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and
AIRCRAFT ENGINEER

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The Outlook

Future of the Forces

THE debate on the future of the fighting Services initiated by Lord Trenchard last week elicited some information from Lord Stansgate (who replied for the Government), but not very much. He was definite in his denial that the Government intended to unify the three Services, as Mr. Patterson has advised the United States to do. He could give no information about the future strength of our forces, and therefore could not comfort troubled officers and other ranks who want to know what their prospects will be if they continue in uniform. He gave the good news that the Imperial Defence College would reopen next year, and agreed that it ought to be a residential college, though quarters at present were difficult to find. He suggested that the chairman of the Defence Committee was in effect the Minister of Defence. He did not accept wholeheartedly Lord Trenchard's advocacy of the short-service system. Universal service is one thing, and would, we think, be a very good thing; but we have never felt enthusiastic about Lord Trenchard's plan for officering the R.A.F. mainly with short-service men. Lord Stansgate pointed out some of the drawbacks. Permanent commissions in the Air Force are to rest, as before, on the basis of Cranwell, the universities and the promotion of airmen.

The Air Minister's support of the A.T.C. was very welcome; but it was puzzling to hear him say that it is to be the main source of recruits both for aircrews and ground services in the regular and non-regular Air Forces. What is to happen to Halton and the other schools of aircraft apprentices? Lord Stansgate cannot have meant that those splendid institutions are to disappear, but he did not make it clear what he really did mean.

As for the Reserve, it is to form a new Command in the R.A.F., including both the volunteer reservists who join from civil life and the regulars who have done their time with the squadrons. Once before there was only one Reserve, comprising regulars and civilian volunteers, but then all pilot members held commissions. When the R.A.F.V.R. was formed at the time of the expansion, nearly all the members joined as sergeant-pilots. Presumably that will still be the arrangement.

The debate brought out the general desire among the peers for the closest integration of the work of the three Services, and that is evidently the policy of the Government as well. Lord Stansgate was able to allude to the School of Air Support (on which there is an article on another page in this issue), and to announce that the R.A.F. instructor at the Imperial Defence College will be Sir Hugh Lloyd, who commanded the Air Force at Malta at the time of the toughest attacks on the island, and who consequently knows a great deal about the three Services and how they must work in unison.

Altogether, the debate was encouraging, though it did not carry one as far forward as one would have wished. The crux of the matter is the Government's inability to forecast what will be the future strength of the forces. That difficulty cannot be overcome by wishing; but it is to be hoped that there will be no undue delay.

A Memorable "First"

THE council of the Royal Aeronautical Society is to be congratulated on founding the British Commonwealth and Empire series of lectures, and on selecting for the honour of giving the first of these lectures a man who has done a very great deal for Empire aviation, Mr. W. Hudson Fysh. We have not the slightest doubt that in time these lectures will rank in

importance with that other series of annual lectures, the Wilbur Wright Memorial lectures.

As we see it, the two series of lectures should be complementary to each other. It has been the practice to invite as speakers in the Wilbur Wright series men of international repute. In the first of the Empire lectures Mr. Hudson Fysh dealt with political and operational aspects, and few men could be better qualified to deal with these subjects. As managing director of Qantas Empire Airways he has had very long experience of aircraft operation, and the close link which exists between B.O.A.C. and Qantas will, we hope, be maintained during the new set-up now proposed by the Government, so that he will be playing a very important part in the future development of Empire aviation. A key to the way in which he will play that part is afforded by his remark: "It is quite clear that for the good health of our future we have to be just as thoroughly British about our air effort as the Americans are American and the Russians Russian, but in the long count excellence is the only final test."

Celebrating the Record

THERE was a typically British atmosphere at the luncheon in London last week when the two Meteor pilots were toasted by representatives of British aviation: pleasure that this country has added the world's air speed record to the land and sea speed records which she already held, and a quiet confidence that if anyone should care to attack the speed of 606 m.p.h. we shall be ready to defend it. But no extravagant claims nor any vainglorious boasting.

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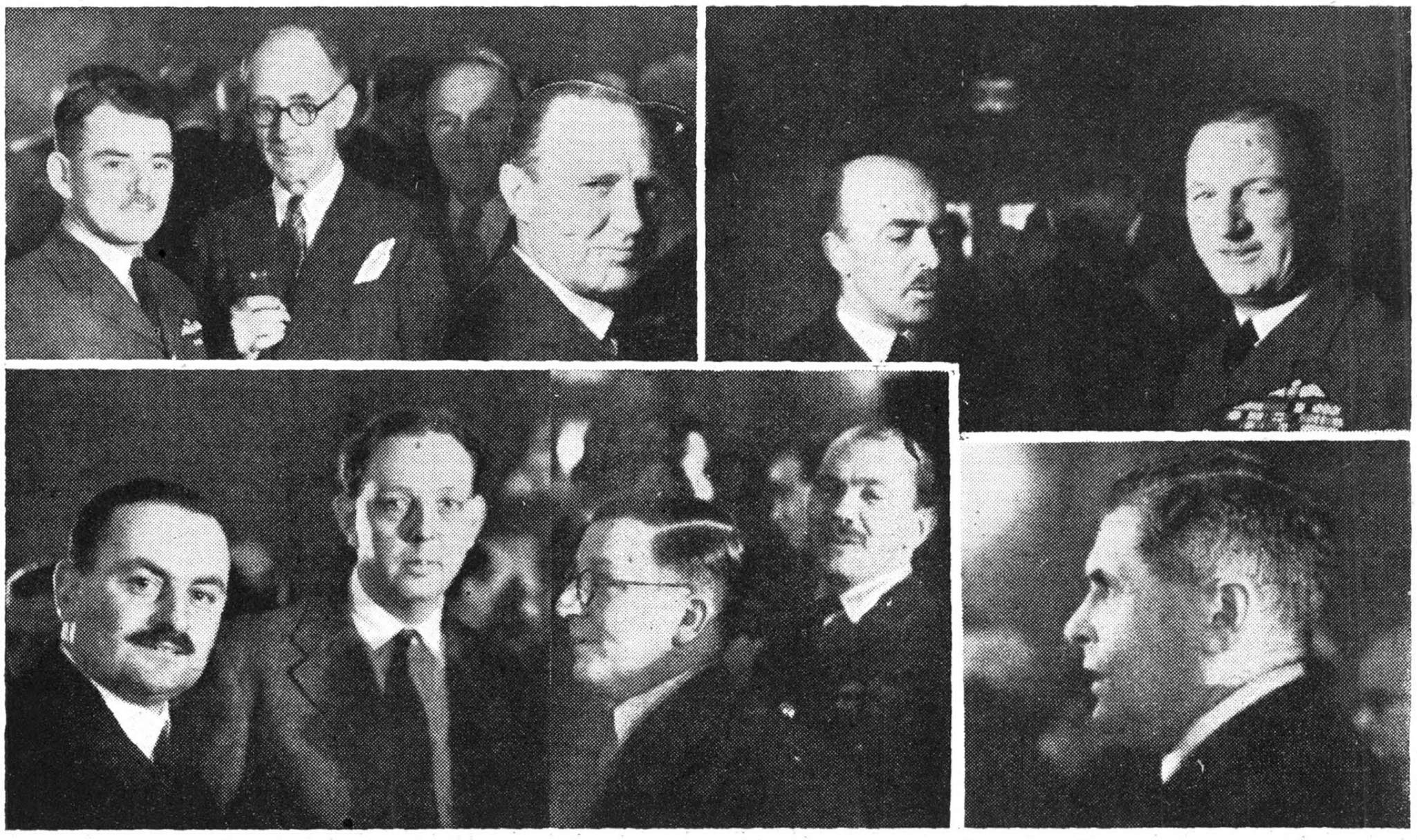
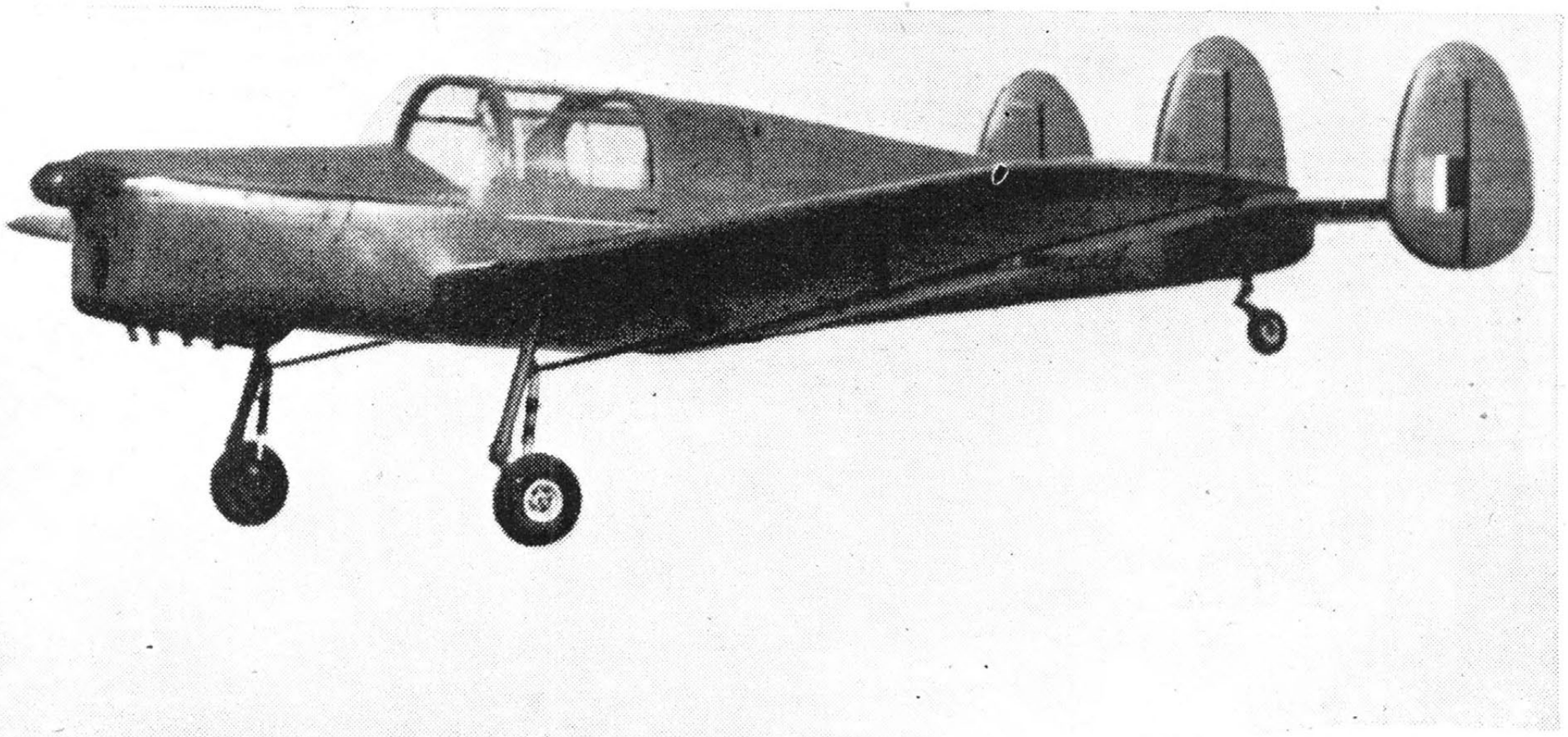
The achievement was, in fact, the culmination of a long period of close teamwork by members of nearly every section of the British aviation community. First and foremost, the designers of the aircraft and power plants. Their genius laid the foundation, but to translate their ideas into practical results the help of many others, unstintingly given, was needed. The employers and employees who built the machines; the Controller of Research and Development, who sponsored the programme; the Air Ministry and the R.A.F., who organised the high-speed flight; the Royal Aircraft Establishment, who contributed useful data; the National Physical Laboratory, who organised the timing equipment—all these, and others too numerous to mention, played an essential part in reminding the world that the spirit of co-operation which did so much towards winning the war is still alive. May it be extended to many other spheres of peaceful air development.



AT THE WORLD RECORD LUNCHEON: All sections of British aviation combined to honour the two Meteor pilots for their record-breaking flights. In the upper pictures are, from left to right, Air Commodore Whittle; Mr. C. E. Wallis; Mr. Geoffrey Smith; Air Vice-Marshal S M. Vincent, S.A.S.O., Fighter Command; Air Marshal Sir J. Robb, A.O.C.-in-C. Fighter Command; Air Marshal Sir L. H. Slatter, A.O.C.-in-C., Coastal Command. In the lower pictures are Mr. Eric Greenwood Gloster's chief test pilot; Dr. S. G. Hooker and Mr. J. P. Herriott, of Rolls-Royce; Group Captain Wilson, pilot of th record Meteor; and Air Vice-Marshal J. Boothman, Assistant C.A.S. (Technical Requirements), who piloted a Supermarin seaplane to victory in the last Schneider Trophy Contest in 1931 at a speed of 340.1 m.p.h.



The 3/4-seater Miles Messenger : A pilot who knows it well is able to take the Messenger off in a matter of 60 yards. The stalling speed is in the region of 28 m.p.h.

To-morrow's Light Aircraft

Conflicting Claims : Wood or Metal? High Wing or Low? Comfort and Safety versus Performance

By ROGER TENNANT

WHAT will our post-war light aircraft look like? "Indicator" and the recent correspondence his ideas have inspired give us some idea of what the private owner wants. How will the designer meet their demands? Like all users of aircraft they ask for the maximum in conflicting requirements. High top speed and low stalling speed; good vision and good lines; performance, comfort, safety and economy—all directly conflicting requirements with which the designer must juggle until he reaches the best compromise.

