the advance of the invader. Consider the changes that have come upon the industries of Western Europe since the war began—new buildings built, plants shifted, workers transmigrated. In Central Africa new roads have been hewn through jungle, the ports of French Equatorial Africa have been and are being continually improved at Duala, Libreville, Port Gentil and Point-Noire. The coastline of West Central Africa, from Bathurst to Point-Noire, has become a zone for air traffic whose present volume would have been considered fantastic before the war, for that coastline is a landfall for United Nations' aircraft flying from America to China and all the lands between, save those in enemy occupation. Brazzaville, former capital of the French Congo, is now the capital of all French Central African territory, newly called Fighting French Africa.



From *Air Navigation Simply Explained* (Pitman).



When is a straight line not the shortest distance between two points? When it is drawn on a Mercator projection. The shortest route is a great circle shown as a curved line on the Mercator projection, but as a straight line on a gnomonic projection.



A Consolidated Liberator over San Diego.

Know Your Landing-Ground

You who may be going to be a member of an aircrew ought to know as much as possible about the world over which you will fly and upon which you must land, because such knowledge will help you to be more efficient when you begin operational flying. But your immediate concern should be to study basic geography, which is not subject to the fluctuating influences of war; upon this should be superimposed a survey of current geography (to bring your knowledge up to date) when you are just about to graduate.

What Every Pilot Should Know

If I were asked to define the essential elements of basic geography for those who fly, I would suggest the following: (1) The areas of the land masses of the world; (2) their situation relative to one another and the distances between them; (3) their permanent physical features; (4) their contour, that is, the heights of each land mass above sea-level; (5) their situation relative to the Equator; (6) their climate and vegetation; (7) their hours of daylight and darkness throughout the year; (8) special cases where exceptional conditions are found; (9) the four great oceans—Pacific, Atlantic, Indian and Arctic; (10) coastlines; (11) hinterlands; (12) the great inland seas; (13) natural subdivisions of the land masses; (14) types of people, their language, general character, population density; (15) cities, railways, roads, canals, irrigation works, docks, telephone and radio facilities, currency; (16) minimum range and height of flight required for safe travel over and within each zone.

If pilot and navigator know, in addition, with sufficient exactitude, which areas are in occupation by the enemy, they can reach a quick geographical solution of any flying problem.

Note that basic geography would ignore classification by the artificial boundaries of ephemeral states and nationalities. Current information would have to be superimposed upon the basic knowledge, just as a key grid is overlaid upon a map. This is the only way to indicate that the world belongs to man as a whole; sectional holdings are mutable from year to year; to airmanship these changes are artificial and should be so regarded geographically.

It is useless to teach students that Tokio is the capital of Japan or Delhi the capital of India unless they have a clear idea where the two countries lie, the distance between them, the gradual transformation of the types of men found in the intervening territory, from one race to another, one language to another, by processes of climatic and tribal selectivity, until two entirely different peoples are found.

Precision

Yet it does not help United Nations aircrews to know the difference between a French West African and a French Equatorial African, unless thereby they got sufficient warning to take off before being arrested by Vichy partisans if by mistake they landed in the wrong place. It is too much to expect aircrews who to-day fly thousands of miles in the course of a few days to know at a glance the appearance of every kind of man or to begin to try to understand the hundreds of languages and dialects in the world. What is more important is the nature and climate of the terrain, its hours of daylight at different seasons and its situation relative to other lands. It is essential for aircrews to know precisely where they are before they land. Pinpoint precision is the thing that matters. Then, with a true knowledge of geography, they will know beforehand what it will be like after they land.

Aircrew geographic needs are different from those of groundsmen. To-day no one can afford time to acquire redundant knowledge. The geographic studies of future air pilots, navigators, observers, bombardiers, wireless operators and flight engineers should therefore first be directed to the acquisition of a sound basic knowledge if their operational efficiency is later to become of the highest order, for the present artificial divisions of the world may alter radically before they even graduate.

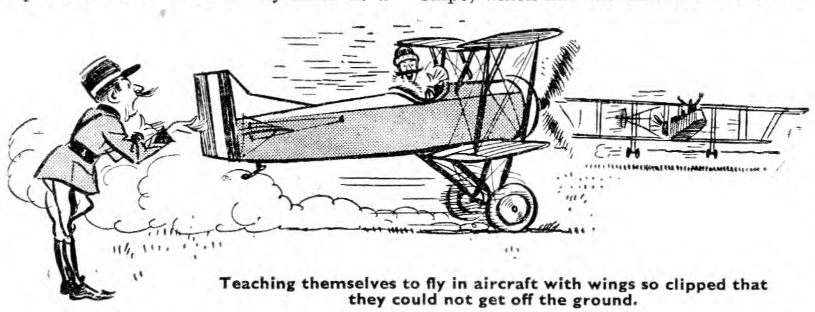
SO IT CAN BE DONE!

by **W. E. Johns**

IN 1924 (or thereabouts) I took a minor part in a curious and somewhat unpleasant episode. At the time I was a station adjutant. An officer reported for duty. I asked for his log book. He said he had lost it—a strange remark for a flying officer to make, because if there is one thing he takes care not to lose it is his log book. However, I asked for his training card. He had no training card. In short, this officer had no documentary evidence whatever to show that he was entitled to wear the wings that he sported on the breast of his tunic. I reported this unusual state of affairs to the C.O., who instructed me to obtain from the officer concerned particulars as to where and when he had done his flying.

He Just Flew

In due course I was handed one of the most incredible documents it has ever been my lot to read. I own frankly that I put the writer down in my mind as a



Teaching themselves to fly in aircraft with wings so clipped that they could not get off the ground.

liar—as Mr. Churchill would say—of the first order. For this, briefly, is the story he told. He asserted that in 1919, while on the ground staff at Cranwell, he had occasion to make an urgent visit to Hendon. So, observing a Sopwith Snipe preening itself on the aerodrome, he, without ever before sitting in a cockpit, got into the aircraft and flew it to Hendon. Then he flew back.

Now this, to my mind, made him a double-dyed liar, for I was not prepared to believe that anyone could just step into what was then considered a high-performance aircraft, and fly it for more than 30 seconds without colliding with something with considerable violence. Remember, I was a pilot, and I had flown Snipes.

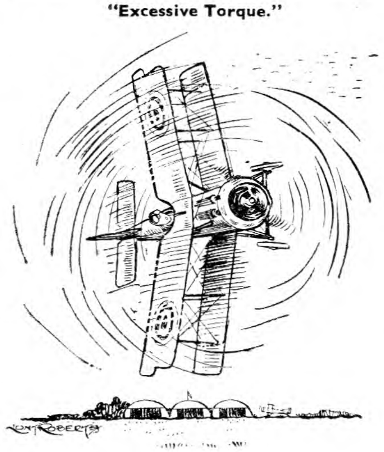
This officer went on to say that after this initial flight he made it a habit to fly an aircraft whenever he found one available, and so, in due course, he taught himself to fly. In these circumstances he felt justified in putting up his wings.

Now, it is one thing to think a fellow a liar, but quite another matter to call him one to his face. I did go as far as to tell this chap that I found his story rather hard to believe. I can't tell you what the C.O. said, because every alternate word of his considered opinion was unprintable. The C.O. was a war pilot of note, and, I am glad to say, he is still with us. I spoke to several old pilots in the mess, and their opinions differed only from his in the choice of their adjectives. It was a difficult position, and I retired to think the matter over.

Penguin Progression

I knew, of course, that the earliest pilots had taught themselves to fly, for the simple reason there were no instructors. I had also watched French embryo pilots teaching themselves to fly in aircraft with wings so clipped that they could not get off the ground. Having made themselves proficient with these penguins, they passed on to a type that had a normal ceiling of about ten feet. And so they went on, by degrees, to orthodox aeroplanes. But none of these training types was to be compared with a Snipe, which had the inherent vice of all machines fitted with a powerful rotary engine—excessive torque. I won't say that the Snipe was as tricky as the old Camel, because, for one thing, it had dihedral on both upper and lower planes, which the Camel had not. But that any man could step into a Service type like the Snipe, and fly it, I was not prepared to believe. Nor did I think it likely that any man who had never been in the air could find his way from Cranwell to Hendon

"Excessive Torque."




Aged 16, He Flew Plane to 2,000 Ft., Made Perfect Landing for Half-Crown Bets

From Our Own Correspondent

A MIDLANDS TOWN, Friday.

THREE half-crown bets with workmates who had dared him to fly an aeroplane tempted 16-years-old Peter Lancaster to take one up for 25 minutes.

He flew round the aerodrome at 2,000ft. and made a perfect landing—at the second attempt.

But he had to pay for it today. The magistrates here fined him £2 for taking away an aeroplane and flying it "to the prejudice of public safety."

His three friends not only lost their half-crowns. They were also fined £2 each for aiding and abetting.

MADE MODELS

For years Peter has been keen on aeronautics. He read books, made model planes, and then ... the ground staff at ...

T.B. Allowances Modelled On Servi...

and back. In this line of thought I was not alone, for the view was shared by every pilot on the station.

The upshot of it all was this budding Icarus narrowly escaped a court-martial. He was sent to an F.T.S. for training. Subsequently he appeared with wings that had been acquired in the manner approved by the Air Council, but even then he would often boast that he had taught himself to fly.

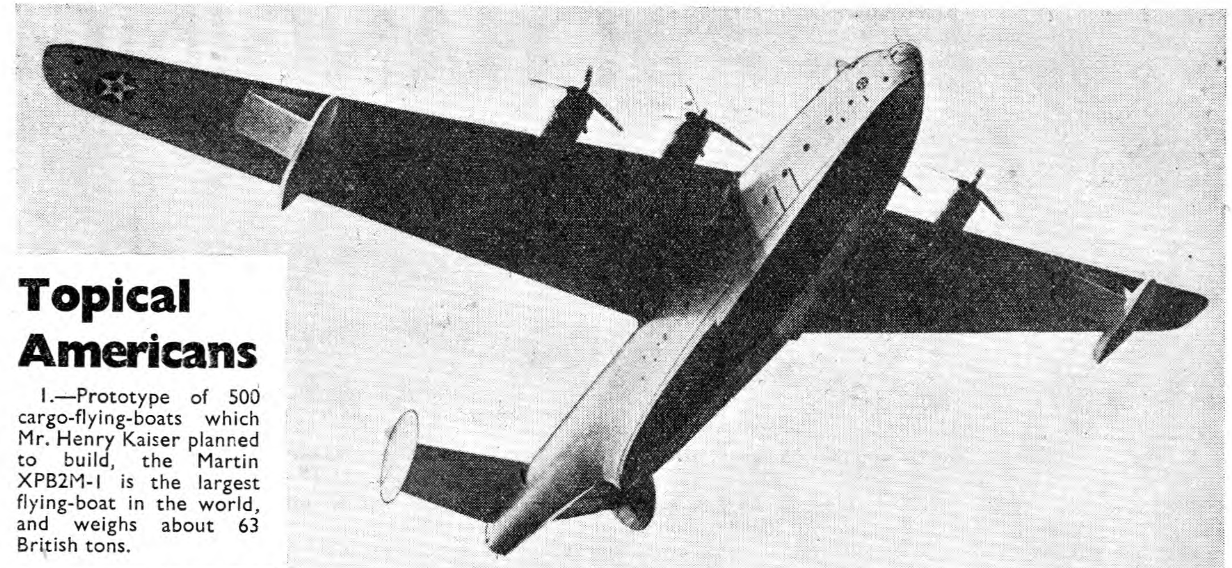
I should say that I have heard of other cases of alleged self-training, but this was the only one that came to my personal notice. For years I have been satisfied in my mind that no man without air experience could take a modern aeroplane off the ground and put it down again without bending something. Apparently I have been wrong. If the newspapers are to be believed, it has just been done. For three half-crown wagers, one Peter Lancaster, aged sixteen, stepped into a Tiger Moth, the property of the R.A.F., took it up to 2,000 feet, stayed there for 25 minutes, and then returned it intact to *terra firma*. It takes a bit of believing, but there it is.

Homework

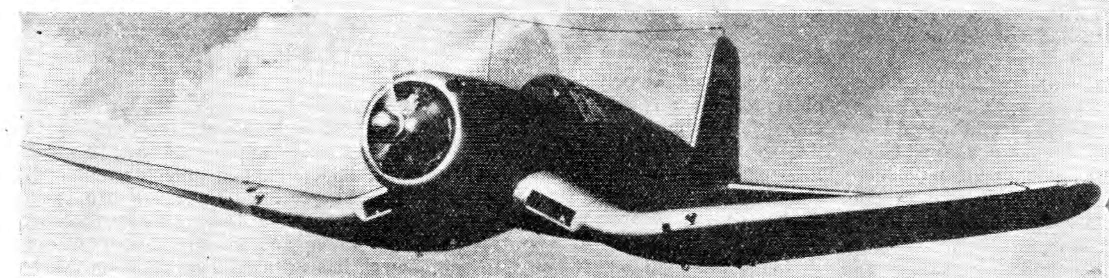
Later, after he had paid for this most joyous joyride, Peter is alleged to have stated that he had read many books on flying, and made models with success. As I read that a frightful picture sprang into my mind's eye. It was a picture of what the sky—and the earth—would look like if every youth who had read books on flying, and made models with success, decided that he could, in fact, fly the full-sized article. There are quite enough things dropping out of the heavens without making matters worse.

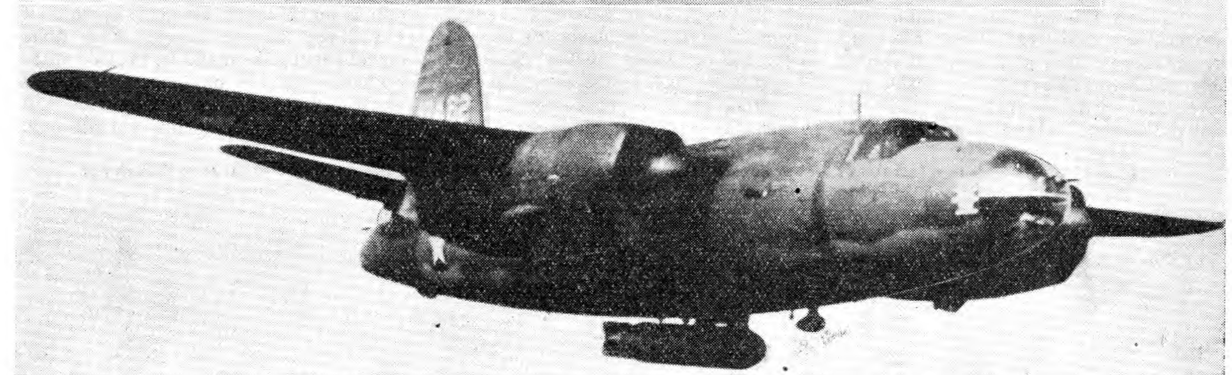
Let us be fair. Peter's show was, from one angle, a good one. But any intelligent person must take a poor view of it. After all, he wasn't just risking his own neck. He might have killed a lot of people. He might have bumped into a hangar and written off a whole squadron of machines. Regarded from that aspect, the show was definitely not so good. I deplore that it was so slightly condemned, because it might create the impression that flying is easy—that every cadet could fly, without training, if he had the necessary nerve. Well, you may be able to fly, but it is much better to have someone with you, who knows he *can* fly, when you decide to find out.

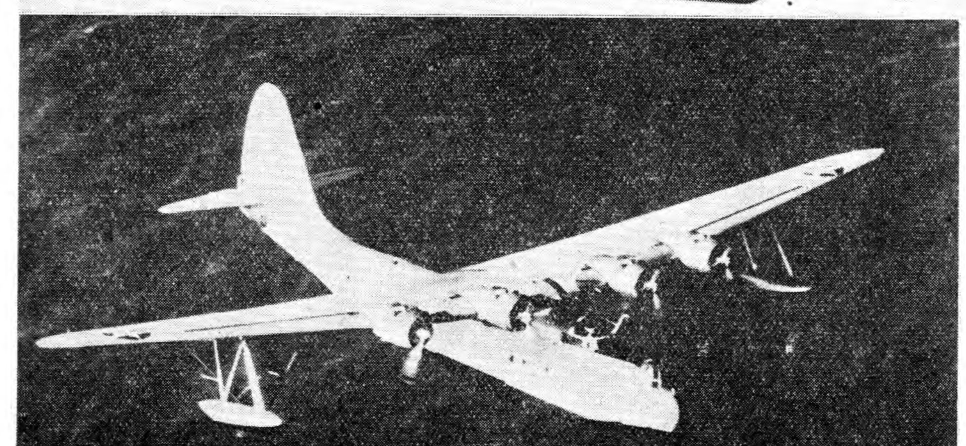
Topical Americans



1.—Prototype of 500 cargo-flying-boats which Mr. Henry Kaiser planned to build, the Martin XPB2M-1 is the largest flying-boat in the world, and weighs about 63 British tons.







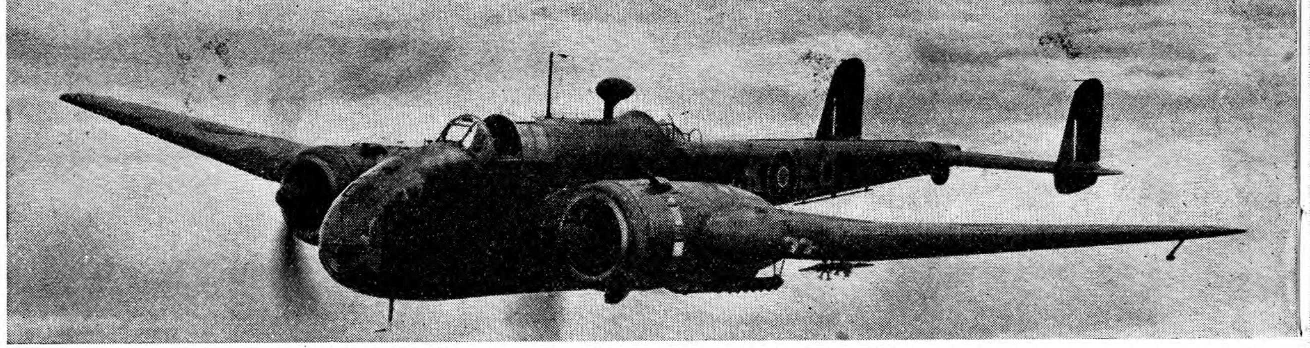
2.—Large numbers of Vought-Sikorsky F4U-1 Corsair shipboard fighters are now serving in the U.S. Navy. Top speed quoted as 366 m.p.h. at 16,500 feet.

3.—The Martin B-26B or Marauder fast medium bomber.

4.—Vought - Sikorsky XPBS-1, experimental flying-boat powered with four 1,050-h.p. Pratt & Whitney Twin Wasp engines. There are bow, midship and stern gun turrets.

CHANGING WAYS by Donald W. Seager.

Modern aircraft are generally better for the navigator, but they demand greater speed and accuracy from the crews than the antiques of 1939



The Handley Page Hampden, which did good work at the beginning of the war.

HEAVIER and higher, faster and further. Such is the developing trend of the modern bomber. Each of these factors has a marked effect upon the work and working conditions of our aircrews.

Take the navigator, for example. The increase in size of aircraft greatly helps him. This can perhaps be illustrated best by a comparison between two actual types—the Hampden, which performed such valiant service in the early days of the war, and the more modern Handley Page product, the Halifax.

The navigator's position in the Hampden is excellent for all-round vision, but extremely cramped. He sits on a small circular-topped stool at a glorified card-table which folds down from the side of the aircraft. To rest his weary back a small adjustable, webbed strap is provided. As there is not even sufficient space for him to stand upright, unless he is a midget, you can hardly envy him this small comfort.

More Space

In a Halifax, on the other hand, the observer has a very comfortable "office," complete with cushioned chair and well-planned table. Freed from the discomforts of his less fortunate fellow in the Hampden, he has a flying start along the difficult path of accurate navigation.

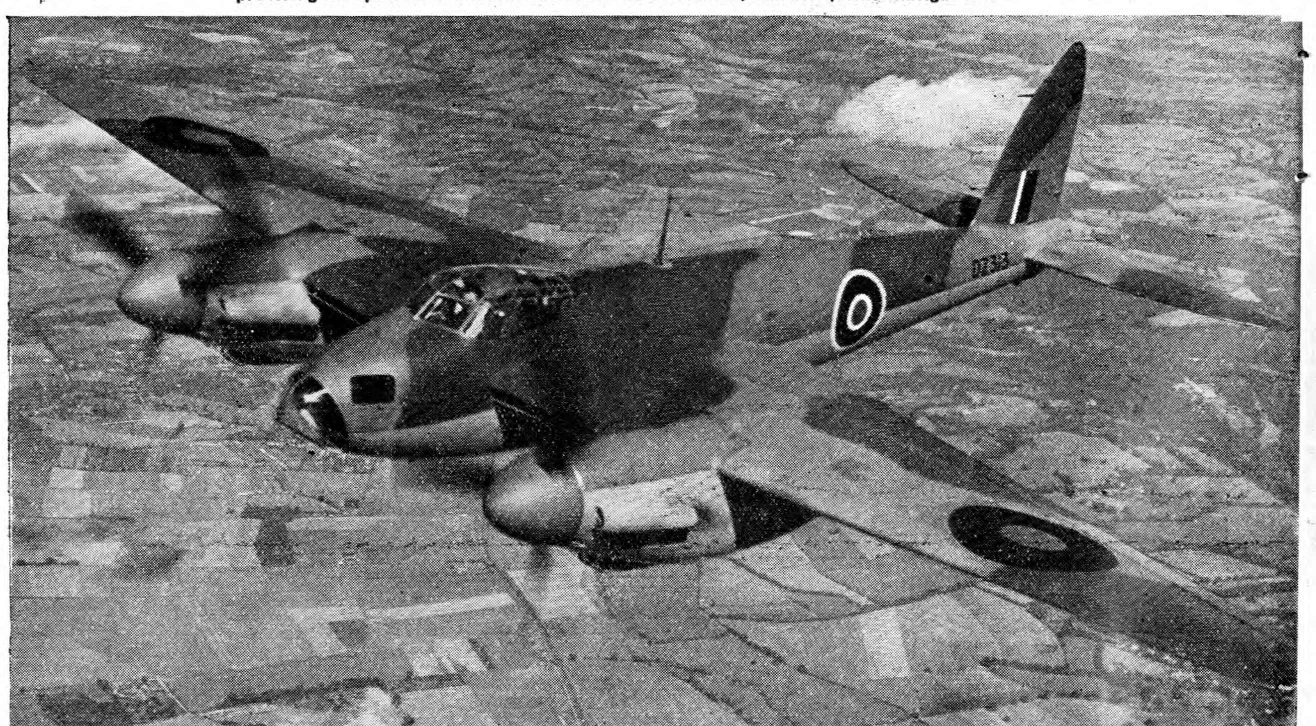
Better Equipment

Apart from the improvement in purely personal comfort, the navigator finds his work rendered easier by the installation of equipment such as the astrograph and an astrodome. The poor wretch trying to guide a Hampden along its easterly path has to poke his head out into the chill night slipstream in order to get a star-sight. These improvements in aids to astro-nav. in more modern aircraft are a logical reaction to the increase in operational flying heights.

Greater Heights

During night attacks on Germany in 1940 aircraft approached and bombed their targets from a lower average level than at present. There are two main reasons for this. Their operational ceiling was lower and enemy opposition was much less intense. The latter consideration is no reflection upon the courage of present-day bomber crews. It is quite obvious that flak should be avoided when its avoidance will not affect the operations. A pilot who continually and *needlessly* jeopardises his aircraft and crew can hardly be described as a good captain.

The Mosquito, Britain's new fast light bomber constructed of wood and used for daylight raids on pin-point targets, though not providing the spacious comfort of the Lancaster or Halifax, calls for quicker navigation.



The Avro Lancaster brings more power to the pilot's elbow and more room for the navigator.

More Astro-nav.

At great heights on night ops. map-reading is extremely difficult, and this increases the importance of the use of astro-nav. Astro-nav. generally becomes easier about 15,000 feet, as there is less chance of the stars being obscured by cloud.

Another favourable factor is that the faster an aircraft travels the less relatively it is affected by the wind. Take, for instance, an aircraft flying directly cross-wind at 150 m.p.h. If the wind speed is 30 m.p.h., it will drift 60 miles off course on a 3,000-mile trip. If the air speed is 300 m.p.h., it will drift only 30 miles off course on the same journey. You can prove this for yourself with a vector drawing.

Disadvantages

High flying does create certain personal problems. The colder conditions encountered, for example, mean that heavier flying clothing must be worn, and this makes movement inside the aircraft more difficult, to say nothing of the inconvenience of oxygen tubing. These disadvantages are somewhat offset by the lack of bumpiness during high-altitude flight. As an interesting experiment, incidentally, cadets might attempt writing a navigator's log, in legible handwriting, whilst wearing three pairs of gloves.

Faster Work Required

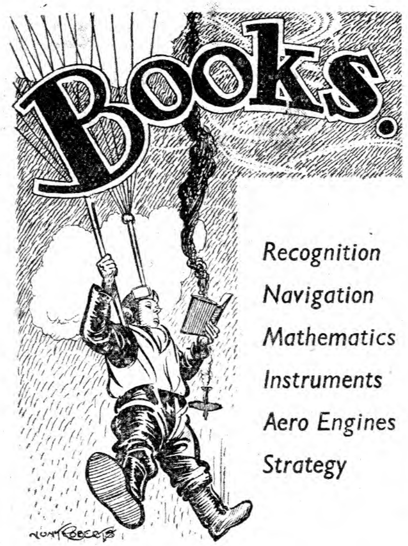
The air navigator of 1943 will have to be considerably speedier in his calculations than his counterpart of 1940. Cruising in a Lancaster, for example, he will have to work twice as fast as in a Whitley.

Greater Accuracy Necessary

Navigation is also affected by the gradual reaching out to more distant objectives. If the full 3,000-mile range of the Consolidated Liberator were utilised, the observer would have to set himself an extremely high standard of accuracy. Errors in D/R navigation are progressive. Unless position can be checked by some other means—none too easy when flying over enemy territory—larger errors can result. It has been estimated that if Colonel Lindbergh had steered three degrees either side of his correct course when flying the Atlantic he would have passed no nearer than within 180 miles of his objective, Paris. Whether this would have been wholly an unfortunate event is not for us to judge, but it does serve to illustrate the need for accurate navigation on long flights.

The Effect of Early Errors

A handy rule to remember is that a one-degree error in course means an error in position of one mile for every 60 flown (approximately). Thus, on a 1,500-mile flight, such as a Liberator might attempt, the error would amount to some 25 miles. You need not become alarmed at this prospect, as it is based on the assumption that the position is not checked by other means. However, it may persuade some cadets to set a higher standard of accuracy in their plotting work. Good aircraft need quick and accurate navigators.