If we look at some of these problems from the designer's angle we shall, perhaps, be in a better position to see how far the pilot's demands can be met.

The first problem for the designer is to choose his materials—wood, light alloy, or steel and fabric. Wood has always been the favourite medium in Britain, and is likely to remain so.

A light alloy stressed-skin design is very expensive for prototypes or small-scale production. Only a large firm with orders enough to enable quantity production can be expected to produce a metal-skinned aeroplane at a competitive price. Even then it is likely to remain a luxury type for the wealthier class of owner.

The fact that the minimum gauges for handling and secondary-failure requirements will be thicker than those indicated by the direct loads also tends to make a metal-skinned type rather heavier than its equivalent in wood.

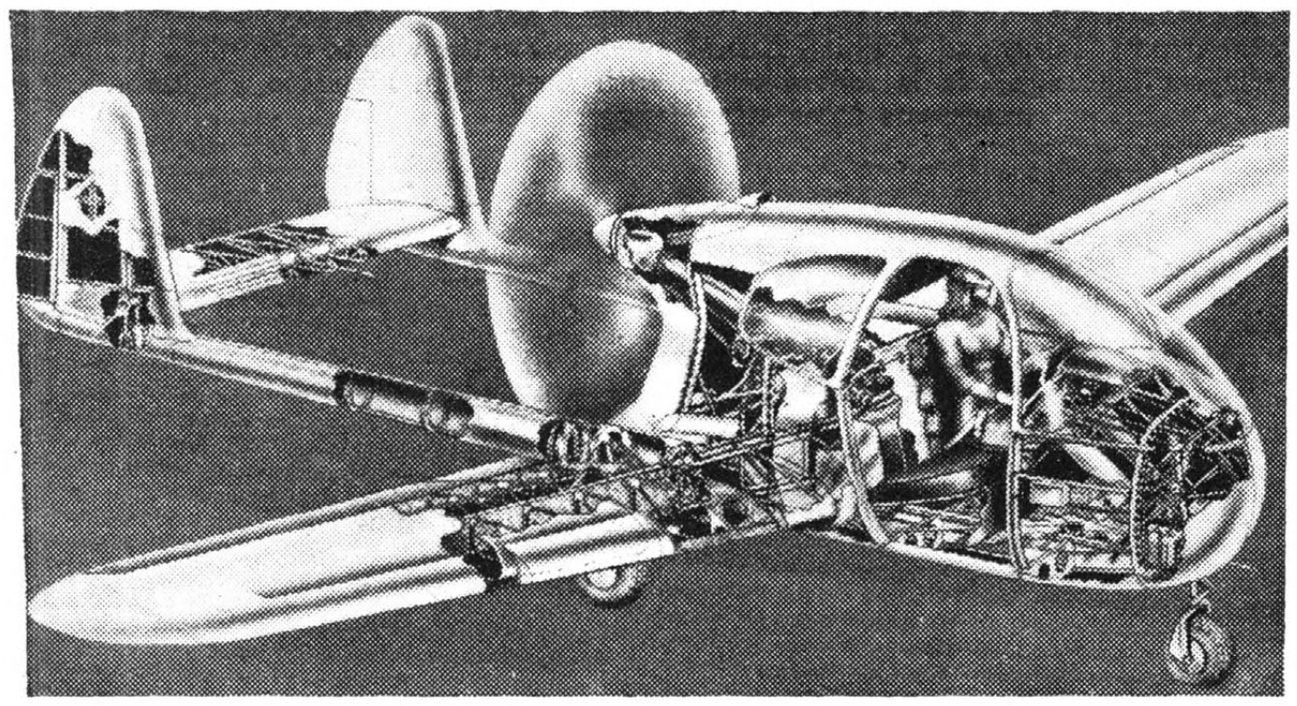
For these reasons, it seems unlikely that light alloys will ever gain the ascendancy in the private-owner field that they have among commercial and military types.

Constructional

A welded-steel-tube fuselage and a wooden wing—once called "Fokker construction"—has long been the favourite in America for low-priced types. The anglicised versions of the American Taylorcraft and Aeronca have been the only recent British representatives in this class.

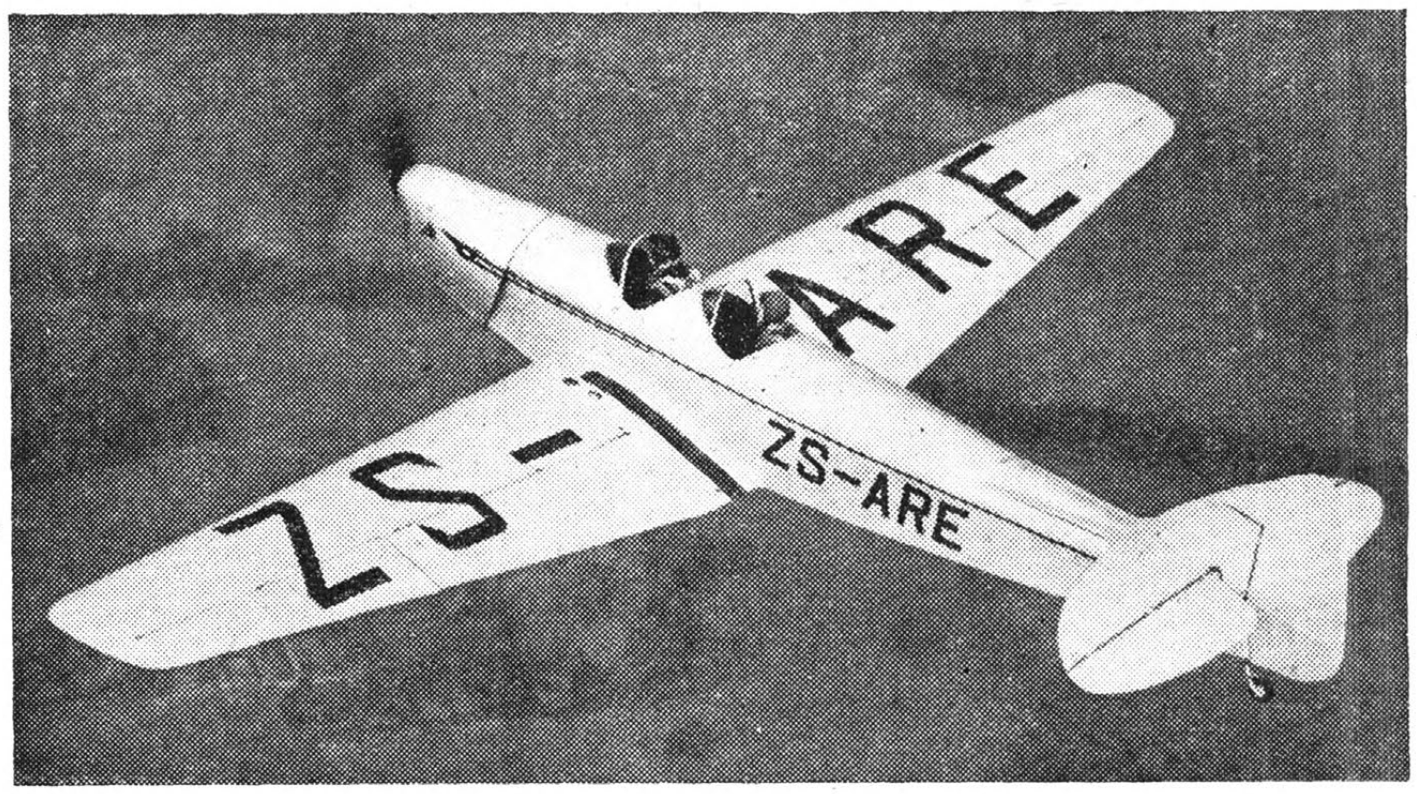
Welded-tube construction has much to commend it for light aircraft, particularly in keeping down the costs in prototype or small-scale production. One efficient welder and a couple of hard-working fitters can build an experimental fuselage in a matter of two or three days—an economy in labour not to be approached by any other method. Steel also gains some points for durability and ease of maintenance.

One disadvantage is its slightly greater weight compared with an equivalent fuselage in wood. Another is the fact that the efficiency of the structure depends not only on the efficiency of the designer but on the skill of the welder. Designer, welder and inspector all need considerable experience to guarantee safe fuselages. Once the welding is done no modification or repair work can be done



Ultra modern in conception is the twin-boom Piper Skycoupe. It has a "flat four" engine driving a pusher airscrew through bevel gears. As an anti-stall device, fixed slots are built into the leading edge.

TO-MORROW'S LIGHT AIRCRAFT



The D.H. Moth Minor of pre-war design had a top speed of 118 m.p.h. Fully loaded it had an all-up weight of 1,550 lb. and the normal range was 300 miles. Production plans were interfered with by Nazi aggression in 1939.

without reheating the metal and, consequently, weakening it. Distortion is another trouble that sometimes makes it difficult to work to close limits.

In a tried production model such as the Taylorcraft all these problems have long been solved, but they must be considered afresh in deciding the materials for a new design.

On considerations of weight, cost, accuracy and ease of working, wood is probably still the best material for a light aircraft. Improvements that we are likely to see include moulded plywood monocoques to give attractive fuselage lines, and compressed and impregnated wood to save space in highly stressed members, such as centre-section wing spars. In this way we may eventually reach the all-plastic airframe.

High or Low Wing?

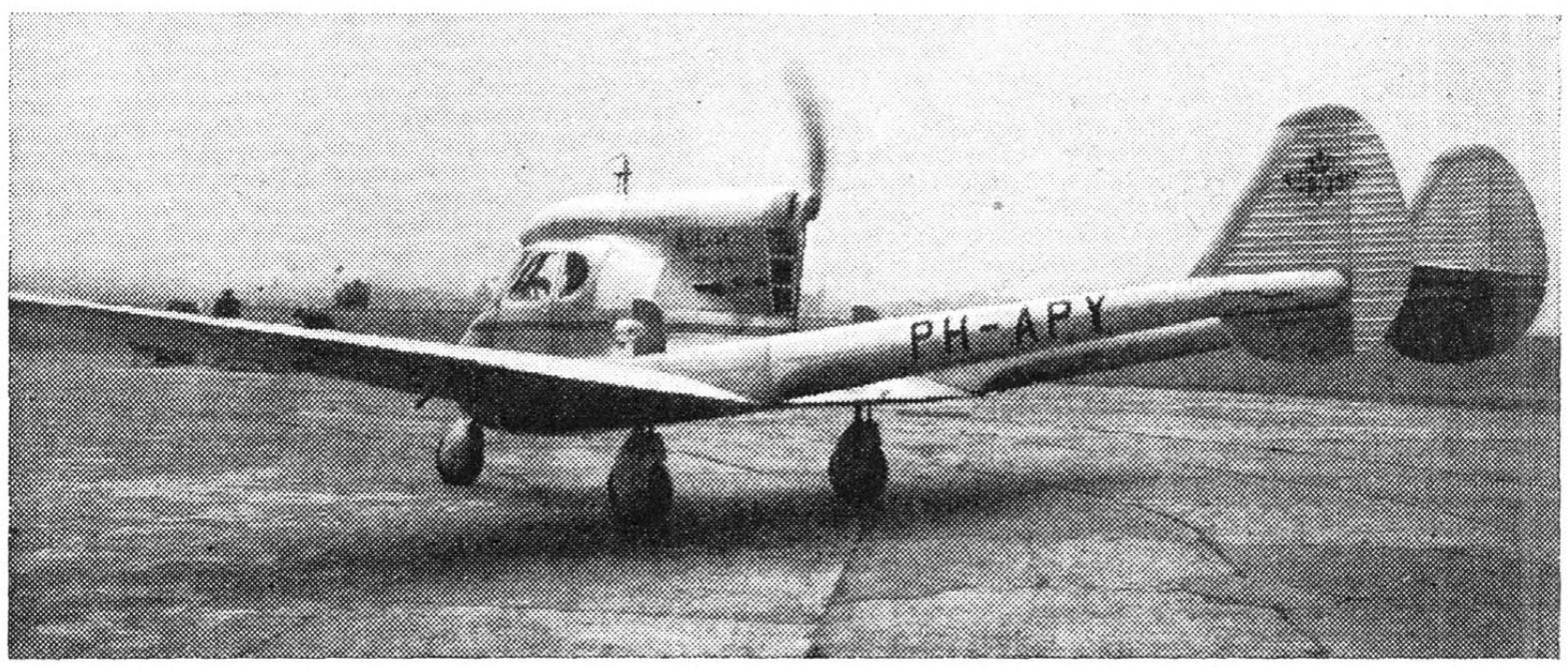
In the Miles M.38 family, plywood monocoque fuselages replace the box type of earlier models. The box fuselage probably still wins on weight, because of the relative precision and simplicity of its stress analysis. It also gives a good wing-fuselage joint for a low-wing monoplane—only its somewhat crude appearance is against it.

A fundamental decision in deciding the outline is between high wing or low wing. The low wing has been the British, indeed, the European, tradition. Only in America has the high-wing fashion persisted. Even there, the proportion of high wings among the new post-war projects is relatively low. The mid-wing is out altogether for tractor types, because it interferes with the cabin space and blocks the pilot's view.