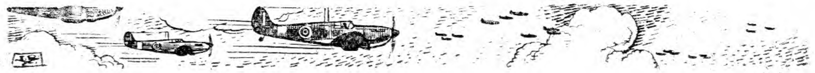


Recognition
Navigation
Mathematics
Instruments
Aero Engines
Strategy

Planes Explained
By Roger Tennant (Diagrams by J. H. Clark). Argus Press. 1/-. 88 pages. $7\frac{1}{4}'' \times 4\frac{3}{4}''$.
A most interesting, accurate and useful book which should be of great help in aircraft recognition. The author brings recognition features to life by explaining the history, purpose and aerodynamic effects of the varied arrangements of fuselage, wings and other parts. Everyone who is keen on aircraft recognition should study this book well.

Oddentification
By Wren. *The Aeroplane*-Temple Press. 2/-. 64 pages. $6\frac{1}{2}'' \times 4\frac{1}{2}''$.
Sixty-four amusing cartoons of well-known aircraft cleverly emphasising recognition features. Accurate details but bad verses.

Relay Races
(March 1941.) By Robert Fyfe. Craig & Wilson. 63 pages. $7\frac{1}{4}'' \times 5\frac{1}{2}''$. Diagrams.
Descriptions with diagrams of a large number of varied relay races suitable for juniors and seniors.



The Observer's Book on Aircraft Instruments
(1942.) By W. J. D. Allan. Allen & Unwin. 2/6. 102 pages. $6\frac{1}{2}'' \times 4''$. Diagrams.
A useful handbook dealing with the usual instruments, and in addition giving interesting details of the Cathode-Ray Compass, the Sun Compass and the Astro Compass, which we do not remember having seen in recent instrument handbooks.

Aircraft Comparisons
Part I — Single-engined Aircraft. Real Photographs. 9d. 16 pages. $8\frac{3}{4}'' \times 5\frac{1}{2}''$. Photographs.
A well-illustrated leaflet dealing with some of the varied sub-varieties of Spitfire, Hurricane, Master, Harvard and Battle.

Elementary Navigation
By C. Barrington Gyford, B.Sc. Longmans Green. 1/-. 48 pages. $7'' \times 4\frac{3}{4}''$. Diagrams.
A useful pocket-sized book for those new to the subject.

General Mathematics
Book 2. By Leonard Turner. Edward Arnold. 5/-. 287 pages. $7\frac{1}{4}'' \times 4\frac{3}{4}''$. Diagrams.
Chapters on logarithms, slide rule, equations, geometry and mensuration, loci, trignometry and vectors. Concise but adequate explanations. Exercises and answers. A valuable mathematical textbook for budding engineers, and of use also to navigators.

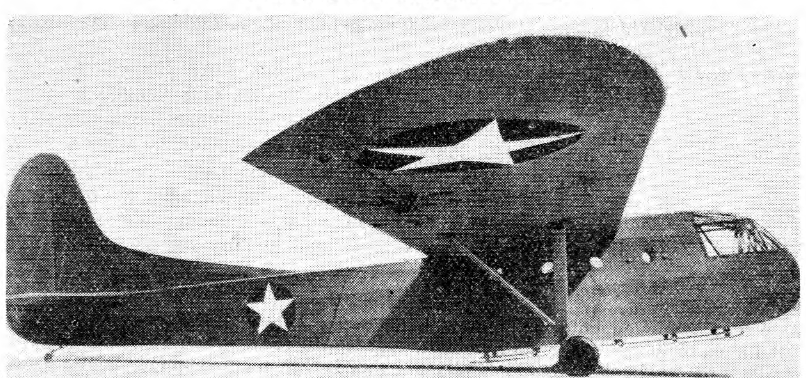
Air Navigation
(November 1942.) By E. R. Hamilton. Nelson & Son. 5/-. 175 pages. $7\frac{1}{4}'' \times 5''$. Diagrams.
Did you know that the term "pitot-head" comes from a man named Pitot, who in the eighteenth century employed an instrument on the same principle as that of the airspeed indicator for measuring the speed of rivers? That and other useful facts, figures and exercises on navigation will be found in this manual.

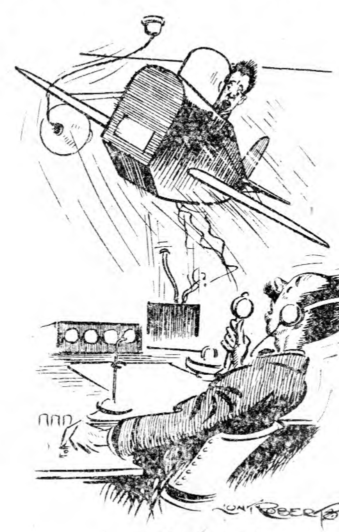
The Use of Air Power
By Flight. Lieut. V. E. R. Blunt. Thorsons. 8/6. 169 pages. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. No pictures.
Although the immediate concern of cadets is technical mastery of their various trades, those who aspire to high rank may like to give some thought to strategy and tactics, about which so much nonsense is spoken and written. This is an up-to-date book, in which the theories of pre-war writers are shown to have been confirmed or refuted by war experience. The author may sometimes seem to be labouring his points, and not everyone will agree with the conclusions he reaches. But the book is thought-provoking and should help the reader to get a proper perspective view of the various war operations.

Elementary Aero Engines
By H. C. Russell. Allen & Unwin. 2/6. 73 pages, with diagrams. $6\frac{1}{2}'' \times 4''$.
Here is a good little book for those who, although not training as aero-engine fitters, would like to know something about the engines they are going to control, or at least to hear and see. It does not describe the detailed action of various types of engines, but gives a plain outline of the working of aero engines in general, with some hints as to their proper management.

Navigation for Aircrews
Part 1. (August 1942.) By John E. C. Gliddon and Edward C. Hedges. University of London Press. 2/-. 64 pages. $7\frac{1}{4}'' \times 4\frac{3}{4}''$. Diagrams.
An attractive and lucid introduction to navigation, with exercises and answers.

The first transport glider to be made by the Ford Motor Company. Designed to carry 15 men, it has a wing span of 84 feet.





Air-borne."

The Link trainer in action at an operational training unit of the R.A.F. Army Co-operation Command

Men and women at work on the centre section of a Halifax

Fighting Aircraft

OF THE UNITED NATIONS

Equipped with Curtiss Electrics

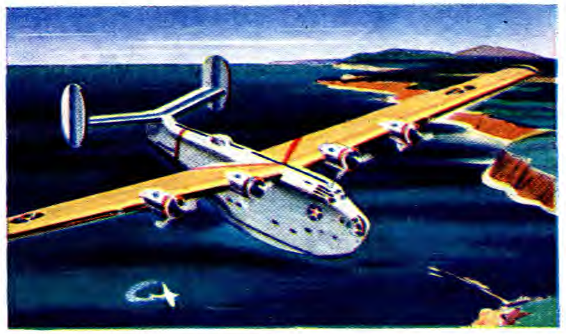
NOTE.—British names in brackets. The new American marking on wings and fuselage is a white five-pointed star without the red centre.

Bell P-39D Airacobra

North American P-51 Apache (Mustang I)

Brewster SB2A-2 Buccaneer (Bermuda I)

Curtiss SB2C-1 Helldiver



Consolidated PB2Y-2 Coronado

Republic P-43 Lancer

Curtiss P-40F Warhawk (Kittyhawk II)

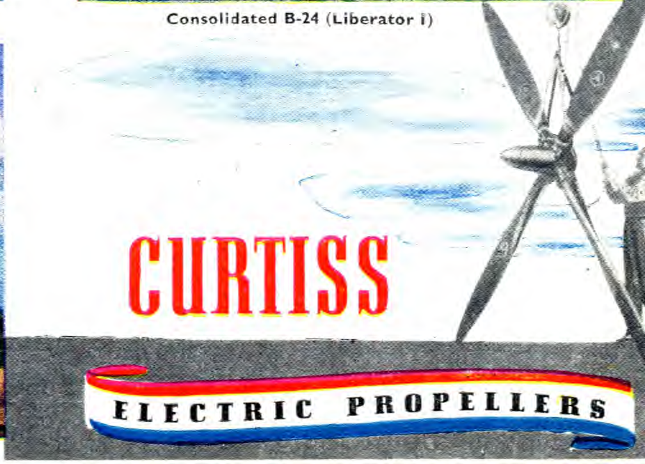
Republic P-47B Thunderbolt

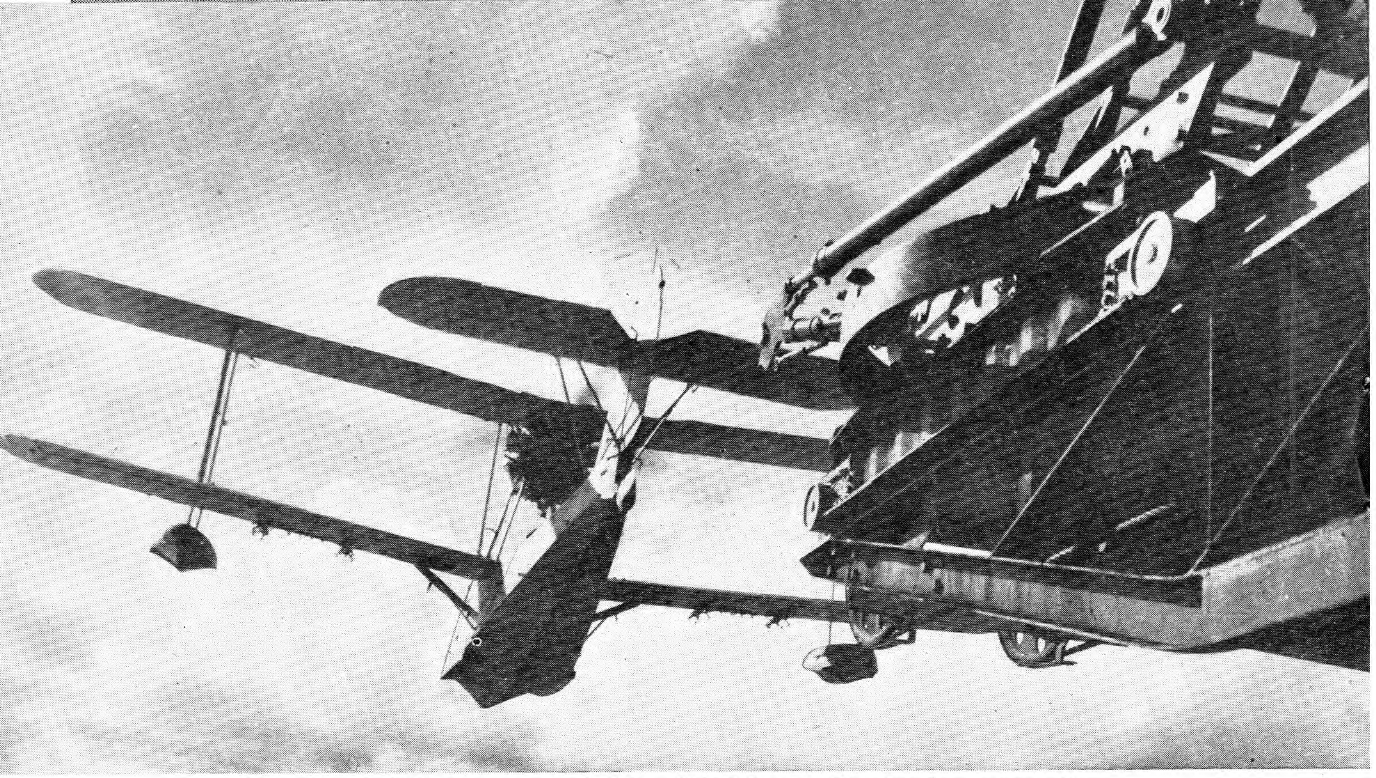
Martin B-26B (Marauder I)

Consolidated B-24 (Liberator I)

Martin PBM-1 Mariner

Curtiss C-46 (similar to British St. Louis)





A fine shot of a Walrus being catapulted from H.M.S. *Pegasus*, Fleet Air Arm training ship

The Martin Baltimore, medium bomber, which played a great part in the Middle East operations

Aerobiographies—*by C. G. Grey*

OSWALD SHORT

OSWALD SHORT was the youngest of the three Short brothers, to whom we owe, more than to anybody else, the fact that we have been ahead of the world with our sea-flying aircraft. And to Oswald Short particular credit belongs, because, after the death of his eldest brother, Horace, one of the greatest men in the history of aviation, he took hold of the business and built it up to a size of which his brother would have been supremely proud.

When I met Oswald Short first, Short Brothers were the official balloon-makers to the Aero Club of Great Britain, and they made balloons in the arches under the London, Brighton & South Coast Railway, as it then was, near the Dogs' Home at Battersea. They started to make aeroplanes early in 1909, and were the agents in Great Britain for the Wright Brothers, the first men who ever flew.

Horace Short, about whom a big book ought to have been written, had been for several years before 1909 the right-hand man of the Honourable Sir Charles Parsons in the development of the steam turbine, a form of power plant which has revolutionised steam power on land and sea. He was largely responsible for the production of that amazing little boat the *Turbinia*, which shook the navies of the world when it appeared suddenly and illicitly at Queen Victoria's Jubilee Naval Review in 1897. But that is another story.

As soon as he saw the immense future of aircraft Horace Short quitted turbines and came down to Battersea, where, until then, his next brother Eustace and young Oswald were making balloons. And at that time Oswald was very much the kid brother from whom nobody expected much.

The first Short aeroplanes were built on a bit of swamp land called Leysdown, on the Isle of Sheppey. But in 1910 the Shorts, and the Aero Club's flying-ground, moved to Eastchurch, right in the middle of the island, where Mr. Frank McClean (now Sir Francis) had bought a large tract of land and given it practically free of charge to the club.