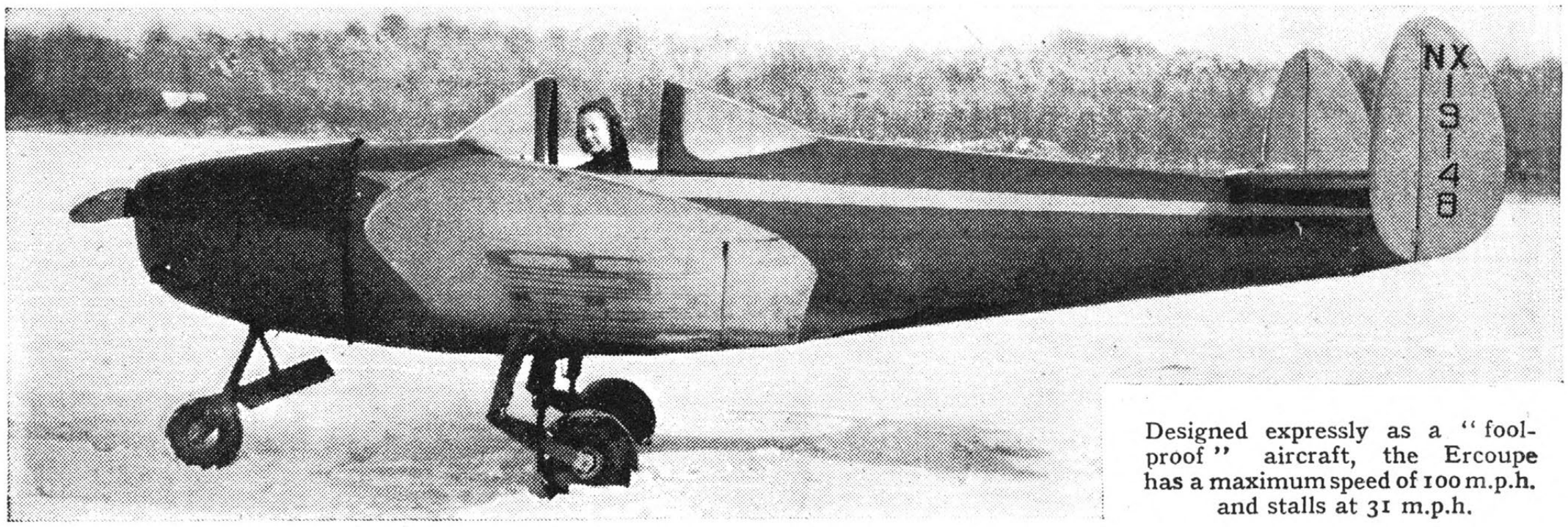
The high-wing type gives good inherent stability and good view earthwards, but cuts off the pilot's view in a turn. The fuselage is easy to get into, and can be built satisfactorily of welded tube, but not so easily of wood, because of the concentrated loads and large openings for doors and windows. The low-wing monoplane allows a lighter fuselage and is much better suited to wooden construction, as the fuselage can be a simple wooden box with a curved lid into which the passengers climb from on top. It also provides a better anchorage for the undercarriage legs and enables them to be kept out of the slipstream, or retracted if desired.

This does not by any means exhaust the pros and cons of a subject that can be argued indefinitely. Suffice it to say that the low wing is in the ascendant, and is almost certainly the best for an all-wood aircraft.

Although the typical pre-war light aircraft, high wing

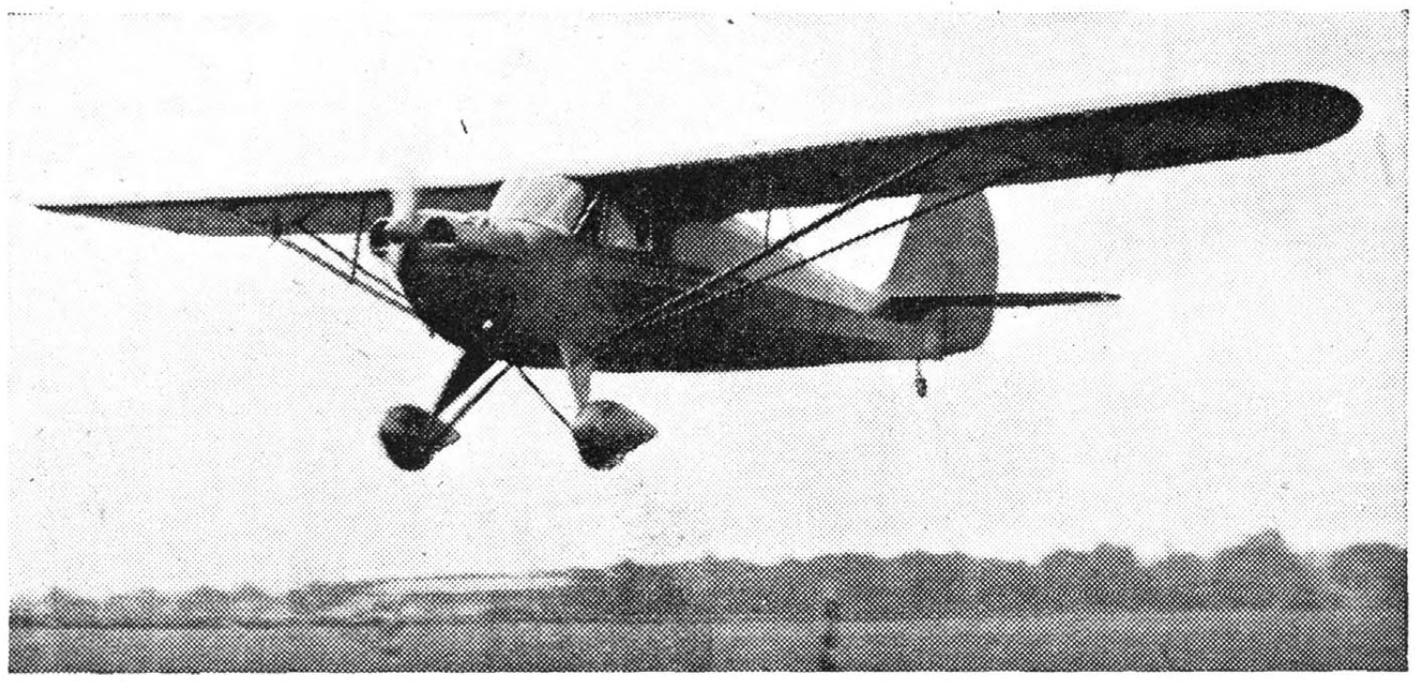


The unorthodox Stearman-Hammond Y which K.L.M. used before the war to train their pilots in the art of tricycle landings. It is a two-seater with a 150 h.p. Menasco engine and numerous interesting features.



Designed expressly as a "fool-proof" aircraft, the Ercoupe has a maximum speed of 100 m.p.h. and stalls at 31 m.p.h.

TO-MORROW'S LIGHT AIRCRAFT



Lightest of light planes the Aeronca weighs only about 600 lb. It has a maximum speed of 88 m.p.h., a rate of climb of 450ft. per min. and still has a family resemblance to the old original wire-braced Aeronca of the 1936 era.

or low, was of conventional tractor layout, there has been an increasingly strong "left-wing" opposition in favour of the pusher with engine and airscrew behind the cabin and twin booms in place of a rear fuselage.

The obvious advantages of this layout are much better view for the pilot and passengers, less engine noise, and less inconvenience from the airscrew on the ground. The long nose also provides a good wheelbase for a tricycle undercarriage.

Disadvantages are greater weight and drag, and various technical difficulties in keeping the engine cool, providing airscrew clearance with the tail down, and arranging the flying control system. To put the matter briefly, the advantages in comfort can be gained only at some cost in performance. Is the comfort worth the cost?

"Indicator" says "yes." He likes to be in the nose of his aircraft so that he can see what he is going to hit, and so avoid it. Is this preference general? I doubt it. Pilots who have spent many hours up in the nose of a multi-engined machine may become accustomed to it, but the average amateur, whether he is driving a car or piloting an aircraft, feels safer and judges his distances better if he is somewhere aft.

Pusher Possibilities

The Piper Skycoupe described in *Flight* of August 30th shows that America is taking the pusher seriously, but the pictures and description suggest a somewhat premature release of an experiment, to test public opinion, rather than a production design. No weights or performance figures were given, but judging from the illustrations it seems a little overweight and oversize for its 113 h.p.

Yes, the pusher has possibilities, but not yet does it seriously challenge the popularity of the tractor.

No one can doubt that the tricycle has come to stay, but at the same time, its advantages are not so overwhelming that one must necessarily spoil the performance of an otherwise efficient design by insisting on its employment in every case. It is unfortunate that the average light aircraft with a tractor airscrew has so short a nose that it is difficult to obtain the distance between the nose wheel and the main wheels desirable for good stability. As already mentioned, this is a point in favour of the pusher.

A light aircraft is better able to exploit the potentialities of the tricycle than heavier types, because it can safely take advantage of the opportunities for sudden braking or violent changes of direction. Also, it can be just flown on to the ground.

The tricycle is a "must" for trainers and for any low-performance types that place special emphasis on safety or simplicity. For the fast touring aircraft or air-taxi it is desirable, but not essential.

"Fixed or retractable?" is another undercarriage problem about which there will be great argument. It is the writer's own opinion that the value of retractable undercarriages in light aircraft has been over-rated, and that retraction is unlikely to be worth while on any light type with a cruising speed of less than 150 m.p.h.

Levered suspension with "liquid springing" is another modern development more usefully applied to large types than small ones.

If the undercarriage is to be fixed, a cantilever leg is desirable, to reduce air resistance to the minimum. Wheel and leg fairings are usually considered necessary for appearance's sake, while not making maintenance any easier.

If a tricycle is fitted, a steerable nose-wheel is most desirable. The question as to whether it should be steered from the rudder pedals or the wheel brings up the prior question of whether the ailerons and elevators should be controlled by wheel or column. It would be interesting to have "Indicator's" opinion on this. The writer's own preference, based on extremely limited and inconclusive experience, is for a "stick" with a spade grip, but the push-pull wheel seems to have become a standard feature in America. Is the wheel really a more suitable form of control, or merely a subterfuge to make the motorist feel at home in the air?

The average pilot is still suspicious of patented safety aircraft with two-control systems or limited elevator movement. They may limit the pilot's ability to get into trouble, but the pilot is afraid that they may also limit his ability to get out of trouble, if trouble is thrust upon him.

Very rightly, "Indicator" emphasises the desirability of large and versatile wing flaps, connected so that they can provide what Mr. Miles has called "glide control." The type of flap that is to be used brings up the question of wing loading. The war years have seen the wing-loadings of military aircraft doubled, and post-war airliners are inheriting both the high loadings and the long runways. Shall we see the same tendency in the light aircraft?

Almost certainly not. Most light aircraft already have high-power loadings, and always will have. High-wing loadings go hand in hand with low-power loadings. Only in the case of a few fast touring types are we likely to see any noticeable increase in wing loading.

If wing loadings are not to increase, need we go on from split flaps to Fowlers, Irvings and other complicated types? Only if we want to go on from cricket-pitch landings to tennis-court landings. The simple split flap seems likely to do all that is required for the average light aircraft. It can be supplemented by an extra drag flap if required.

Whatever "Indicator" may say about luxury interiors, appearances count for so much in selling a light aircraft that motor car "styling" is inevitable for popular types. However scornfully the sports-car enthusiast may talk of the "chemist's shop" interiors of American cars, the man in the street likes them.

In cabin design, both comfort and safety are in conflict with performance. Side-by-side seating has come to stay, and cabin widths are continually on the increase. A few years ago the grudging designer considered a 36in. cabin width as much as he could afford to give away for side-by-side seats. Now 44in. would be considered the minimum for reasonable comfort. Incidentally, experience has shown that increasing fuselage widths has not reduced performance as much as was imagined.

A deep windscreen as near the pilot's face as possible is essential. As "Indicator" has pointed out, the old-fashioned tunnel with an almost flat windscreen at the end is not safe enough for the crowded skies of the near future.

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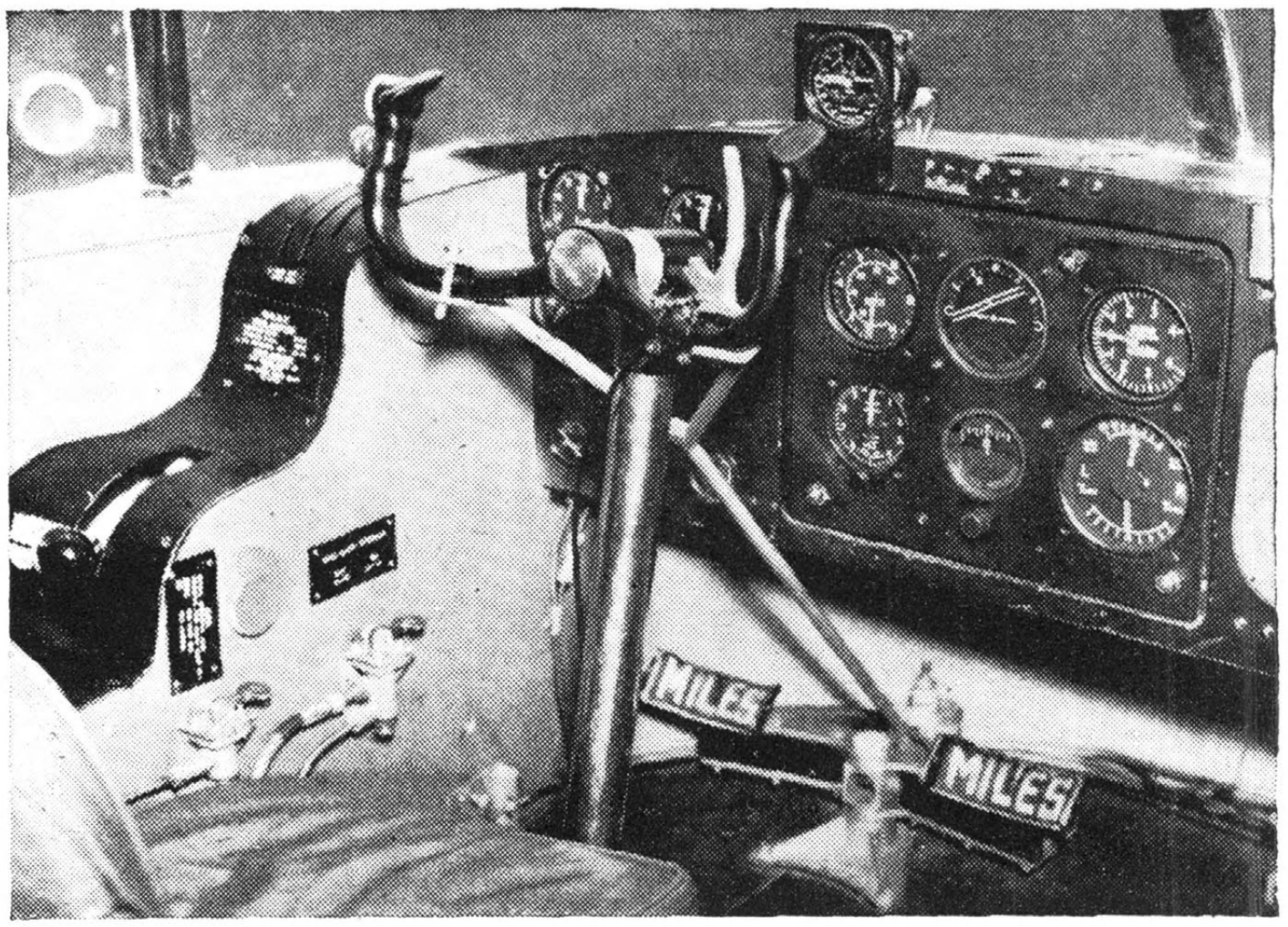
HERE AND THERE



SIMPLICITY is the keynote of the pilot's cabin in the Miles Aerovan. Above the blind-flying panel is the gauge for the brakes, and to its left the few dials required by the unblown, air-cooled engines.

City's Wartime Record

AN addition has recently been made to the pictures of local factories on war work which provide the Manchester City Art Gallery with a lasting record of the city's wartime production.

It is Sir Muirhead Bone's drawing of the Dunlop barrage balloon factory which has been accepted by the art gallery from the company.

Research Celebration

ON the next page is a picture taken at the dinner recently held by the Directorate of Engine Research and Development of the Ministry of Supply and Aircraft Production, which was by way of a victory celebration.

Some 240 members of the directorate were present, including technical and clerical staff from Millbank and from various "out-stations," and the guest of honour was the new Controller of Research and Development at the Ministry, Air Marshal Sir Alec Coryton.

Scandinavian Sky-pilots

WHAT is believed to be the world's first flying missionary service has been started from Stockholm.

The Swedish, Danish and Norwegian missionary societies have jointly purchased an aircraft (type unstated) to carry relief to a number of their members who have been cut off from their homes for several years, and some of whom are reported to be seriously ill.

On its first trip the aircraft is flying by way of Marseilles, Athens, Addis Ababa and Nairobi to Madagascar, and is carrying ten Norwegian and three Swedish relief missionaries. It is hoped to make 15 similar trips during the next twelve months.

MAKESHIFT: This runway of wooden planks was laid by the Japs at Sapporo municipal airport, Hokkaido. It is about 4,000ft. long and 300ft. wide, the planks being about 4in. thick. Capt. R. A. Hickerson, co-pilot of Gen. Eichelberger's B-17, describes it as "pretty bad."

Air Excursions?

SPEAKING "as no expert, and therefore as one with no partiality for any particular method of transport, road, rail, water or air," the Minister of War Transport, Mr. Alfred Barnes, told members of the Institute of War Transport at their 26th anniversary luncheon recently that he was resolved that the masses should in future enjoy the full advantages of every form of modern locomotion.

Sir Frederick Handley Page, the president, appealed to the Minister for some governmental assistance in securing a fitting home for the Institute of Transport—"as a memorial to that Victorian era when private enterprise held sway."

Liberated

THERE is great jubilation (and naturally so) among the devotees of model aircraft—design, construction and use of—at the final removal of wartime restrictions on flying their creations. The last few "don'ts" to disappear applied chiefly to petrol-driven models and limited their engine running time to a mere 45 secs. per flight, and on a closed circuit at that. But at last they are again free to fly as straight and for as long as they like (or can!) subject only to "normal police regulations."

R.A.F. Flying Club

THE temporary committee which has been formed to reorganise the R.A.F. Flying Club will be glad to hear from all pre-war members who wish to resume membership, and from potential new members, and those interested should write to Wing Cdr. R. E. G. Brittain, Air Ministry, King Charles Street, London, S.W.1, giving full name, rank and permanent address, and stating if pre-war or potential new members.

The ban on civil flying lifts on January 1st, 1946, and the club intends to resume activities as soon as possible when formalities are completed to obtain aircraft and the use of an airfield. Before the war, the club operated from Hatfield and had a branch at Almaza airfield, Egypt.

Giving Youth a Chance

A SCHOLARSHIP to the value of approximately £200 a year has been established by the board of Edgar Allen and Co. in memory of their late chairman, Mr. C. K. Everitt, and will be tenable at a university or other appropriate educational institution. It will be known as the Charles Kingston Everitt Memorial Scholarship and will be confined to the firm's employees or those of subsidiary companies.

Applicants must, except in very special

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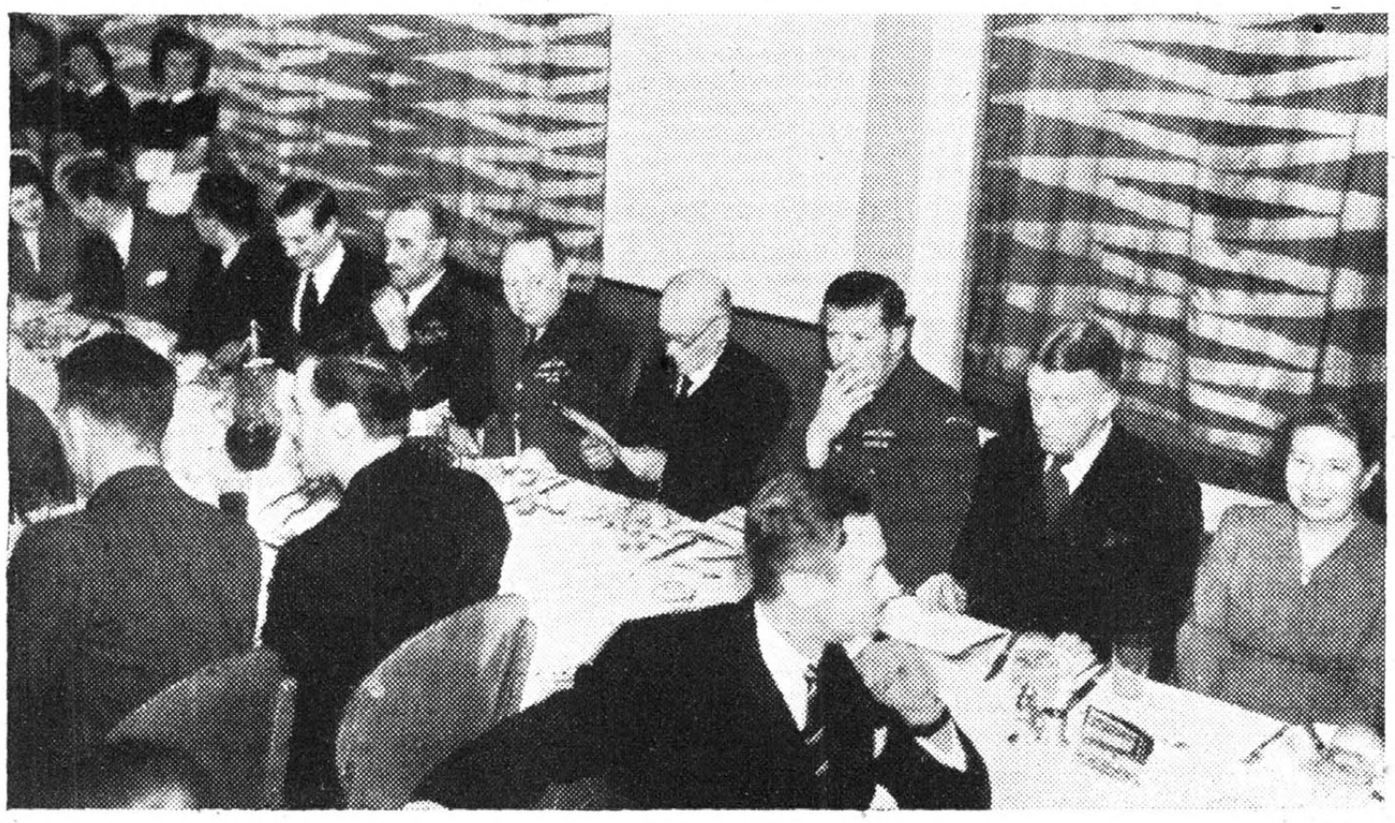
circumstances, have had at least two years' service, and the first scholarship will be awarded next autumn to the one who, in the opinion of the works education committee, has shown best progress at his work and part-time studies and is able to take full advantage of a university or other course of study.

Without Comment

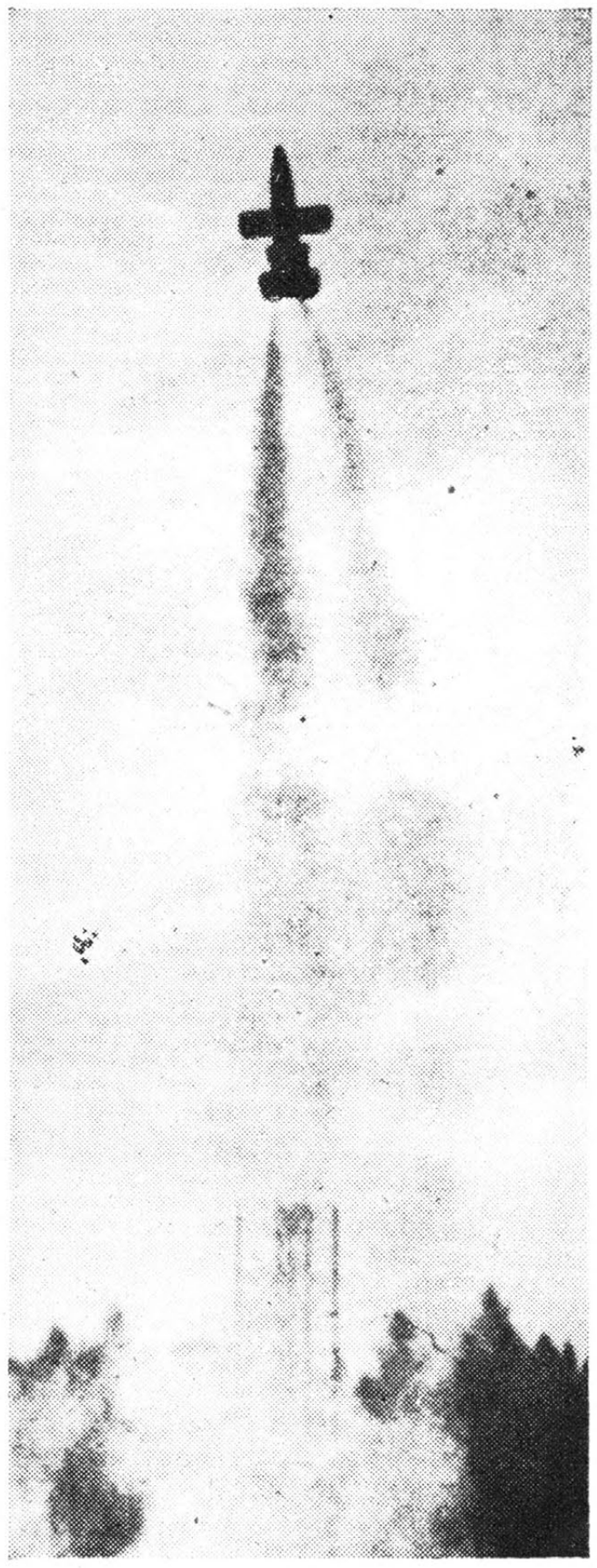
OPPOSING the proposal to merge the U.S. armed forces in a single defence department, Vice-Admiral Charles M. Cooke, U.S. Deputy Chief of Naval Operations, recently told the Senate Military Affairs Committee: "We all know the British Navy entered the war almost fatally defective in its air arm. "It had to come to the U.S. Navy to get aircraft with which it could defend its ships from air attack and contend on even terms against a modern navy such as the Japanese."

Admiral Cooke claimed that because of the lack of an adequate air arm the British Navy would have been unequal to launching the air-sea offensive which enabled the U.S. to seize the positions in the Western Pacific which led to the defeat of Japan.

Referring to the proposed merger, he said: "Such a merger made twenty years ago would have confronted the U.S. with the very real possibility that victory would have been delayed for several years or we would not have won the war at all."



RESEARCHERS CELEBRATE: Some notabilities at the dinner held by the Directorate of Engine Research and Development, M.A.P. (see previous page). Left to right at the head table are: Dr. W. R. Hawthorne (Deputy Director, engines); Mr. F. A. Foord (D.D. reciprocating engines); Capt. (E.) M. Luby, R.N. (D.D. engines); Air Marshal Sir Alec Coryton (Controller R. & D.); Air Comdre. F. R. Banks (Director, engines); Major A. A. Ross (Chief Technical Advisor); Group Capt. G. E. Watt (D.D., turbines); and Capt. A. Swan (D.D., engine accessories).