Seaplanes for Sailors

There the Short brothers built the first floatplanes for the Navy, and they built the first machines to fly off ships in Europe—Glenn Curtiss had already done so in the States.

With the outbreak of war in 1914 the Short business grew colossally. They moved in 1916 to Rochester, where at the outbreak of this war in 1939 they had two enormous factories, one by the river and one on an aerodrome.

In 1917, after the firm had taken on the big job of building airships at Cardington, near Bedford, as well as their gigantic seaplane work, Horace Short died. Eustace Short was by profession and temperament an artist, and took little part in the business. So the whole burden devolved on young Oswald. Things were going so well then that the real test of his courage did not come until after the Armistice in 1918, when all orders for aircraft for the R.A.F. were cut off, as if by a guillotine.

Planning for Peace

All aircraft works were practically shut down flat. Many of them went out of business and their owners pouched their profits. But not so Oswald Short.

When the end of the war seemed in sight he began to make plans for the future. He wisely saw that in spite of the popular enthusiasm for our gallant young air fighters there was going to be mighty little flying after the war. So he organised the factory for the building of barges and motor-boats and watercraft generally. It was a brilliant idea, because his men were used to working on combined metal and timber, and his tools and shops could tackle that job.

Then he started making bodies for omnibuses. His biggest customers were the London General Omnibus Co. Ltd., now the London Passenger Transport Board. Also, he built 'bus bodies for provincial 'bus companies all over the country. That was another stroke of genius.

Work for Everyone

Three or four years after the war, when everybody was hard up and things were going very badly, Oswald Short told me with justifiable pride that at no time since the war had there been fewer men on the payroll of Short Bros. than on Armistice Day.

But in spite of these diverse activities Oswald never forgot his aeroplane work. He spent his profits largely on experimental work. In 1919 Short Bros. built the first all-metal, stressed-skin aeroplane in the world. They were already building flying-boats when the war ended, and they went on developing them. All the time between wars the R.A.F. has always had Short flying-boats "on charge."

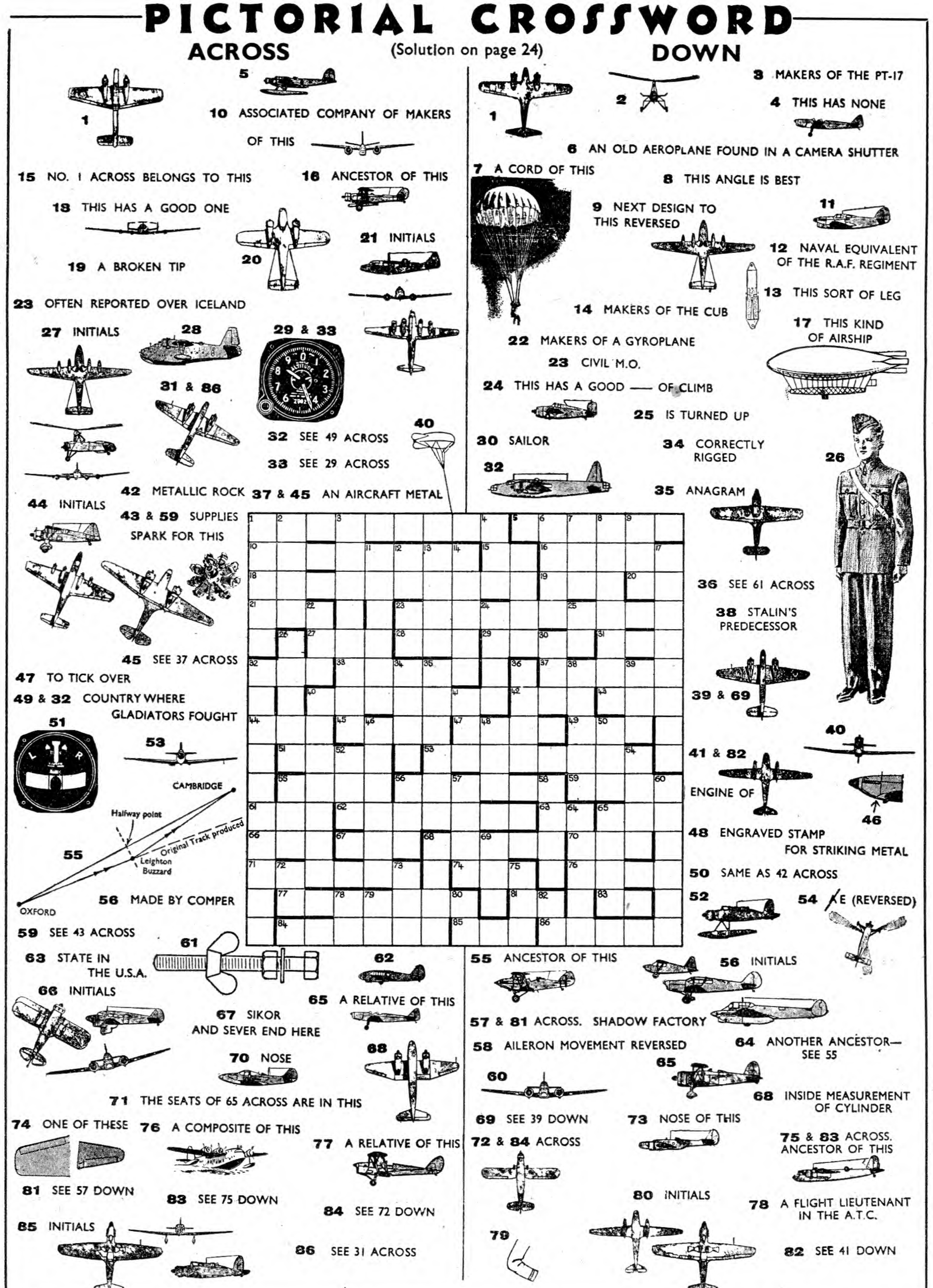
His brother Eustace, who had taken to flying as a hobby after the war, died suddenly in a miniature floatplane which had been built for him. He alighted safely on the River Medway opposite the works, stopped his engine, and then nothing happened. When a boat went out to see what was the matter, they found Eustace dead in the cockpit.

Aircraft for Attack

The flying-boat side of the business developed so well that when Mr. George Woods Humphery, managing-director of Imperial Airways Ltd., decided to run a flying-boat service to India, and eventually to Australia, he chose Short Bros. Ltd. to build what came to be known as the Empire Boats—by far the finest aircraft of their class in the world. Before the war the Service version of the Empire Boat had already been produced, called the Sunderland.

Everybody who reads the Air Ministry communiqués knows what magnificent work the Sunderlands and the Stirling bombers have done during this war. Oswald Short, who designed the first all-metal, stressed-skin aircraft, still takes an active part in all design work, and we owe to his foresight and intelligence all the products of that great firm. The Stirling four-engine bomber, which can carry eight tons of bombs at about 300 m.p.h., is the firm's latest product to become publicly known.

Mr. Arthur Gouge, who is a director and general manager and chief designer, has been responsible for the technical development of these great aircraft. To him also the R.A.F. owes much gratitude.



UNDERCARRIAGE SAFETY

by **Harold P. Lees**

To prevent the undercarriage collapsing when an aeroplane lands, the wheels are always mechanically locked when in the "down" position. Many are locked in the "up" position as well, but there are some aircraft where the "up" position is held only by hydraulic pressure.

One method of locking the legs in the "down" position is to arrange for the last few inches movement of the hydraulic jacks piston rods to push a sleeve over the joint where the leg bends, to retract and hold it there. The leg then becomes solid, and cannot collapse. In retraction the reverse takes place. The first movement of the jacks is to withdraw the sleeve from the joint and to allow it to bend.

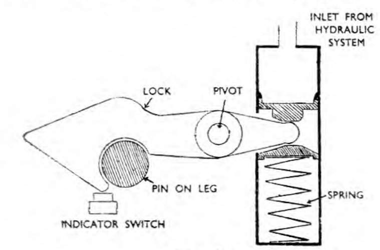


Fig. 1.

Another method of locking is to push the joint slightly past central by a spring, which prevents it bending in the retracting direction. When the leg is retracted, the hydraulic pressure overcomes this spring, allowing the leg to bend upwards.

Hook-Type Locks

Figs. 1, 2 and 3 show a system of locking the undercarriage with a hook type of lock. The hook is shown in Fig. 1. The lock jack is hydraulically operated to lift it. As soon as the hydraulic pressure is taken away, the spring closes the hook. A pin on the leg hits the hook on the cam-shaped face, and forces it upward against the load exerted by the spring. The hook snaps to over the pin, and is held there by the spring. The hook cannot be released until the plunger is depressed hydraulically. A switch just below the point of the hook, upon contact, lights up the indicator in the cockpit, and shows that the hook is home and the leg safe for landing.

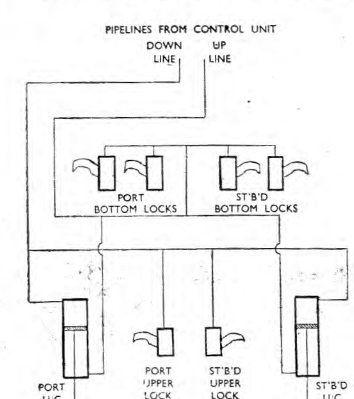


Fig. 2.

"Framed" Legs

On large aircraft which have framed legs, that is, two oleo legs to each wheel, one on each side, it is usual to have two locks at the bottom and one at the top. The hydraulic piping diagram for such a system is shown in Fig. 2. Supposing the undercarriage were retracted and the pilot wished to land. He selects "down" on the control unit and the hydraulic fluid is directed into the "down" line. The two upper hooks are connected to this circuit, so that the locks are released and the undercarriage is free to descend. Immediately it reaches its full "down" position the four bottom locks will snap to over the pins on the legs, and the indicator in the cockpit will show green. When the legs are up two red lights show. In addition to the two red and two green, there may be a master red light, which is lit the whole of the time the legs are not locked down. Thus if one of the green lights failed, but the master red light was off, it would probably be found that a bulb behind the green light had broken.

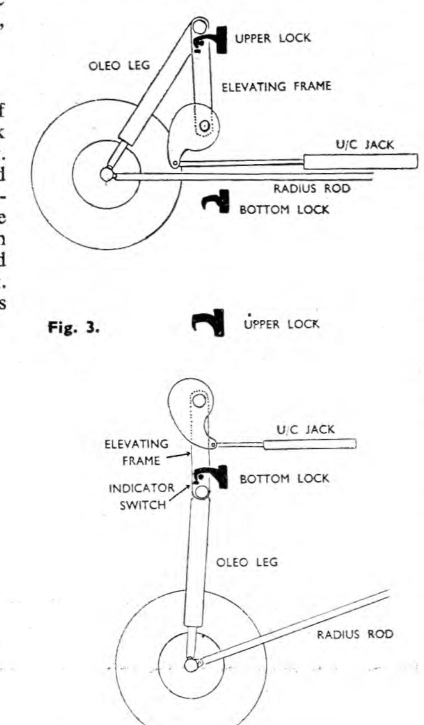


Fig. 3.

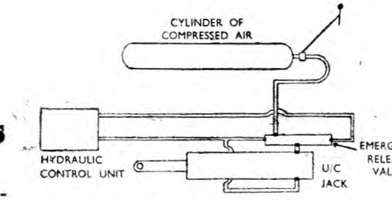


Fig. 4.

Fig. 3 shows the positions of the upper and bottom locks and the way they engage the pins on the legs in the extended and retracted positions. The cam-shaped wheel which is connected to the jack piston rod is geared to the elevating frame, so that it is not necessary for it to pass through 180 degrees, as the elevating frame does.

One hydraulic system uses, to lock the undercarriage down, a lock which is situated inside the hydraulic jack. It is released by the initial pressure of the hydraulic fluid.

Emergency Lowering

Another safety measure which most aircraft have is an emergency lowering device which can be used in the event of the hydraulic system failing. The Hurricane's wheels, for instance, are retracted inwards and the upper locks are situated just below the cockpit floor. Two pedals on the bottom of the cockpit are connected to the locks, so that in the event of an hydraulic failure all the pilot has to do is to step on these two pedals. The wheels fall under their own weight, and are locked home by a spring which forces a locking-lever slightly past central. The Whitley's is lowered by mechanical means. Two levers in the centre section are pulled to release the upper hooks, and the undercarriage is wound down by a handle and wire cable fastened to the elevating frame.

Fig. 4 shows a system which uses compressed air to lower the undercarriage in an emergency. Normally it is lowered hydraulically, but when the pilot wishes to make an emergency landing he pulls a lever which opens up the valve from the bottle of compressed air. The charge goes first to the emergency release valve which it actuates, thereby sealing off the pipelines leading to the control box. If these were not sealed off the air would be able to escape up that way. The whole force of the air is then directed against the jack piston. The fluid forced out of the other end of the jack is ejected into the atmosphere through the release valve.

Two precautions for the pilot are usually incorporated into the cockpit. To prevent his landing with the undercarriage up, a warning buzzer is attached to the throttle. If he throttles back below a certain speed to land, while the red lights are still showing on the undercarriage indicator, a buzzer sounds. To prevent him accidentally knocking the undercarriage lever into the "up" position, it is always held by a spring or a clip, so that before he can move it he has to hold the spring up. This also prevents his selecting "undercarriage up" for "flaps up."