"G" WHIZZ!—A captured picture of a German piloted rocket-driven missile, the Viper, leaving its launching ramp. The pilot ejects himself after aiming it at the intended target

News in Brief

THE French Air Minister is recruiting personnel, preferably with flying experience, to man airfields in France and her colonies.

* * *

R.A.A.F. courier flights of 7,000 miles to Tokyo were recently begun. The route by way of Morotai, Manilla, and Okinawa was begun on a five-day schedule, later to be shortened to four days.

* * *

The Postmaster-General announces that air mail correspondence for Australia, New Zealand and the South West Pacific area, prepaid at 1s. 3d. per half ounce (postcards 7d.) as well as 6d. air letters, will be carried all the way by air from Britain.

* * *

President Edelmiro Farrell has accepted the resignation of Sr. Edmundo Sustaita, the Argentine Secretary for Air, and has designated Brigadier Bartolome Delacolina, who formerly held that post, as his successor.

Mr. J. Ure Primrose, nephew of a former Lord Provost of Glasgow, who has just been appointed Lord Provost of Perth, has been chairman of Perth Town Council's airport committee for several years, and is a former chairman of the Aerodrome Owners' Association.

* * *

No. 80 Squadron, B.A.F.O., R.A.F., is anxious for news of three of its former Commanding Officers, namely, Major V. D. Bell (C.O. in 1918), Major G. Allen, and Major C. M. Leman (C.O.s in 1919). Anyone who can furnish helpful information, such as a last-known address, is asked to write to F/O. F. L. Withers at the Squadron, c/o B.A.O.R.

* * *

The Association for Scientific Photography is holding a dinner and social meeting on Friday, November 30th, at Frascati's, 6.30 p.m. for 7.15 p.m. till 10 p.m. On the previous evening the Association will hear a paper by Mr. A. G. Sabin, at the Alliance Hall, Westminster, entitled "Some Notes on Illumination Photomicrography." This meeting starts at 6.30 p.m.

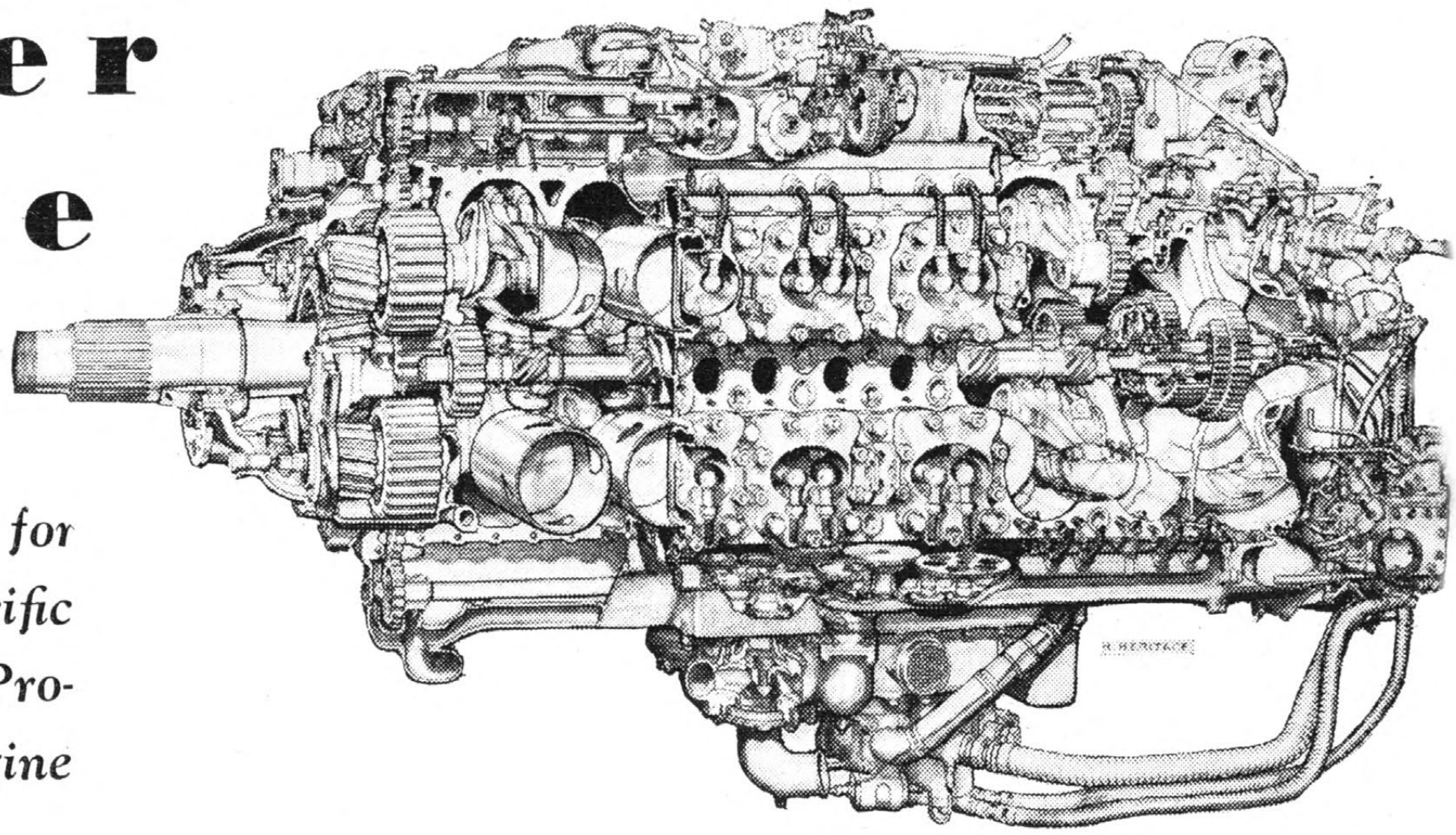
* * *

Marshal of the R.A.F. Sir Arthur Tedder was awarded New York's "Certificate for Distinguished Services" by Mayor La Guardia on November 10th at an impressive ceremony at the City Hall. After lunching with New York's celebrated Mayor, Sir Arthur and Lady Tedder saw a football match at the Yankee Stadium, which drew a gate of 75,000 people.

* * *

A party of officials and workers in the Rolls-Royce factory at Hillington, Glasgow, recently honoured Mr. C. D. Platt, chief of the A.I.D. in Block A3, who leaves to take up a post in the firm's Derby works. Mr. Hodkinson, deputy chief inspector of the factory, presented Mr. Platt with a wallet of notes, and Mr. A. Dorward, production superintendent, and other officials added their tributes to Mr. Platt for his services.

Napier Sabre VII



Over 3,000 b.h.p. for Take-off: Lowest Specific Weight of Any Production Piston Engine

REGULAR readers of *Flight* may remember that a detailed description of the Sabre engine was given in the March 23rd, 1944, issue, together with a good many illustrations, including a special cut-away drawing; but the subject of that description was the Mk. II, whereas the latest Sabre is the Mk. VII.

Series II engines were developed in three guises, the II, IA and IIB, in which the boost pressures were progressively increased and the power outputs stepped-up from 2,090 to 2,220 and then to 2,420 b.h.p. Weight had also increased, but not proportionally, so that specific weight went down respectively from 1.12 to 1.06 until, with the IIB, it dropped below unity with the value of 0.98 lb./b.h.p.

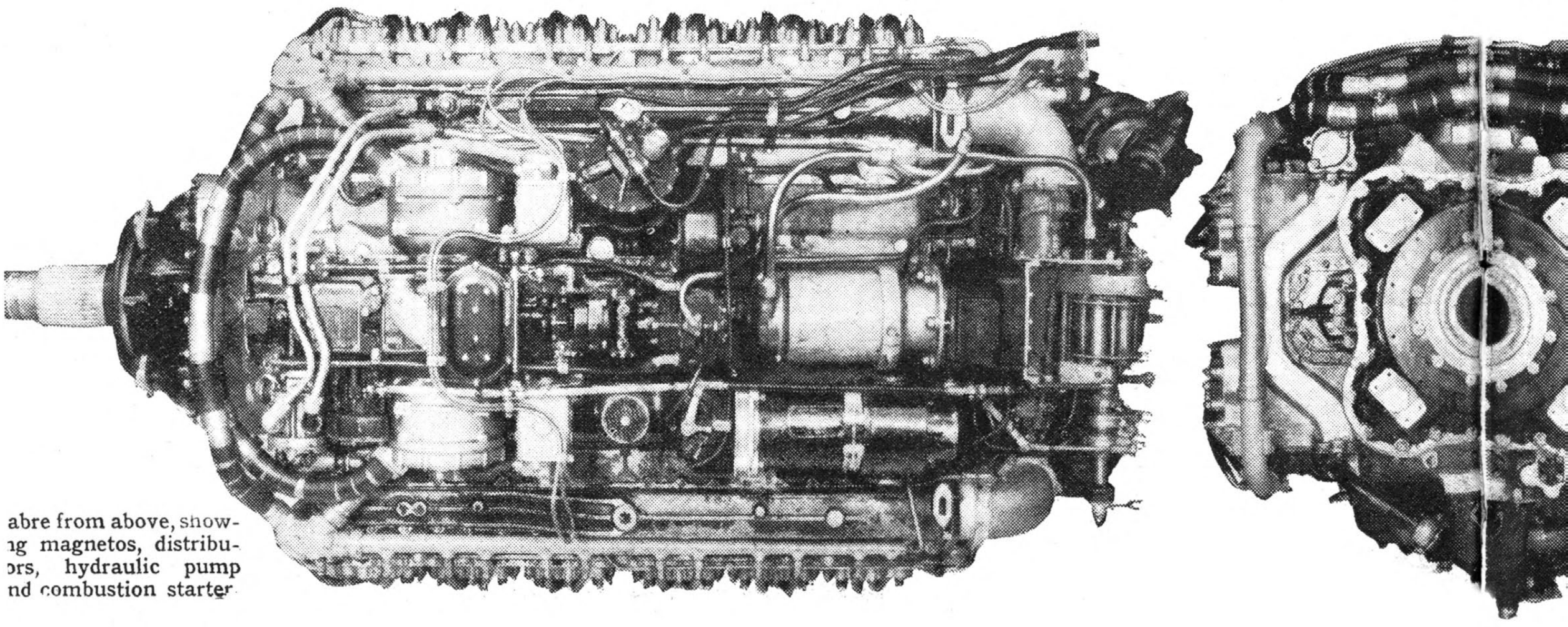
With increased output and increased rate of development the equipment for research and production testing naturally had to be extended, and in their choice of additional testing equipment those responsible displayed the established tendency of Napiers to explore and utilise the latest developments. By building a complete test establishment with fully regenerative dynamometers for engine and unit development the firm created an extremely valuable precedent. (It is interesting to point out that this idea was proposed many years ago by Mr. G. Geoffrey Smith, Managing Editor of *Flight*.) Thousands of gallons of high-octane fuel are no longer burned to produce only hot water, which is immediately cooled again; by using regenerative dynamometers the power output is used to produce electricity for the factory and outside supply, and an example of the output is that if a Sabre is running on a Sunday (when the factory is not working) the electricity generated by a single engine is sufficient to supply the entire demand from the whole Willesden area and still leave sufficient over for feeding into the national grid system.

Teething Troubles Cured

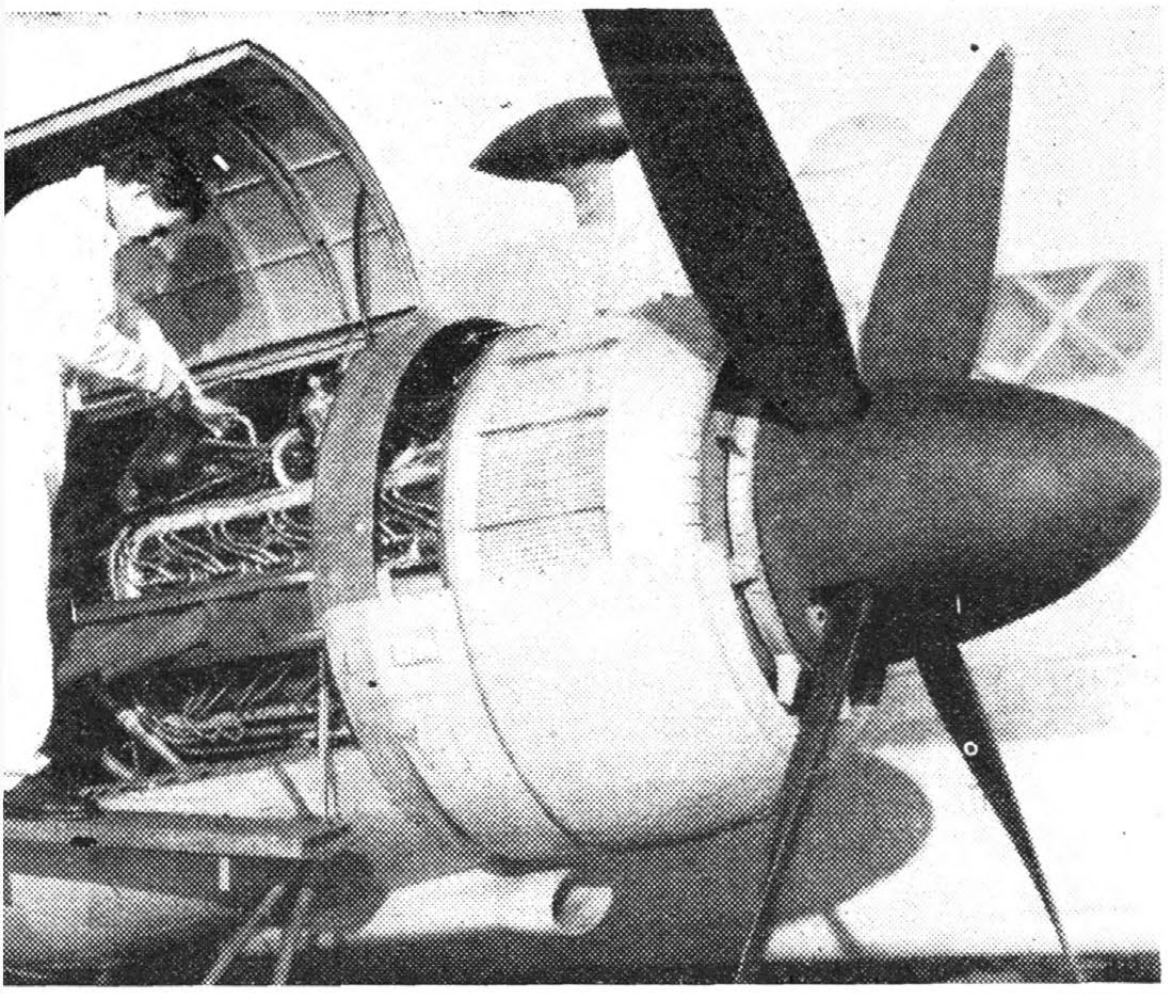
As with all engines developed at high pressure during the war, teething troubles were experienced with the Sabre. One such trouble was sleeve wear due to the ingress of sand and dust from new airfields and landing-strips. The resultant wear was in the nature of a groove, and piston-ring failure followed if this was allowed to become excessive. The consequent investigations were carried to great lengths in order to find a solution, which eventually lay in having the sleeves nitrided and lapped before assembly; but some 18 different materials and manufacturing processes were investigated before the final choice.

Trouble was also experienced with supercharger clutch linings, which was found to be due to the speed-up of pro-

Maximum Power 3,055 h.p. *Dry Weight 2,540 lb.* ← *3ft. 4in.*



Sabre from above, showing magnetos, distributors, hydraulic pump and combustion starter



(Above) Warwick installation of the Napier Sabre VI with annular radiator. (Right) Graph showing performance at altitude of the Sabre VII on 100 octane fuel. *Allows for drop in power due to weak mixture.

duction and not to design. The practice of using the linings immediately after manufacture robbed them of an age-hardening process, but an artificial hardening was introduced which satisfactorily overcame the trouble.

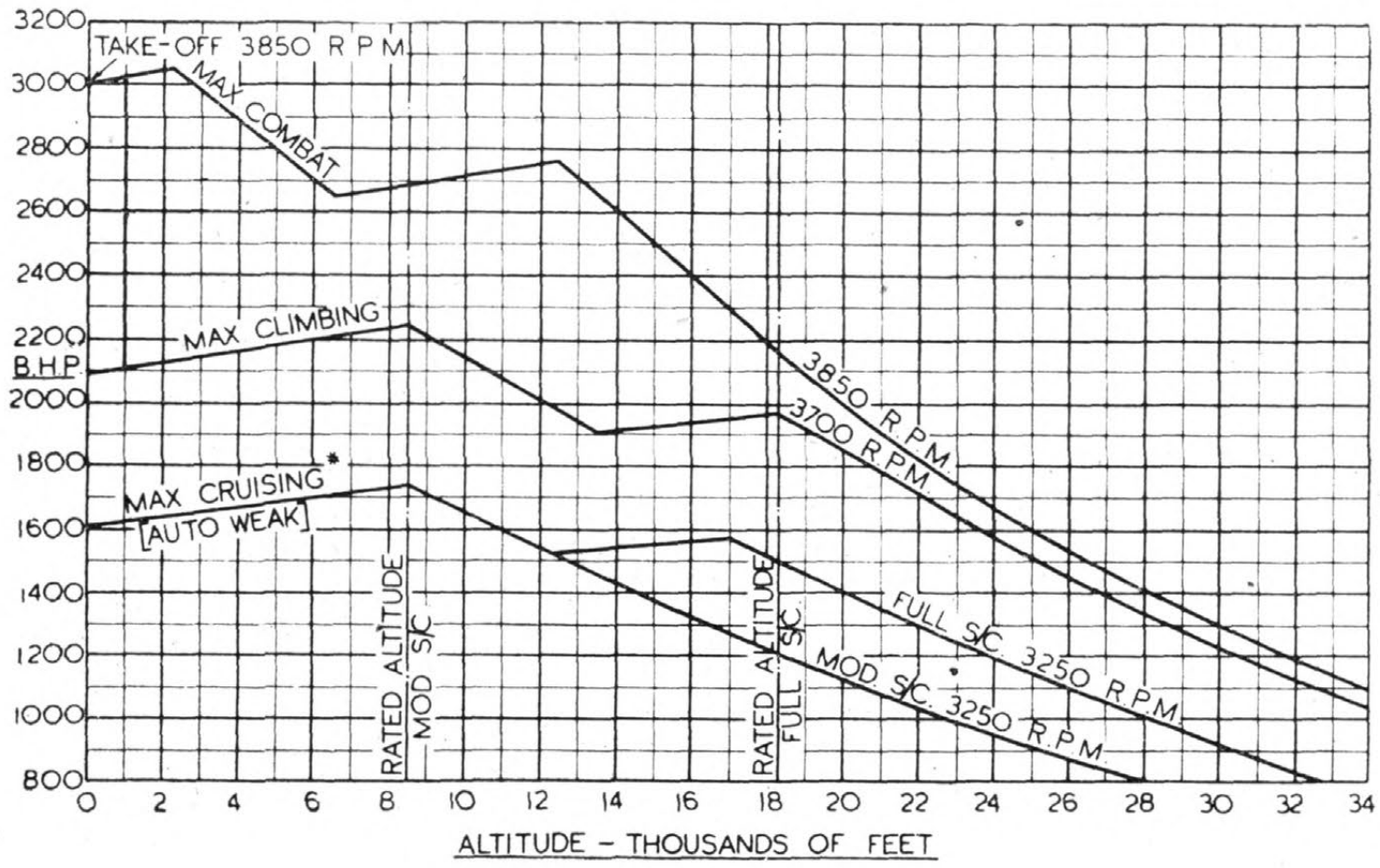
The Sabre IIB was installed in the Hawker Tempest V, and this engine was closely followed by a Mk. III which was specially developed for the Blackburn Firebrand; however, only 25 Mk. III units were installed, owing to the very high priority attached to the production of the Mk. V. A preliminary flight development engine for the Mk. V was known as the Sabre IV.

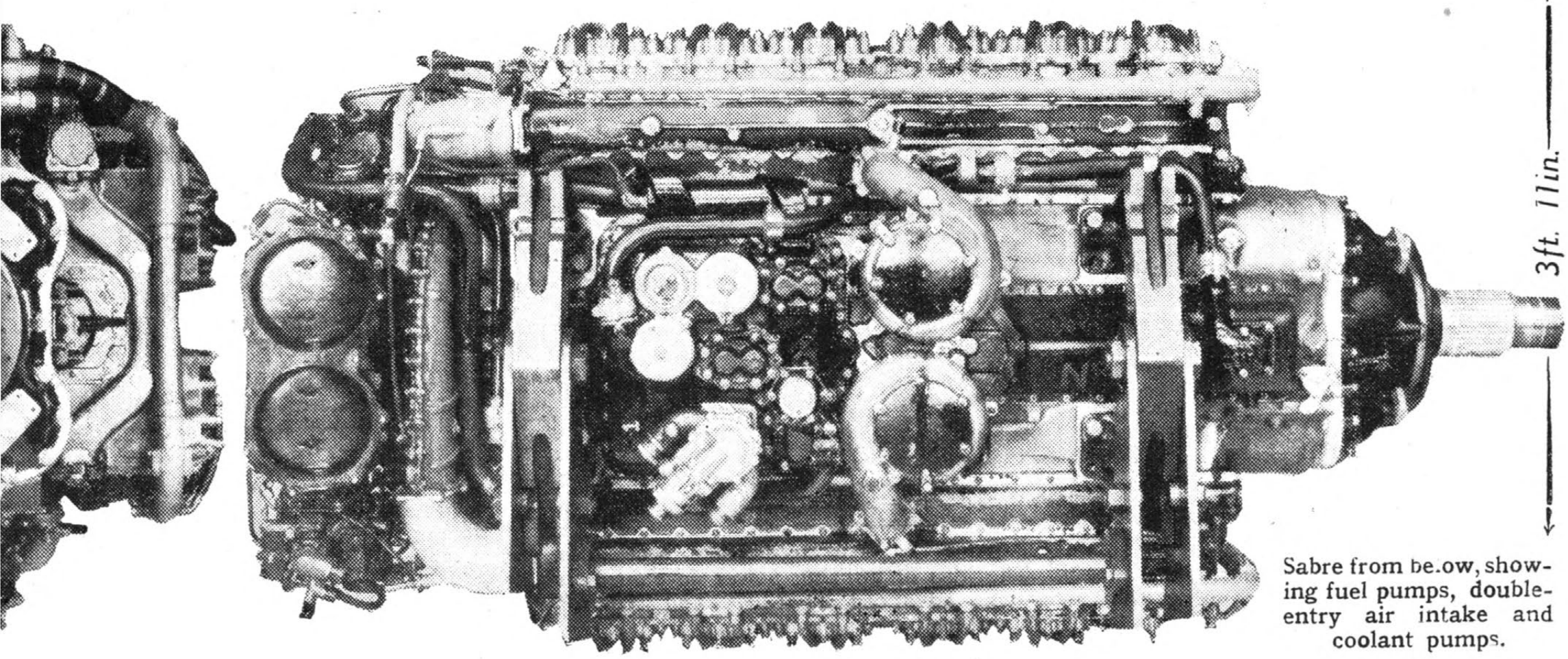
Numerous modifications were incorporated into the design of the Mk. V and VA, among which were internal increases of strength to withstand higher boost pressures and r.p.m., and the use of Vandervell strip-type thin-wall bearings, this being the first occasion on which such bearings have been used in an aircraft engine with such high r.p.m. and heavy loadings. Disposition of the sparking plugs was also altered and ignition harness was re-designed to obtain more advantage from the high-altitude ignition equipment now fitted.

Supercharger Modifications

The double-entry supercharger impeller was replaced by a single-entry impeller of increased capacity, and the hydraulically operated two-speed clutch was re-designed to effect a saving of space and an increase in efficiency. Remodelling also included the addition of a boost pressure correction capsule to the boost-corrected ignition servo unit which, linked to the c.s.u. and thus responsive to engine speed, regulates the ignition timing for any engine operating condition. Perhaps the major modification of the VA over the previous marks was the replacement of the carburettor with Hobson-R.A.E. fuel injection and metering equipment, which embodies a fully automatic

	MAX R.P.M.	MAX BOOST LB./SQ.IN.	MOD. SUPERCHARGER		FULL SUPERCHARGER	
			MAX. B.H.P.	ALTITUDE	MAX. B.H.P.	ALTITUDE
TAKE-OFF	3850	+17½	3000	S.L.	–	–
CLIMBING	3700	+10½	2235	8500	1960	18250
COMBAT	3850	+17½	3055	2250	2760	12450
MAX. CRUISING	3250	+7	1730	8500	1570	17000





Sabre from below, showing fuel pumps, double-entry air intake and coolant pumps.

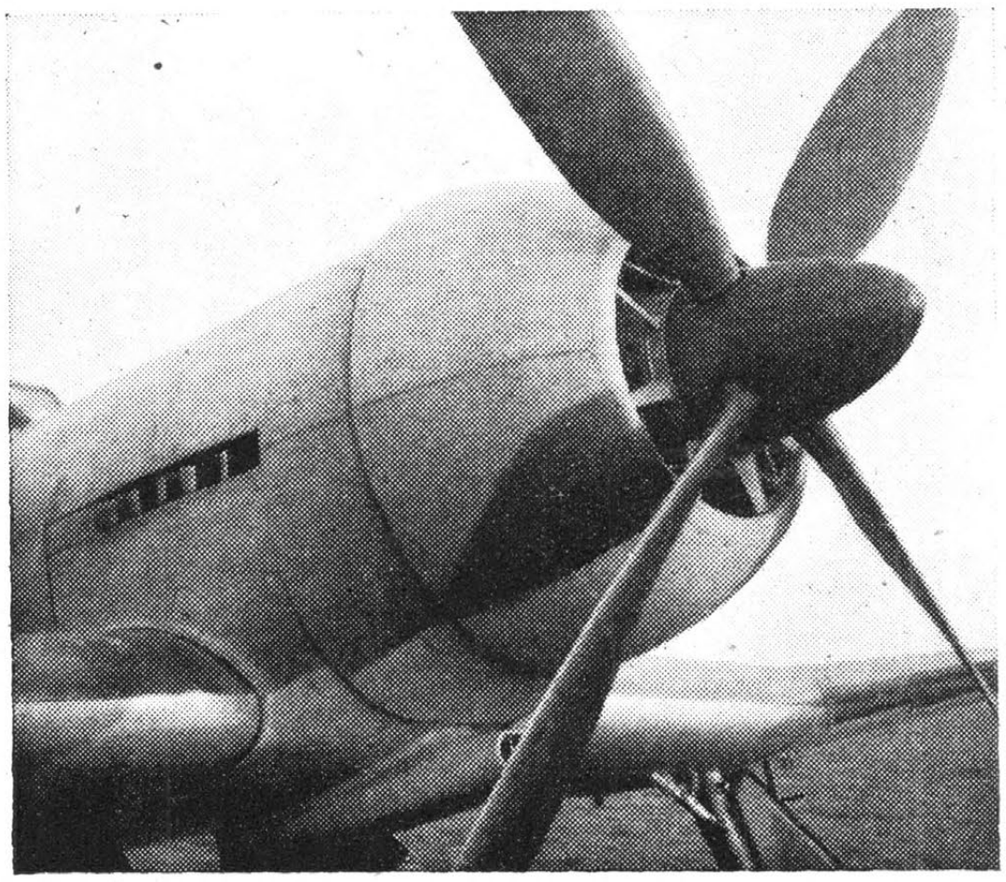
NAPIER SABRE VII

boost control unit and charge temperature correction of the fuel/air ratio.