HOW MUCH OF THE HEAVENS CAN YOU SEE?

by **L. R. Glegg**

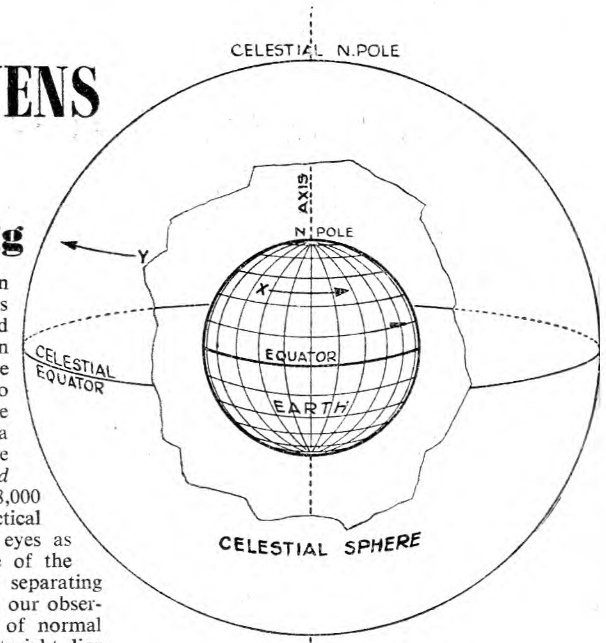


Fig. 4.

THE obvious answer to the question asked in the title of this article is: "As much as lies above the horizon"—but this leads us to two more questions: What exactly do we mean by the "horizon"? and What part of the heavens is visible from a given place at any one time?

The Horizon

Fig. 1 shows a very large man standing on a very small earth. It is clear that he can see anything which lies on the sides of the lines OA and OB away from the earth. In Fig. 2 a rather smaller giant is standing in the same position; owing to the fact that his eyes are nearer to ground-level the lines OA and OB more nearly form a single straight line than in Fig. 1. These two cases obviously do not correspond with conditions met with in actual fact, since even if we climb a high mountain or go for a flight in a stratosphere aircraft our eyes are only a very short distance above the earth's surface *as compared with its diameter* (some 8,000 miles). Therefore, for all practical purposes we can regard our eyes as being actually on the surface of the earth, so that the line AOB separating what is visible and invisible to our observer (now reduced to a man of normal stature) becomes in fact a straight line (Fig. 3).

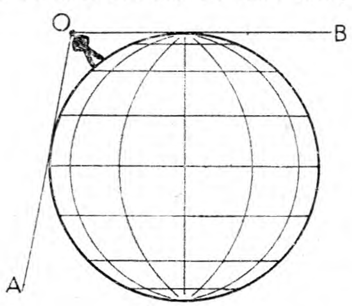


Fig. 1.

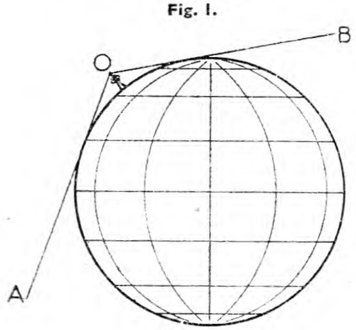


Fig. 2.

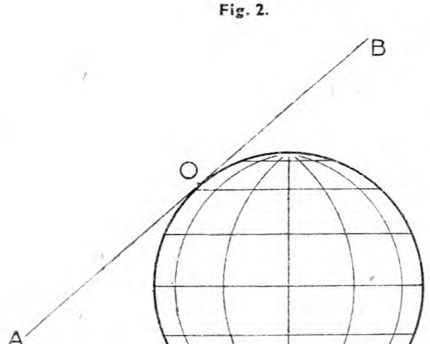


Fig. 3.

Of course, the observer can look all around him (instead of only to the north and to the south, as the illustration seems to indicate), so that the boundary between the seen and the unseen is really not a line, but a flat surface. This is known as "the plane of the horizon," and can best be demonstrated by placing a flat sheet of paper on a globe; anything situated on the opposite side of the paper from the globe will be visible to an observer situated at the point where the paper touches the globe; everything else will be "below the horizon."

The "Celestial Sphere"

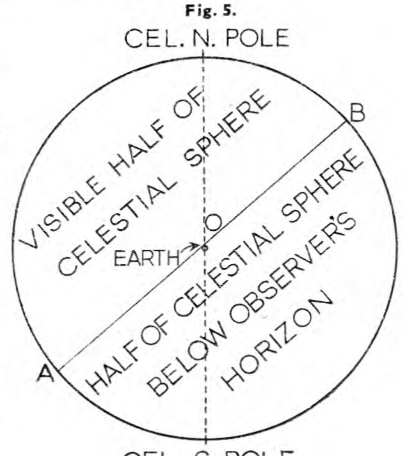
The various stars are at vast distances from the earth—some so far away that their light takes thousands of years to reach us, and others nearer whose light arrives in a few years only (the light of the sun, which is 93 million miles away, takes only about eight minutes to reach the earth!). However, for convenience we regard all the stars as being at the same distance from the earth, so that we can picture them as being painted on the inside surface of an enormous hollow globe at the centre of which our earth lies. This globe is called the "Celestial Sphere" (to distinguish it from the earth, or "terrestrial" sphere). It has an axis which is a prolongation of the earth's own axis, a North Pole, a South Pole, and an Equator which divides it into northern and southern hemispheres. Fig. 4 shows the Celestial Sphere with part cut away to reveal the earth inside it. It can be seen that the North and South Poles of the Celestial Sphere lie vertically above the earth's North and South Poles respectively, whilst the Celestial Equator lies in the same plane as the earth's Equator.

Now, we have said that the stars are at immense distances from the earth, so that the Celestial Sphere is really of almost infinite size, and therefore to be in a correct proportion in a diagram the earth must be represented as a microscopic pinpoint. This has been done in Fig. 5, and our line AOB of Fig. 3 has become a line *passing through the centre of the circle which represents the Celestial Sphere*, thereby cutting it into halves. Remembering that an observer can look all around him, this line actually represents a flat surface—in fact, a *disc*, the centre of which is the centre (O) of the Celestial Sphere and which divides the latter into two equal parts.

We have now answered part of our original question: From a given place you can always see *exactly half* of the Celestial Sphere—that is, half of the entire heavens—at any moment. Thus all the stars to be left of the line AOB in Fig. 5 are visible to an observer situated at the same spot on the earth's surface as the observer of Fig. 3.

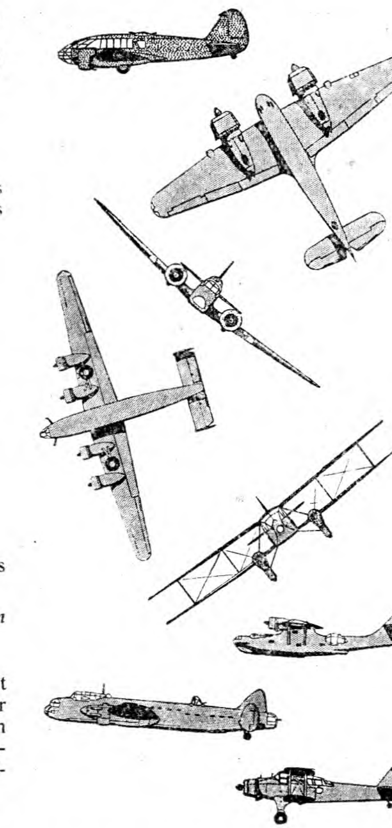
Having found that one-half of the heavens is always visible, the next point to settle is: Which half? This will be dealt with in a further article.

Fig. 5.

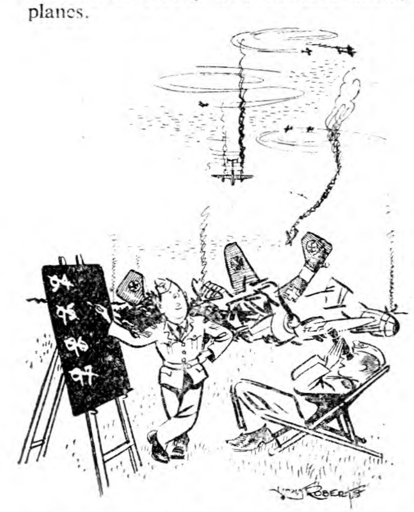


AIR TEASERS

by **Hubert Phillips**



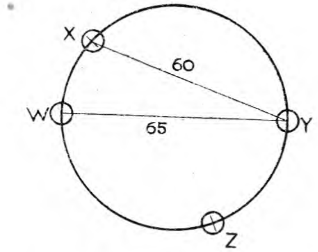
1. Three fighter-pilots named Airworthy, Battleboy and Chaser have collectively shot down exactly one hundred enemy planes.



Wishing to find out their several shares in this total, I discovered (1) that Battleboy and Chaser had between them shot down 14 more planes than Airworthy, and (2) that Airworthy's score would have been double Chaser's score had Airworthy shot down one plane more.

How many planes has each of the three accounted for?

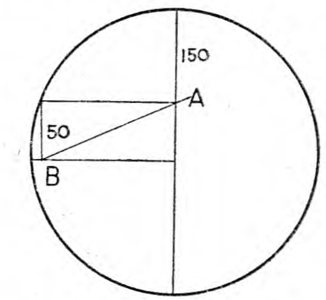
2. Looking at a map the other day, I discovered that the four searchlight posts, W, X, Y, Z, are all situated on the circumference of the circle of which WY is one diameter.



It is 65 miles, as the crow flies, from W to Y, and 60 miles from X to Y. The distance between Y and Z exceeds by 14 miles the distance between W and X.

How far is it from W to Z?

3. In the local park there is a circular pond 400 yards in diameter. A swimmer diving in at the northernmost point of the pond, and swimming due south, reaches raft A after swimming 150 yards. If he now swims due west until he comes to the edge of the pond, and then turns



south again for fifty yards, he reaches raft B.

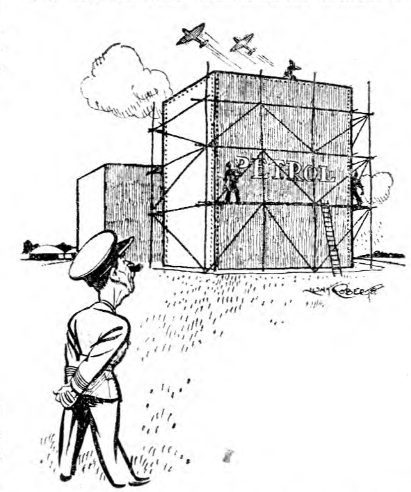
How far are the two rafts from one another?

4. Trying out a new aeroplane, a pilot flew the three "legs" of a triangular course. The three "legs" were equal in length (i.e. the course was an equilateral triangle), but owing to wind conditions, etc., the pilot's speeds were:

For the first leg . . . 180 m.p.h.
For the second leg . . . 240 m.p.h.
For the third leg . . . 360 m.p.h.

What was his average speed over the entire course?

5. For storing petrol, Group Captain Cubitt had made two cubical containers. The side of each was an exact number of



feet (i.e. no fractions), and the difference in capacity between the larger tank and the smaller tank was 1,685 cubic feet.

What were their respective capacities?

(*Answers on page 22*)

JUMBLED NAMES

HERE is a new type of puzzle devised by Hubert Phillips. In each sentence below, the letters of two or more consecutive words jumbled together give the name, or the makers' name, of one of the aircraft shown above.

1. The pilot can put the supercharger in top gear, but if he overdoes it he may damage the engine.
2. A Hudson in Iceland stood on the tarmac waiting to take off for Atlantic patrol.
3. Once you get your Spitfire's guns on the target you see rapid and devastating results.
4. There is no need to freeze up or panic if your engine stops. Just put her nose down and make up your mind quickly where to land.
5. The pilot admitted that a Roc, able though it was to deal with a Ju. 87, was no match for the Fw. 190.
6. Cadets should take a pride in their appearance.
7. In Africa we sometimes have to barter oil for water.
8. The engine is all right, sir, except for her ten cams, which need replacement.

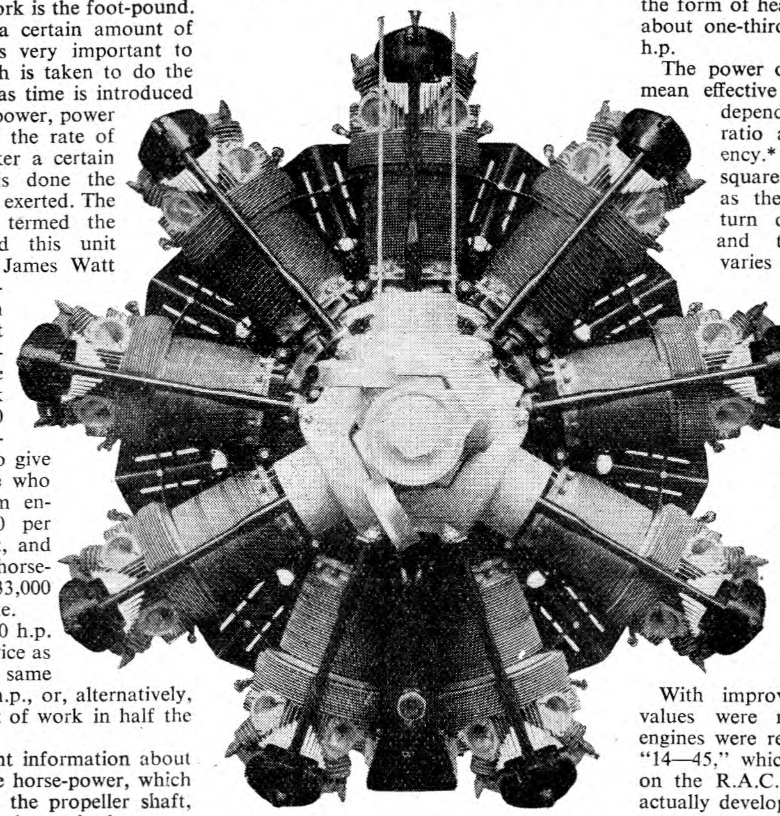
(*Solutions on page 26*)

HORSE-POWER

by G. D. Duguid, M.A.

THE term "work" is used in engineering to denote the product of a force multiplied by the distance which its point of application moves in the line of action of the force. If the force is expressed in pounds weight and the distance in feet, the unit of work is the foot-pound.

In accomplishing a certain amount of work, however, it is very important to know the time which is taken to do the work; and as soon as time is introduced we obtain a unit of power, power being a measure of the rate of working. The quicker a certain amount of work is done the more power must be exerted. The unit of power is termed the "horse-power"; and this unit was introduced by James Watt during the development of the steam engine. It is said that he found by experiment that an average carthorse could work at the rate of 22,000 foot-pounds a minute; and in order to give good value to those who purchased his steam engines he added 50 per cent to this amount, and called the unit the horse-power, namely, 33,000 foot-pounds a minute.



An engine of 1,000 h.p. will, therefore, do twice as much work in the same time as one of 500 h.p., or, alternatively, do the same amount of work in half the time.

The most important information about an engine is its brake horse-power, which is the useful h.p. at the propeller shaft, which can be measured on a brake.

The lost h.p. is the h.p. necessary to overcome the friction losses, drive the auxiliaries, and to overcome the pumping loss, namely, getting the mixture into the cylinders and the exhaust gases out. If the lost h.p. is added to the brake h.p., the indicated h.p. is obtained, which is the h.p. obtained at the piston crown. The term "petrol h.p." is sometimes used, and refers to the h.p. available in the fuel in the form of heat units, but of which only about one-third is converted into useful h.p.

The power of an engine varies as the mean effective pressure, which in turn depends upon the compression ratio and the volumetric efficiency.* It also varies as the square of the bore, and directly as the piston speed, which in turn depends upon the stroke and the r.p.m. The B.H.P. varies again as the mechanical efficiency. For the purpose of rating automobile engines the Royal Automobile Club established a formula in which it was assumed that the mean effective pressure was 90 lb. per sq. in., the mechanical efficiency 75 per cent and the piston speed 1,000 ft. per minute. The R.A.C. formula then became

$$\text{B.H.P.} = \frac{D^2 n}{2.5}$$

where D is the bore in inches and n the number of cylinders.

With improved design the assumed values were much exceeded, so that engines were referred to as, for example, "14—45," which means a 14 h.p. rating on the R.A.C. formula, but the engine actually develops 45 b.h.p. on the brake, more than three times its rating.

*These terms were explained in a previous article entitled "Engine Terms."

ANSWERS TO PUZZLES

1. This is a simple simultaneous equation (though the puzzle can easily be solved by guesswork):

Let the 3 pilots' respective scores be a, b and c planes.

Then (i) $a+14=b+c$

(ii) $a=2c-1$

$\therefore 2c-1+14=b+c$

i.e. $c+13=b$

But (iii) $a+b+c=100$

i.e. $2c-1+c+13+c=100$

$\therefore 4c=88$ and $c=22$

whence $b=35$ and $a=43$

Airworthy has bagged 43 planes, Battleboy 35, Chaser 22.

2. The solution depends on two well-known propositions:

(i) the angle subtended by the diameter of a semi-circle is a right-angle;

(ii) the square on the hypotenuse of a right-angled triangle is equal to the sum of the squares on the other two sides.

$65^2-60^2=625=25^2$

$\therefore$ it is 25 miles from W to X

$\therefore$ it is 39 miles from Y to Z

But $65^2-39^2=2704=52^2$

Hence from W to Z is 52 miles.

3. This looks difficult, but in fact it is very simple. A glance at the diagram will show that, after leaving the first raft, the swimmer traverses two sides of a rectangle, one diagonal of which is a radius of the circle (200 yards). The diagonals of a rectangle are equal.

Hence the distance from A to B is 200 yards.

4. There is a "catch" here. The pilot's average speed is *not* 260 m.p.h.

The pilot flies an equal number of miles at 180, 240 and 360 m.p.h.

Hence he flies an equal number of miles in $\frac{1}{180}$, $\frac{1}{240}$, and $\frac{1}{360}$ hours

And his average time per mile is

$$\frac{1}{3}\left(\frac{1}{180}+\frac{1}{240}+\frac{1}{360}\right)\text{hrs.}=\frac{1}{240}\text{ hrs.}$$

Thus his average speed is 240 m.p.h.

5. This is a more difficult puzzle, because at first blush it is not easy to see how one should set about solving it.

Let the sides of the two tanks be respectively x feet and y feet.

Then $x^3-y^3=1685$

i.e. $(x-y)(x^2+xy+y^2)=1685$

Now, the only factors of 1685 are 1, 5, 337, 1685

Hence $(x-y)=1$ or 5

Suppose $(x-y)=1$

Then $(x^2+xy+y^2)=1685$

Then $(x-y)^2=1$

i.e. $x^2-2xy+y^2=1$

Whence $3xy=1684$

But this is impossible $\because$ 1684 is not divisible by 3

Hence $(x-y)=5$; $(x^2+xy+y^2)=337$

Now $(x-y)^2=25$

i.e. $(x^2-2xy+y^2)=25$

whence $3xy=312$

i.e. $xy=104$

It follows that $x=13$, $y=8$

The respective capacities of the two tanks are thus 2197 cubic ft. and 512 cubic ft.

CODES AND CIPHERS

by John Sinclair

IF a secret message is to be transmitted to some distant point wireless telegraphy, submarine-cable circuits, teleprinter lines or telephone lines may have to be employed. Unfortunately these valuable aids to communication are liable to interception, and are not wholly in themselves secret.

Code and Cipher

Consequently, in order to keep our good intentions from our enemies, code and cipher systems have been devised. A code system is one in which several words are represented by one or more letters. Cipher systems are usually devised by rearranging letters and numerals. Cipher systems, because they follow orderly rules, can often be solved by a process known as analysis, though a great deal of practice and patience are needed before the art of deciphering enemy messages has been acquired.

Cipher systems fall into two main groups. The first group are known as *transposition systems;* the second are called *substitution systems.*

In the case of transposition systems, the letters of a plain language (P/L) message are arranged in some orderly manner to produce a new text, which on inspection appears quite unintelligible. In substitution systems the letters or groups of letters are replaced by substitute characters which may be either letters or numerals. Substitution ciphers are very difficult to "break" (the phrase "breaking a cipher" means finding the key, usually by analysis, to an enemy cipher system).

Code Systems

During the last war code systems were used by the pilots and observers of reconnaissance aircraft for conveying information to the artillery engaged on counter-battery work. One such code—known as the Clock Code—enabled a pilot to give with reasonable accuracy the position of each "burst" in relation to the target. For example, a shot which fell 50 yards due north of the target was recorded as A12—the letter A indicating the approximate distance from the centre of the target and the numeral 12 indicating its direction. A shot falling 200 yards due east of the target would have been signalled as C3. Registering by means of the Clock Code was carried out by wireless telegraphy, the pilot being in communication with the ground wireless station attached to the battery co-operating in "the shoot," as it was called.

Other codes were used by the pilots for giving weather reports. For example, UL FR UD meant that the weather was *U*nfit for *L*ine work (trench strafes), *F*it for *R*econnaissance observation (troop movements), but unfit for counter-battery work.

Single letters or pairs of letters were used to pass orders from the aircraft to the guns; for example, the letter G gave the order for the battery to open fire, whilst the signal MQ meant "wait."

Special code signals were used to convey details of snap targets, such as small groups of infantry or a column of motor transport. Really "hot" targets were reported by means of a special signal, known as an "LL" call. Believe me, "Jerry" got "L" when our batteries opened up on these choice targets!

The International "Q code" as used by land and ship stations provides another example of a simple code system. By the use of this code a ship operator is able to convey the intelligence of a comparatively long message by sending *only three letters*. Every Q signal begins with the initial letter Q, hence the name "Q code."

The following are only three of the very large number of Q signals in general use:

QRA? What is the name of your station?

QRB? How far approximately are you from my station?

QRD? Where are you bound for and where are you from?

Replies are given by repeating the appropriate signal and adding the desired information. As an example, suppose the s.s. *Cadet* is in mid-Atlantic, bound for New York from, say, Liverpool, and is in wireless communication with the North Foreland land station. The ship's operator would answer the signals QRA? QRB? QRD? with the message: "QRA Cadet QRB 1200 QRD New York Liverpool."

The Q Code has been internationally recognised and is used by all marine operators. For this reason it cannot be classed as a secret code, although, as will be seen, it fulfils one of the chief purposes of all code systems—it enables us to "say a lot quickly."

Radio amateurs—there were nearly 100,000 of them before the war—use the Q Code and other similar codes for conveying information. One great advantage gained by the use of these internationally recognised codes is that the recipient need have no knowledge of the spoken language of the person with whom he is in "conversation."

During the years before the war I "conversed" in the Morse code with thousands of foreign radio amateurs who know no word of spoken English, our conversations being carried on by means of the Q Code and recognised abbreviations.

One further example of the use of code systems is to be found in the commercial codes, in which code words are used to represent business phrases. If you look at the note-headings used by many of the large commercial firms you will find a reference to the cable address of the firm and the code it uses. Customers who wish to telegraph orders or instructions can, by means of the code, reduce their communications to a few words.

During the present war many different code systems have been used and developed, but the majority are based on the principle of representing several words by one or more letters and numerals.

Cadets training as wireless operators will already have "rubbed shoulders" with a well-known R.A.F. code known as the "X Code."

Cipher Systems

Cipher systems lend themselves to much ingenuity. For example, most readers have experimented with transposition ciphers such as these:

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

A simple form of transposition cipher in which the letters of the alphabet are arranged in sequence.

A	B	C	D	F	G	H	I	L	N	R	T	W
Y	Z	E	Q	J	K	O	M	P	S	U	V	X

A transposition cipher in which the letters are mixed.

H	U	D	S	O	N	A	B	C	E	F	G	I
J	K	L	M	P	Q	R	T	V	W	X	Y	Z

A mixture with a key. A key-word (in this example 'Hudson") is first inserted and the remaining letters of the alphabet follow in the usual order.

Transposition systems have the disadvantage that frequently occurring letters like "E" provide useful clues to the system. If two coupled letters are substituted for one in the plain text, this disadvantage can be diminished, since each letter can be represented by 26 different two-letter groups.

As the varying lengths of words might provide a clue, ciphered messages are usually divided up into groups of four or more letters.

Syko

Syko is a transposition-type cipher which has been developed by the R.A.F. for conveying secret intelligence by means of wireless telegraphy. The word "Syko" has presumably been coined from the first syllables of phonetic pronunciation of the words "Cipher" and "Code."

Of course, the methods used by the R.A.F. for preparing Syko messages are quite different from those we have been discussing here, but—and this is an important point—practice in preparing messages of the Syko type can be obtained by following the suggestions made in this article.

In the Syko system a plain-text letter may be represented by a large number of different cipher letters or numerals. Furthermore, the cipher groups used for any one day are never employed again, which means that even if the enemy captured a Syko card it would be of no use to him the following day.

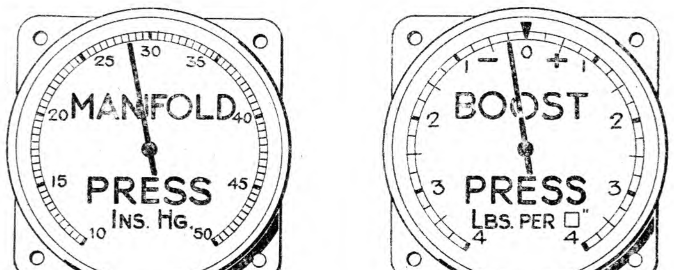
BOOST OR MANIFOLD PRESSURE GAUGE

by **C. Farley**

THE boost gauge, or, as the Americans call it, the manifold pressure gauge, is one of the most important instruments fitted to an aircraft. It shows at a glance the absolute pressure in the induction system of a supercharged engine. The power developed by such an engine is mainly dependent upon this factor. The boost pressure is the additional, forced, or synthetic pressure which is superimposed on that of the atmosphere. What we require to know is the sum total of both pressures combined in the induction system; so the expression "manifold pressure gauge" fills the need rather better than the familiar term "boost gauge." Nevertheless, it will be convenient to continue to refer to it as the "boost gauge," this having become a standard term in most technical journals.

When an aeroplane is flown to great altitudes the efficiency of the engine is seriously impaired owing to the reduced pressure of the atmosphere. To overcome this difficulty a supercharger is employed; that is to say, air is forced into the induction system, by means of a pump, at a pressure above that of the surrounding atmosphere. By this means maximum power can be maintained in spite of altitude. This system may also be used to increase the power of an engine while running on the ground.

Some limit must be fixed to the amount of pressure that can safely be imposed by such means, or damage to the engine may result. Because of this, and in order that we may be kept informed of what is taking place, the "boost," or "manifold," gauge is fitted.



A.—American. B.—British.

Fig. 1.

Definitions

In English machines boost pressure is defined in "pounds per square inch" above or below standard sea-level atmospheric pressure. For instance two pounds negative boost (−2 lbs. registered on the dial of the gauge), assuming atmospheric pressure to be, say, 15 lb. per sq. in., would actually be 13 lb. per sq. in. And two pounds indicated positive boost would be 17 lb. per sq. inch. By this arrangement it will be seen that readings can be taken direct from the instrument without reference to the prevailing atmospheric pressure. The American system utilises a dial calibrated in "inches of mercury." The two systems must not be confused.