The Sabre VA passed its type test at the first attempt and is now being delivered installed in the Tempest VI. Developing 2,600 b.h.p. for a weight of 2,460 lb., its specific weight is 0.94 lb./h.p. Maximum r.p.m. has been increased to 3,850 and the maximum boost pressure to 15 lb., the unit output being equal to 71 b.h.p./litre.

Following a development programme that paid special attention to installation problems, the Sabre VI emerged. This was basically a VA with modifications to suit an annular radiator and an engine-driven cooling fan. Very successful flights have been carried out with this installation and the performance is quite promising. However, this particular form of installation is dependent upon employment in an aircraft especially designed for it if the best use is to be made of the increased performance.

The latest stage in Sabre development has come with the Mk. VII in which the physical capacity of the blower



The Sabre with annular radiator installed in a Hawker Typhoon. The fan can be seen immediately behind the airscrew boss.

impeller has been further increased in conjunction with water/methanol injection equipment. The purpose of water/methanol injection is to enable higher boost pressures to be used with consequent increase in power output; water has an extremely high anti-detonation value when introduced with the fuel and enhances the effective volumetric efficiency by virtue of charge cooling effect. Methanol, although a fuel, is embodied to prevent the water freezing at high altitudes, 60 per cent. methanol additive offering protection for heights up to 40,000 ft. In the Mk. VII the percentage of water/methanol to fuel is of the order of 35 per cent. in M.S. gear and 70 per cent. in F.S. gear, and it is, of course, necessary to arrange proportionate automatic stricture of the fuel passed by the fuel injector if over-rich mixtures are to be avoided.

An interesting point is that with the removal of a few gallons of fuel from an aircraft and its replacement with water/methanol—which is of greater weight—the range of the aircraft is quite considerably increased, this being due to the higher power output obtained.

Various components in the Sabre VII have been strengthened in order to cope with the increased loads, and the controls have been modified to suit the altered boost pressures and speeds and, further, to ensure that the water/methanol cannot be used except under appropriate conditions. In addition to the water/methanol unit, which is fitted on top of the supercharger bend at the rear of the engine, an ignition control over-ride valve is embodied to vary the effective pressure acting on the capsule in the ignition control unit when water/methanol is being used, and thus to alter the ignition timing accordingly. Two safety micro-switches are fitted to ensure that the water/methanol pump cannot function if engine conditions are not suitable, and a boost-restriction servo-valve is incorporated to prevent combat or take-off boost being used unless water/methanol is being supplied. In addition, the cylinder head form has been redesigned to allow two compression rings to be fitted between the head and the sleeve instead of the single ring used on previous engines.

It should be noted that at maximum combat conditions the

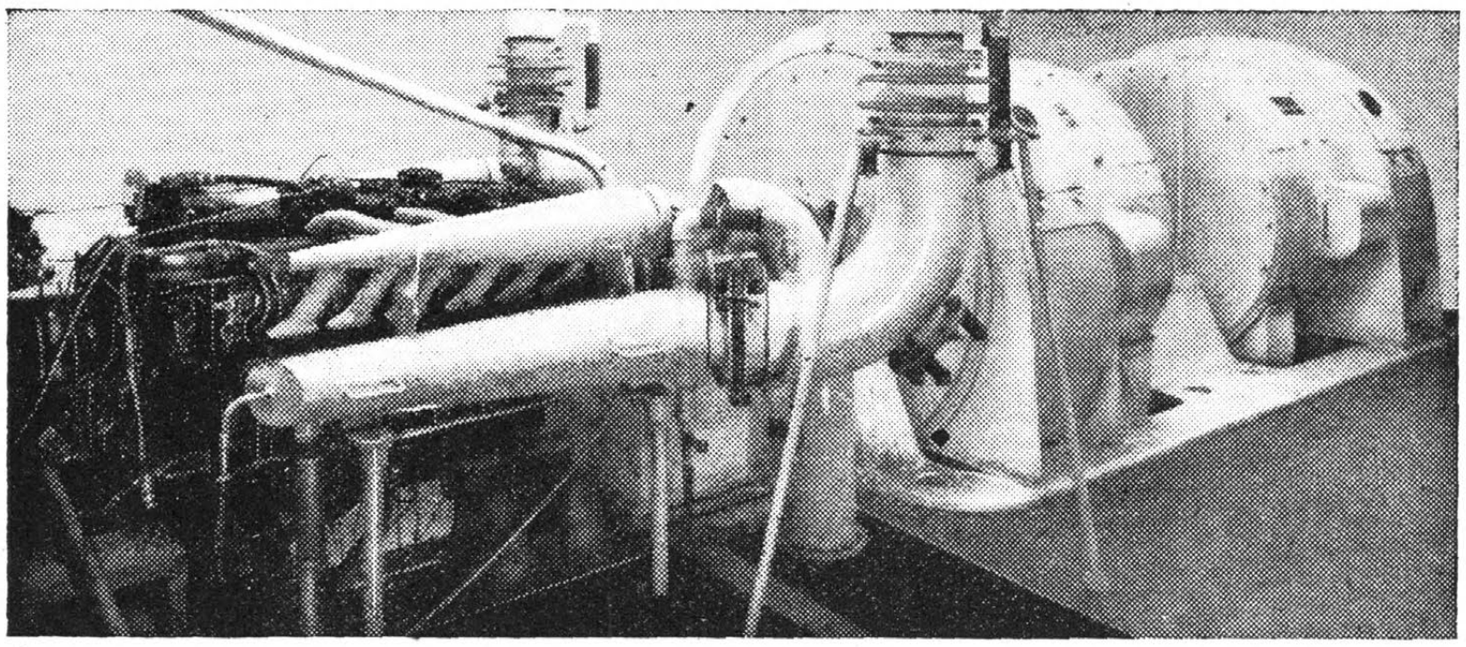
NAPIER SABRE VII

DATA

Bore	5in. (127 mm.).
Stroke	4¾in. (121 mm.).
Compression ratio	7.0 : 1
Total swept volume	2,238 cu. in. (36.7 litres).
Reduction gear ratio	0.2742 : 1
Reduction gear type	Spur gear through four layshafts.
A/S shaft rotation	Left-hand tractor.
Supercharger drive ratios :—	
M.S.	4.68 : 1
F.S.	5.83 : 1
Net dry weight	2,540 lb. (1,152 kilos).
Rated power :—	
M.S.	2,235 b.h.p. at 3,700 r.p.m. at 8,500ft.
F.S.	1,960 b.h.p. at 3,700 r.p.m. at 18,250ft.
Maximum power (combat) rating—5 minute limit :—	
M.S.	3,055 b.h.p. at 3,850 r.p.m. at 2,250ft.
F.S.	2,760 b.h.p. at 3,850 r.p.m. at 12,450ft.
Maximum take-off power :—	
M.S.	3,000 b.h.p. at 3,850 r.p.m. at sea level.
Continuous cruising (weak mixture) :—	
M.S.	1,610 b.h.p. at 3,250 r.p.m. and +7 lb./sq.in.
T V. dive maximum	4,050 r.p.m. and +17¼ lb./sq.in.

CONSUMPTIONS

Fuel :—	
Max. take-off conditions	235 gallons/hour.
Max. climbing conditions at altitude :—	
M.S.	214 gallons/hour.
F.S.	204 gallons/hour.
Max. combat conditions at altitude :—	
M.S.	239 gallons/hour.
F.S.	241 gallons/hour.
Max. continuous cruising conditions at altitude :—	
M.S.	117 gallons/hour.
F.S.	112 gallons/hour.
Water/Methanol :—	
Max. take-off conditions	65 gallons/hour.
Max. combat conditions at altitude :—	
M.S.	66 gallons/hour.
F S.	102 gallons/hour.
Oil :—	
At maximum cruising conditions	47 pints/hour.
At maximum climbing conditions	67 pints/hour.
At maximum combat conditions	71 pints/hour.



On the test bed. The surplus power output from Napier's engine test beds goes to augment Willesden's electricity supply. The idea of utilising power developed on test beds—and normally going to waste—was advanced by *Flight* and *Aircraft Production* in 1942.

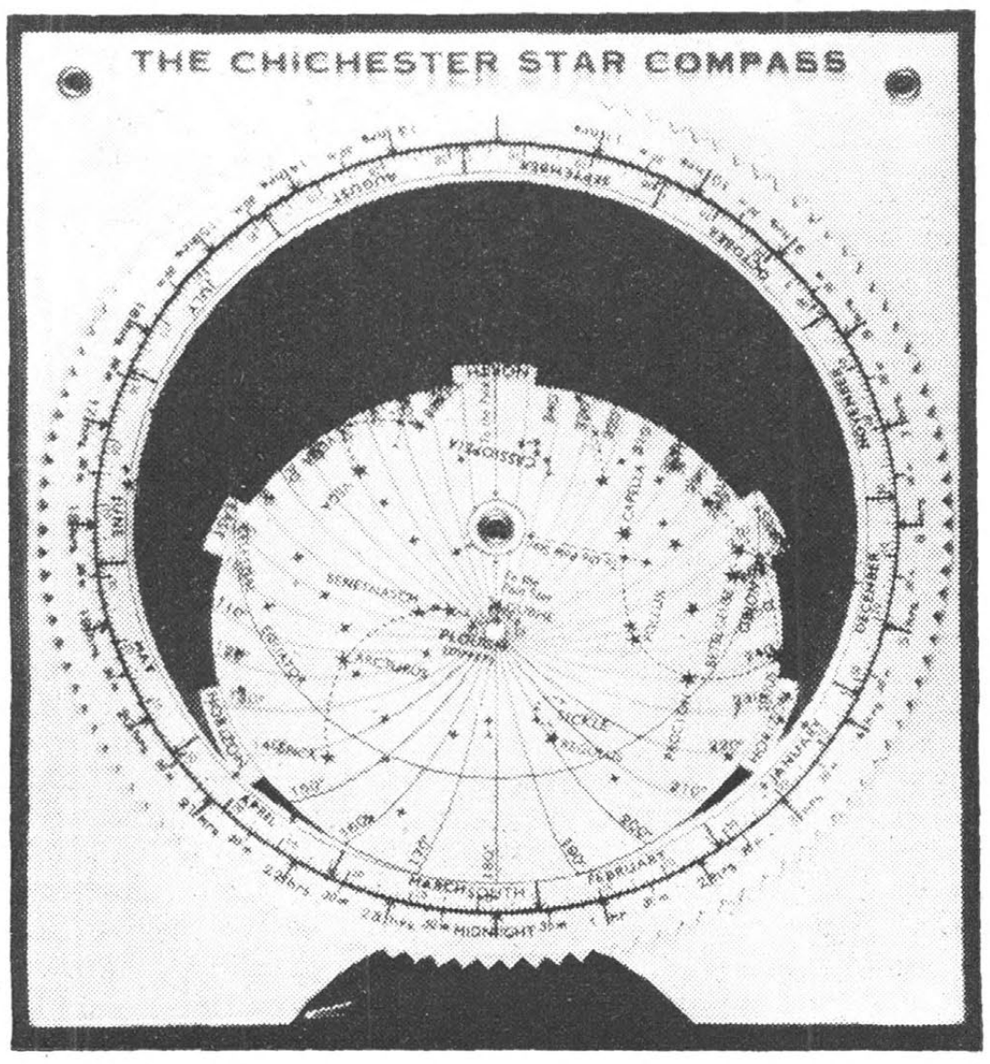
NAPIER SABRE VII

Sabre VII produces no less than 3,055 b.h.p., which is equivalent to the amazing unit output of 83 b.h.p./litre, a figure hitherto unapproached by any other aircraft piston engine in production, and one which represents an increase of 50 per cent. over the original power of the Sabre I—a remarkable achievement which has been attained within a period of five years.

This standard of development applies also to the specific weight, which has gone down to the very low value of 0.83 lb./b.h.p.

UTILITARIAN STAR-GAZING

IT is difficult to know whether one should treat Mr. Francis Chichester's latest navigational device* as a book review. It consists, in fact, of a handy little instrument in the pocket of an explanatory booklet. The "star compass" itself is made up of a rotating disc, carrying the various constellations to be seen in the sky at all times of the year between the latitude belt of 50 deg. and 55 deg. N, covered with a transparent graticule and the whole mounted on a necessary base. By turning the disc to bring the date-marks to coincide with the time-scale on the graticule, the dial provides a picture of the complete night sky at any particular moment. The stars to be seen amongst those used for air navigation are named on the chart in capital letters, while the main groups are named in italics.



Consisting of a rotatable disc carrying the date-marks and star positions, a transparent graticule with a time-scale and bearing lines, and a simple base-board, the Star Compass is quite a small affair. In the position shown, a "picture" is given of the sky hemisphere as at midnight on March 16. The disc's centre of rotation is, of course, the Pole Star, and the opaque section of the graticule covers that part of the star "map" which is not visible on any particular date in the Northern Hemisphere.