Estimated roughly, 1,000 feet of altitude represents a fall of approximately ½ lb. per sq. in. of atmospheric pressure. So at 20,000 feet if an English boost gauge indicated 5 lb. per sq. in., the actual pressure supplied by the supercharger would be about 15 lb., as the indicated pressure is roughly 5 lb. above normal atmospheric pressure at mean sea-level; and we shall already have lost 10 lb. due to altitude. We have already seen that part of the duty of the supercharger is to make good this deficiency.

On the American manifold pressure gauge normal atmospheric pressure is shown as approximately 30 in. of mercury (see A and B, Fig. 1), consequently 5 lb. positive boost will be registered as 40 in. of mercury. Again using approximate figures for the sake of simplicity, we can assume that 1 in. of mercury represents 1,000 feet of altitude. What takes place at 20,000 feet will, of course, be the same as given for the English gauge, but expressed in different terms.

Automatic Control

In addition to changes due to altitude, atmospheric pressure fluctuates with variations of temperature and latitude. This is a complication. But a modern device incorporated in the engine (power unit) relieves the pilot of anxiety in connection with these alternations. It is known as "automatic boost control." Briefly, it consists of an aneroid box within a cylindrical housing. This is connected to the induction chamber by a pipe-line. One end of the box is connected to a piston valve; this controls oil pressure which feeds a servo-motor. A decrease of air pressure will allow the box to open; this causes a movement of the servo-motor piston, which is linked to the air inlet control, and so restores the balance.

It might appear that this convenient device would render the presence of a gauge unnecessary, but, ingenious as it undoubtedly is, we still need to have some means of checking the performance of the engine to make certain that everything is in good working order. It is particularly necessary for the ground testing of engines, and during the period of take-off, when the engine is called upon to develop its maximum effort (which, however, must only be permitted for a specified period), and, of course, when the aircraft is flying at great altitudes.

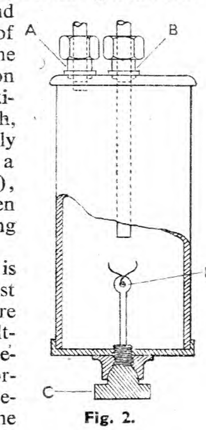


Fig. 2.

So important is this matter of boost or manifold pressure that a special built-in, two-way, change-over cock is incorporated in the pipe-lines to enable the pilot to take a reading of port or starboard engine on either of the two instruments provided. Normally there is a gauge for each engine, but should one become damaged during flight, or be suspected of inaccuracy, a check can be made by switching over to the alternative instrument.

Pictorial Crossword Solution

(*See page* 16)

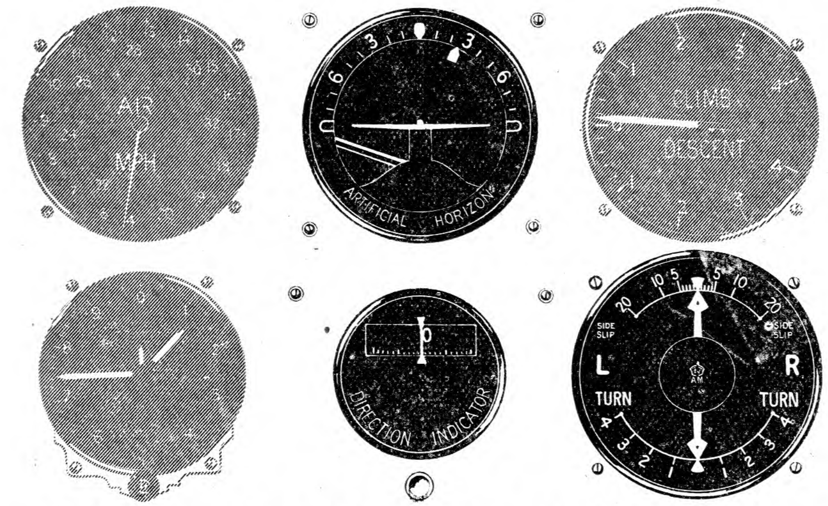
A	R	M	S	T	R	O	N	G	A	I	R	O	N	E
N	O	R	T	H	R	O	P	U	K	R	I	P	O	N
S	T	R	E	A	M	L	I	N	E	I	P	T	D	O
O	A	K	A	W	D	E	P	R	E	S	S	I	O	N
N	C	A	R	K	R	O	E	A	L	T	I	M	A	R
W	A	Y	M	E	T	E	R	T	B	A	L	U	M	I
E	D	B	A	R	R	A	G	E	O	R	E	M	A	G
L	E	O	N	I	U	M	I	D	L	E	N	O	R	I
L	T	U	R	N	E	S	P	I	T	F	I	R	E	D
I	P	L	O	T	S	T	R	E	A	K	N	E	T	O
N	U	T	C	A	P	R	O	N	I	N	C	F	O	X
G	P	O	S	K	Y	B	O	T	H	A	A	I	R	F
T	A	N	D	E	M	O	T	I	P	B	M	A	Y	O
O	L	E	O	P	A	R	D	N	E	S	E	T	H	R
N	B	A	C	O	R	E	D	P	R	Y	L	A	N	D

Competition

The London Naval Centre for "Y" Entries is organising a competition open to 10 cadets from each Air Training Corps unit in the London and South-Eastern Regions. The 20 successful candidates will be given free travelling warrants to Lee-on-the-Solent, where they will spend a day going over the Royal Naval Air Station, with the possibility of a flight in a Service aircraft, conditions permitting. All details may be obtained from your Commanding Officer.

THE GYRO INSTRUMENTS

by **Astro**



The Flying Instrument Board. Gyro instruments have been made to appear bolder in this drawing.

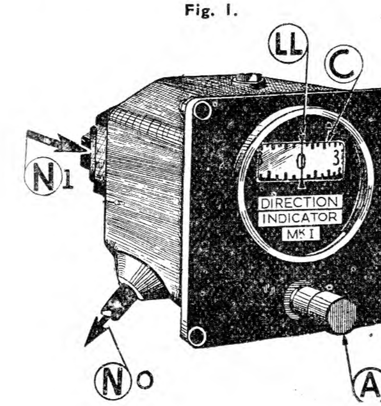
THE so-called "blind-flying instruments" are as useful in clear weather as at night or in fog, because they supply the pilot with more accurate information as to speed, height, direction and altitude than can be provided outside the cockpit and with less fatigue for the pilot.

A turn made by using the rate-of-turn and side-slip indicator is much easier and more accurate than is possible without this valuable instrument.

The *artificial horizon* provides a visual reference for level flight far more dependable than the natural horizon. At high altitudes an artificial horizon indicator is essential.

The *direction indicator*, number five on the panel, is another flying instrument which is used constantly in clear as well as bad weather. This instrument is not a compass in the sense that it indicates direction in relation to a fixed point on the earth, as does the magnetic compass, but is used in conjunction with the magnetic compass. The great advantage of the direction indicator is its more sensitive reaction to slight changes of direction, i.e. yawing.

Fig. 1.



To set the instrument, the aircraft must first be put on the aerial compass course, then the caging knob at A, Fig. 1, is pressed and turned until the lubber line (LL) indicates the required heading in degrees at the card (C). The pilot then steers by keeping the lubber line at the appropriate number of degrees on the card (C), checking up with the compass from time to time.

The direction indicator is not affected during acceleration or turning, like the compass, but will indicate every change of direction, however slight. In this respect it is the most useful directional reference the pilot has.

Each of the three flying instruments just considered is controlled by a gyroscope which provides the necessary reference in space from which the pilot can estimate his flying attitudes.

Fig. 2 shows the gyroscope (R) mounted universally in two rings—(E) the gimbal ring and (F) the outer ring. The gimbal ring is governed by the inertia of the gyroscope, while the outer ring is attached to the aircraft structure at (D) and moves with it. In the direction indicator the gyro is mounted as shown at Fig. 2. Imagine the aircraft to be moving in the direction of the axis (A), then any change of direction of the aircraft around the axis (A2) of the outer ring will not affect the directional reading of the gyroscope. Thus the rotor (R) provides a directional reference (A) independent of the aircraft heading and with such a high degree of accuracy that any change of direction will immediately show itself in a difference in direction between the rotor and its ring (E) and the aeroplane and its ring (F). This difference is read off at the lubber line on the scale (C) at the dial of the instrument (Fig. 1).

When flying by the direction indicator, the lubber line appears to be stationary, while the card (C) seems to move. This is an illusion, for the card is part of the inner gimbal and is governed by the rotor, while the aeroplane and the lubber line move round the card, which is stationary. It is an illusion, just as the apparent movement of the sun round the earth is an illusion. The scale of the instrument is graduated every five degrees, and numbered every 30. This is divided by ten, so 30 degrees reads 3, 60 degrees reads 6, and so on.

To turn the rotor (R), the air is sucked out of the case at N (Fig. 1) through a pipe leading to a suction pump or the outside venturi tube. As air is sucked out of the instrument case at one end (N0) it rushes into it at the other (at N1). In doing so it is directed on to the vanes of the rotor through the nozzle (N, Fig. 2), so turning the rotor like a water wheel

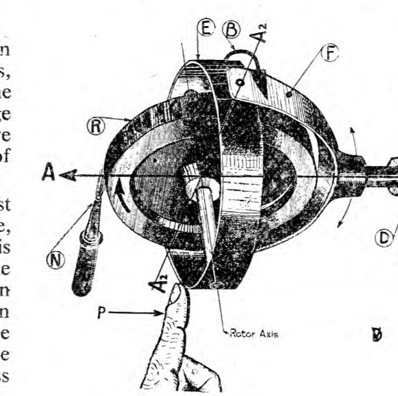


Fig. 2.

or air turbine. The average speed of the gyro rotor is 10,000 r.p.m. A rotating gyro not only possesses inertia, but also a peculiarity called "precession." This is illustrated by pressing the finger at P. which does not cause the ring (E) to move away, but forces the gyroscope to move in the direction of the arrow (B) round D. Even the slightest friction in the bearings of the rotor axis will set up a small force sufficient to cause the gyro to precess about the direction axis (A), thus causing a slight tendency to stray which is periodically checked by the turn indicator and the compass. The secret of all gyroscopic instruments is that the rotating gyro maintains a fixed direction in space, and therefore provides a reference, or flying datum, from which to measure the slightest change about any of the three axes. Skill in instrument flying needs knowledge of the instruments and a quick reaction to their indications.

FLIGHT MECHANIC'S CALCULATIONS

by **P. W. Blandford**

THOSE of you preparing for jobs on the ground may think that you do not need to bother about maths. You may not—in a non-technical job; but if you hope to become a flight mechanic, fitter, instrument repairer, or any of the other tradesmen working on aeroplanes, you will find that a working knowledge of some calculations is not only desirable but absolutely necessary if you expect to progress in your trade.

The calculations you need to know are not very advanced; but you must understand them thoroughly and be able to apply them quickly and accurately. Only straightforward arithmetic is used. Of course, if you have a knowledge of logs. and trig. you will find it useful; but if you can measure accurately, use and convert vulgar and decimal fractions, measure angles in degrees, and employ simple formulæ without tying yourself in knots, you will have gone a step on the road to becoming a good engineer.

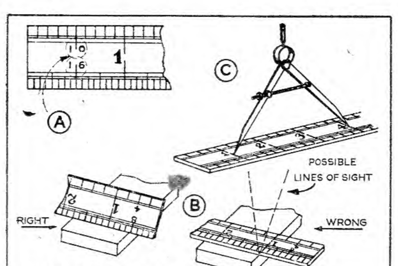
Measuring

Everyone imagines that they can measure, but engineering measurements are rather different from the everyday rough-and-ready sort.

The steel rule used is more accurate than a wooden one. It is often graduated on all four edges. I have seen that confuse beginners. It should not. A common arrangement of scales is: Sixteenths, twentieths, twelfths of an inch, and metric. You can recognise each scale by counting the number of divisions in an inch; but that should not be necessary, as there is a figure near the first half-inch mark indicating the number (A).

An engineer does not usually trust the accuracy of the end of his rule. It may have become worn or damaged; and in any case it is easier to measure accurately from a mark than from an end, so he often works from the one-inch mark. He also holds the rule edgewise on the work, to avoid "errors of parallax"—meaning that he gets the graduations close down to the job, so minimising any errors that might creep in if his eye was not exactly over the mark (B).

Often dimensions have to be set off with dividers, instead of direct from the rule. Again the end of the rule is avoided, e.g. three inches being taken from one inch to four inches (C).



MEASUREMENTS

Fractions

Micrometers and verniers are used for measuring to finer limits than are possible with a plain rule. The instruments used by a Service fitter are graduated in tenths, fortieths, and thousandths of an inch. Tables for converting the usual sixteenths, thirty-seconds, etc., of the ordinary rule to decimals are available; but when these are not to hand a man with only a hazy knowledge of arithmetic may be stumped.

Actually, it is a simple problem to convert any vulgar fraction to a decimal: put a decimal point after the figure on top and imagine an unlimited supply of noughts after it. Then divide by the figure at the bottom, e.g. $\frac{1}{8}=1.000\div8$, or

$$8\,\underline{|1.000}$$
$$.125$$

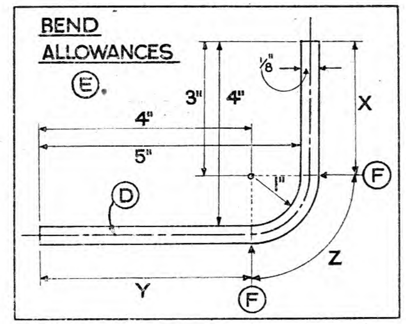
Developments

In repair work a fitter may be called upon to make a sheet-metal patch. Some part may need covering with sheet metal, and the patch may have to be cut to size and drilled before bending.

When metal is bent, the outside of the bend stretches and the inside contracts. Somewhere between the two there must be a layer which does neither, and simply remains the same length as it was before bending. This is called the "neutral axis," and on sheet metal lies halfway through the thickness (D).

All calculations are made on the neutral axis. The length of the piece is divided up into straights and curves, which are calculated separately. As a simple example, take the right-angled patch with radiused corner (E). For calculations this would be divided into three parts. The point where the straight section changes to a curved is in line with the centre of the curve (F). Therefore the straight portions measure:

X - 4 in.−1 in. (radius), i.e. 3 in.
Y - 5 in.−1 in. i.e. 4 in.



As the length of curve has to be measured on the neutral axis, the radius used is 1 in. + half of $\frac{1}{8}$ in. i.e. $1\frac{1}{16}$ in. Now, if this were a complete circle, the length around the curve would be $2\pi\times1\frac{1}{16}$ in. As the angle is 90 degrees, the length Z is $\frac{90}{360}$ or $\frac{1}{4}$ of $2\pi\times1\frac{1}{16}$ in. If the angle had been anything else it would have been treated in the same way, i.e. divided by 360 and multiplied by the circumference of a complete circle on the neutral axis. The complete length of the development is X+Y+Z.

I hope that these few example have shown you that it is not only the flying man who has to manipulate figures: the fitter or mechanic who hopes to reach the top in his trade must also prove his ability to work with mathematical accuracy.

Cadets are reminded that if they send parcels of waste paper to The Stanhope Press, Rochester, Kent, they will help in the production of the *Gazette* and will receive aircraft identification charts to the value of the postage expended.

AIR CADETS . . .

Can you spare a penknife? a cake of soap? and some other small comfort for the gallant men of the Red Army? They are fighting in desperate conditions this winter; simple necessities will make their sufferings a little easier. Show your friendship for Soviet youth by sending *your* parcel with

British Youth's Gift to the Red Army
Write for details to
RED ARMY PARCELS,
Anglo-Soviet Youth Friendship Alliance,
104 Wigmore Street, LONDON. W.1.

Jumbled Names Solutions

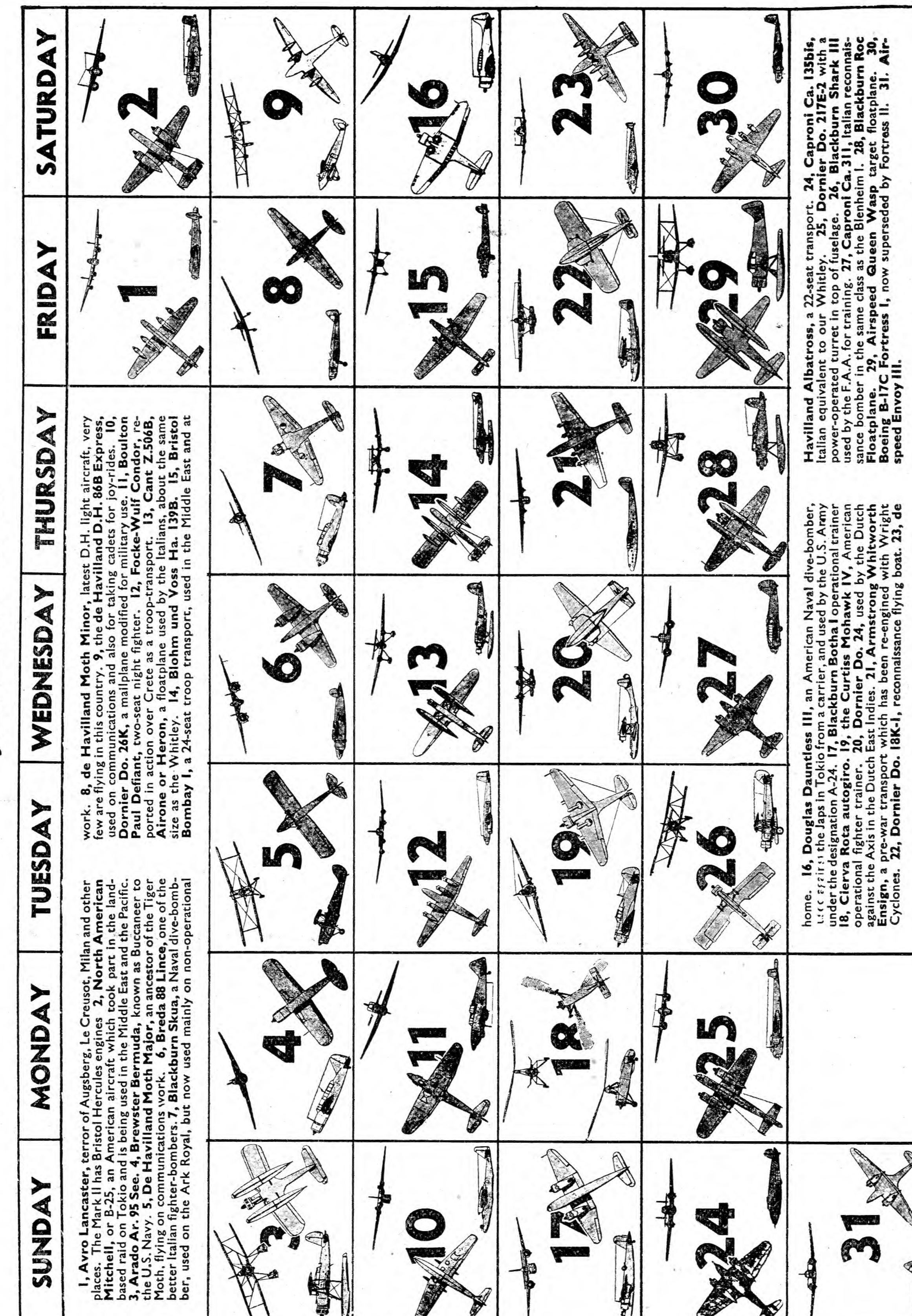
(*see page* 21)

1. Beaufighter—"gear but if he" (2).
2. Consolidated—"Iceland stood" (6).
3. Airspeed—"see rapid" (3).
4. Caproni—"or panic" (1).
5. Albacore—"A Roc able" (8).
6. Rapide—"a pride" (5).
7. Liberator—"barter oil" (4).
8. Manchester—"her ten cams" (7).

(First number refers to sentence, second to silhouette.)

AIRCRAFT RECOGNITION CALENDAR

JANUARY 1943



1, Avro Lancaster, terror of Augsberg, Le Creusot, Milan and other places. The Mark II has Bristol Hercules engines **2, North American Mitchell,** or B-25, an American aircraft which took part in the land-based raid on Tokio and is being used in the Middle East and the Pacific. **3, Arado Ar. 95 See. 4, Brewster Bermuda,** known as Buccaneer to the U.S. Navy. **5, De Havilland Moth Major,** an ancestor of the Tiger Moth, flying on communications work. **6, Breda 88 Lince,** one of the better Italian fighter-bombers. **7, Blackburn Skua,** a Naval dive-bomber, used on the Ark Royal, but now used mainly on non-operational work. **8, de Havilland Moth Minor,** latest D.H. light aircraft, very few are flying in this country. **9, the de Havilland D.H. 86B Express,** used on communications and also for taking cadets for joy-rides. **10, Dornier Do. 26K,** a mailplane modified for military use. **11, Boulton Paul Defiant,** two-seat night fighter. **12, Focke-Wulf Condor,** reported in action over Crete as a troop-transport. **13, Cant Z.506B, Airone or Heron,** a floatplane used by the Italians, about the same size as the Whitley. **14, Blohm und Voss Ha. 139B. 15, Bristol Bombay I,** a 24-seat troop transport, used in the Middle East and at home. **16, Douglas Dauntless III,** an American Naval dive-bomber, used against the Japs in Tokio from a carrier, and used by the U.S. Army under the designation A-24. **17, Blackburn Botha I** operational trainer **18, Cierva Rota autogiro. 19, the Curtiss Mohawk IV,** American operational fighter trainer. **20, Dornier Do. 24,** used by the Dutch against the Axis in the Dutch East Indies. **21, Armstrong Whitworth Ensign,** a pre-war transport which has been re-engined with Wright Cyclones. **22, Dornier Do. 18K-1,** reconnaissance flying boat. **23, de Havilland Albatross,** a 22-seat transport. **24, Caproni Ca. 135bis,** Italian equivalent to our Whitley. **25, Dornier Do. 217E-2** with a power-operated turret in top of fuselage. **26, Blackburn Shark III** used by the F.A.A. for training. **27, Caproni Ca. 311,** Italian reconnaissance bomber in the same class as the Blenheim I. **28, Blackburn Roc Floatplane. 29, Airspeed Queen Wasp** target floatplane. **30, Boeing B-17C Fortress I,** now superseded by Fortress II. **31, Airspeed Envoy III.**

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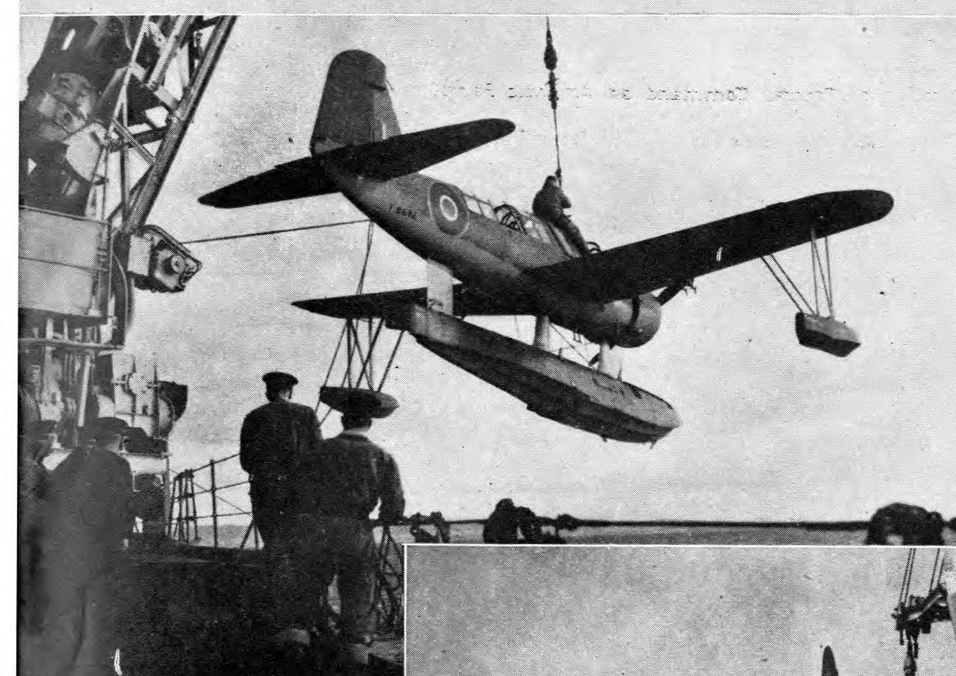

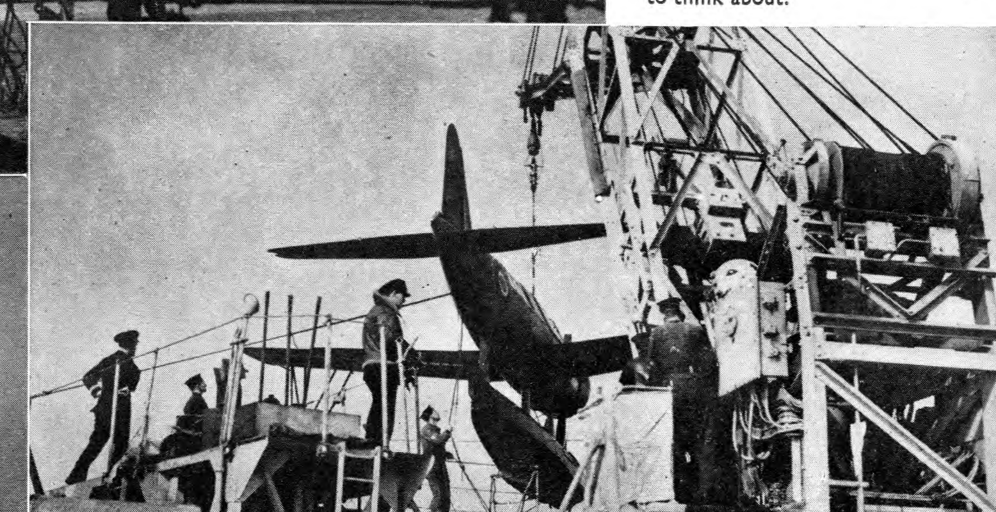

CATAPULT INSTRUCTION

(continued from page 2 of cover)

thrill your first catapult shot is. One pilot is reputed to have said that it was the biggest kick in the pants he had ever had. Acceleration is from 0-55 knots in 2½ secs. (2½ G.)

Airborne, and doing a job. Just aft of the rudder will be seen a small message container—in these days of W/T silence other means of transmitting messages have to be thought of. This Royal Navy Kingfisher is seen doing a practice message drop. Note the rudder on the float.

'Home again." The observer sits in the glasshouse and keeps a fatherly eye on things. This picture gives a good clear impression of the float layout.

'And so to bed." The aircraft has had a busy day, and a few more pilots and observers have something to think about.