Although intended for serious use in setting a course, in checking a magnetic compass, in obtaining the Local Mean Time, or in finding one's longitude, it is felt that the instrument's primary value and interest lies in its educative value as a handy planisphere pure and simple. It can be used for this purpose in most areas of the Northern Hemisphere, and primary students of astro-nav. should, with its use, soon learn both to recognise the various stars of navigational importance and to know their relative positions. For an accurate navigational device it is rather too small, and it is felt that, except in ideal conditions, there might be some difficulty setting the disc correctly and in reading off the appropriate bearings with the required accuracy.

Mr. Chichester, who, at the time of his release from the R.A.F., was Senior Navigation Officer at the Empire Central Flying School, has, nevertheless, produced a most ingenious and useful instrument for the pupil, the casually interested amateur and the navigator travelling in a vehicle somewhat less fast and cramped than the average aircraft. The Star compass is an instrument complementary to the previously "published" Sun compass.

* *"The Chichester Star Compass." By Francis Chichester. George Allen and Unwin, Ltd. 5s. 6d.*

INTERIM R.A.A.F.

THE R.A.A.F. will maintain a strength of 40,000 men until the Government decides what size of force can be carried in peacetime. It will be known as the Interim R.A.A.F. The permanent air force will probably consist of 20,000 officers and men. The Interim Force will remain established for probably another 18 months. Further discharges will be made from the Interim Force when the size of the permanent force has been decided by the Government.

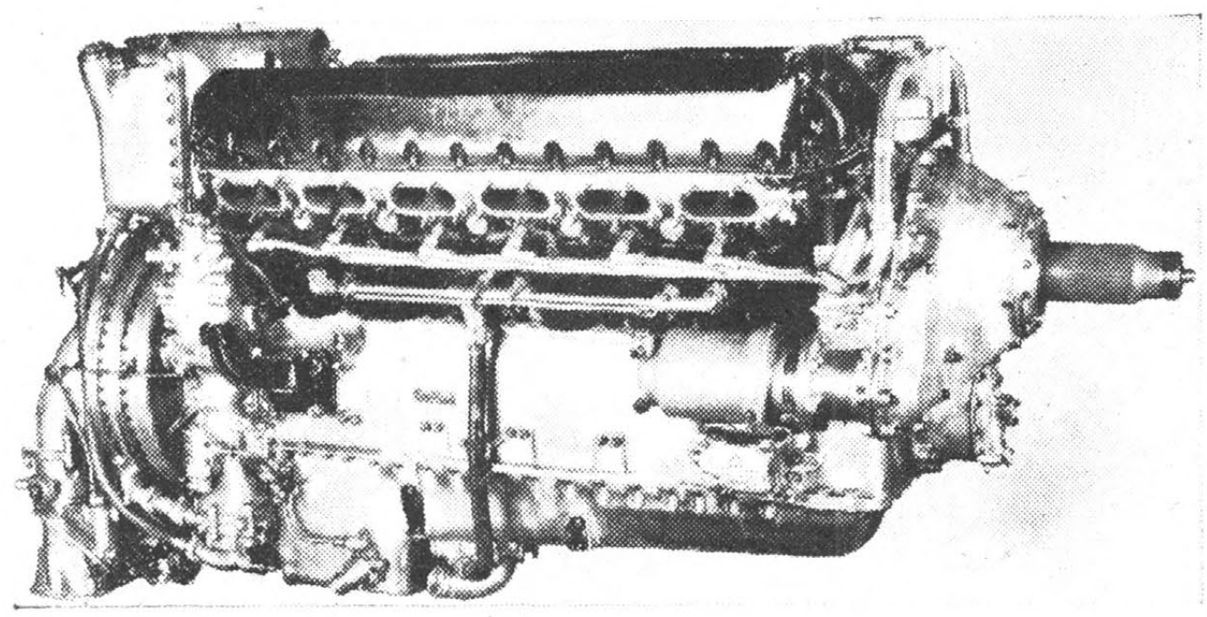
The R.A.A.F. is at present diverting most of its resources to the task of evacuating women and children and prisoners of war from Sumatra, where conditions have been the worst in south-east Asia. In five days it took 2,000 people to Singapore.

SPITEFUL WITH GRIFFON 69

IN the recent release of the Vickers-Supermarine Spiteful it was stated that the aircraft was powered with a Rolls-Royce two-stage two-speed Griffon 61. Strictly speaking, this is not wholly accurate, as the 61 was fitted only to the early prototypes of the aircraft, the normal production machines all having the Griffon 69.

As mentioned in *Flight*, September 20th, 1945, the maximum powers in the appropriate supercharger gears have been increased (in the Griffon 69) to 2,375 b.h.p. at 1,250ft. in M.S. gear, and 2,130 b.h.p. at 15,500ft. in F.S. gear, these being developed at a boost pressure of 25 lb./sq. in. Furthermore, the maximum output of the 69 exceeds that of the earlier two-stage Griffons by some 300 b.h.p. without any increase in weight, and connotes, in addition, that each cylinder contributes no less than 198 h.p., which is equivalent to a unit output of 64.75 h.p./litre and a power of 7 h.p./sq. in. of piston area; specific weight has gone down to 0.88 lb./h.p.

The new Griffon 69 is basically similar to the Mk65 fully described in *Flight* (as above), and differs from the earlier unit only in the arrangement of the ignition timing unit and the automatic boost control.



The 2,375 h.p. Rolls-Royce Griffon 69 as fitted to the Vickers-Armstrongs Supermarine Spiteful.

A Record Party

Meteor Pilots Toasted at Great Gathering

TEAMWORK was the *leitmotif* of all the speeches made at the lunch given in London last Friday by the Rolls-Royce and Gloster companies in honour of Grp. Capt. Wilson and Mr. Greenwood, the two record-breaking pilots. The guests included representatives of the R.A.F., Air Ministry, Ministry of Aircraft Production, research and industry.

Mr. T. O. M. Sopwith, head of the Hawker Siddeley group, who was in the chair, recalled that work began some five or six years ago when the first Gloster jet-propelled machine was designed. Since then there had been rapid development, and Rolls-Royce engineers had obtained more and more thrust from their jet units. In the record flights the whole available thrust was not used, and the record was actually established "in cruising conditions." He paid a warm tribute to all concerned, with a special reference to Air Commodore Whittle. Great Britain now held the world's speed records on land, on the water and in the air. He presented souvenirs to the two pilots in the form of gold cigarette cases inscribed with their names and the speeds which they had attained.

In his speech Mr. Sopwith stressed the need for the British aircraft industry to use its technical superiority in the export market, but he pointed out that the industry must not be handicapped by restrictions such as those which existed at present. In America industry was given every encouragement to make direct contacts and contracts. Was it, he asked, demanding too much for British industry to be given similar facilities?

A Delightful Understatement

Grp. Capt. Wilson said Mr. Sopwith had mentioned six years of development. He and Greenwood were over the course about 11 seconds, and that roughly represented the relative contributions to success! He hoped to be given the opportunity to have another go if the record were challenged. He concluded by thanking the two firms for having enabled him "to have a nice ride"!

Mr. Eric Greenwood spoke of the pleasure he had derived from working with the Gloster technicians, and expressed confidence that they would always be ready to meet any challenge.

Air Marshal Sir Ralph Sorley, who was Controller of Research and Development when the Meteors were being prepared, spoke wittily of the preparations as a game of roulette, with the wheel sometimes doing 16,000 r.p.m., sometimes 20,000, sometimes 14,000.

Famous names on this menu card include those of the designers of aircraft and engines. The signatures of the two pilots are in the bottom right-hand corner

Sir Arthur Sidgreaves, managing director of Rolls-Royce, recalled that all three speed records (land, sea and air) had been established with Rolls-Royce engines. The firm now had a turbine engine more powerful than the Derwent, but so far there was no aircraft to take it. The aircraft designers would have to "get their skates on."

One of the great advantages of turbine units was their great simplicity, which made rapid development possible. Designers were now, Sir Arthur added smilingly, hard at work designing that simplicity out of the units!

Mr. Sopwith read telegrams from Sir Frank Spriggs and Sir Roy Dobson. The former said: "Very much regret enforced absence from what I hope will be another record gathering. Congratulations to all concerned." Sir Roy Dobson sent the following from Canada: "Congratulations to designers, manufacturers, and pilots of the record-breakers. We shall require all your assistance in this country. Dobbie."

LIGHT AIRCRAFT

(*Continued from page 547*)

Here, again, performance lost by deeper windscreens is less than it might appear to be.

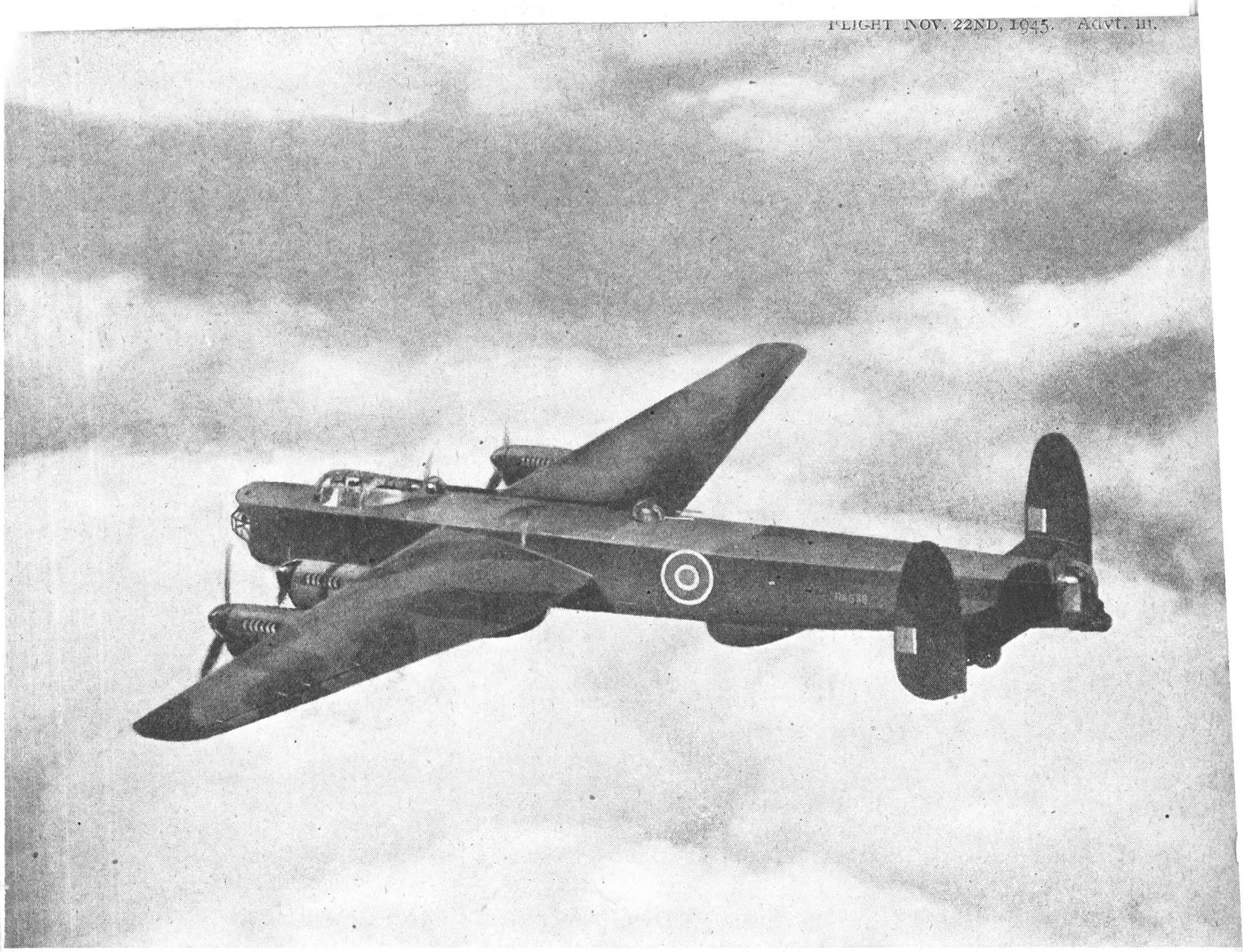
In the years immediately before the war, a number of small twin-engined aircraft were experimented with, but none of them ever reached the production stage. The small twin has much to recommend it on security considerations, but it will not have the performance of a single-engined type of the same total power. Its size, first cost and maintenance costs will all be greater, and it will not be so easy to handle. Consequently, it is never likely to have a wide market.

The inverted four-in-line has long been the standard form for the more popular British light engines. During the war we have been introduced to the flat four so popular in America, and used with success in the Auster IV and V. How the price of these engines will compare with their British equivalents is yet to be seen.

Comparison of typical engines of both types shows that the flat four is both lighter and more compact, and it fits well into the lines of a side-by-side two-seater. The flat four can also have wet-sump lubrication, which eliminates the complication of external oil tanks and piping, and the carburettor is placed below the engine, making possible the use of gravity-feed without pumps. Some of these engines also have reduction gears, which increase airscrew efficiency. The American Franklin company are said to be producing a two-speed gear which will improve the take-off.

All these points add up to a considerable advantage on the side of the flat four, and British constructors may well feel justified in applying their wide experience to developing an even better engine of this type.

The new controllable-pitch airscrews for low powers announced by de Havillands will give considerable improvements in all-round aircraft performance. Their simple design arouses hopes of a price within the reach of the average private owner. A cheap variable-pitch airscrew promises much greater improvement in take-off than a gear box on the engine, as well as improvement over the whole of the speed range.

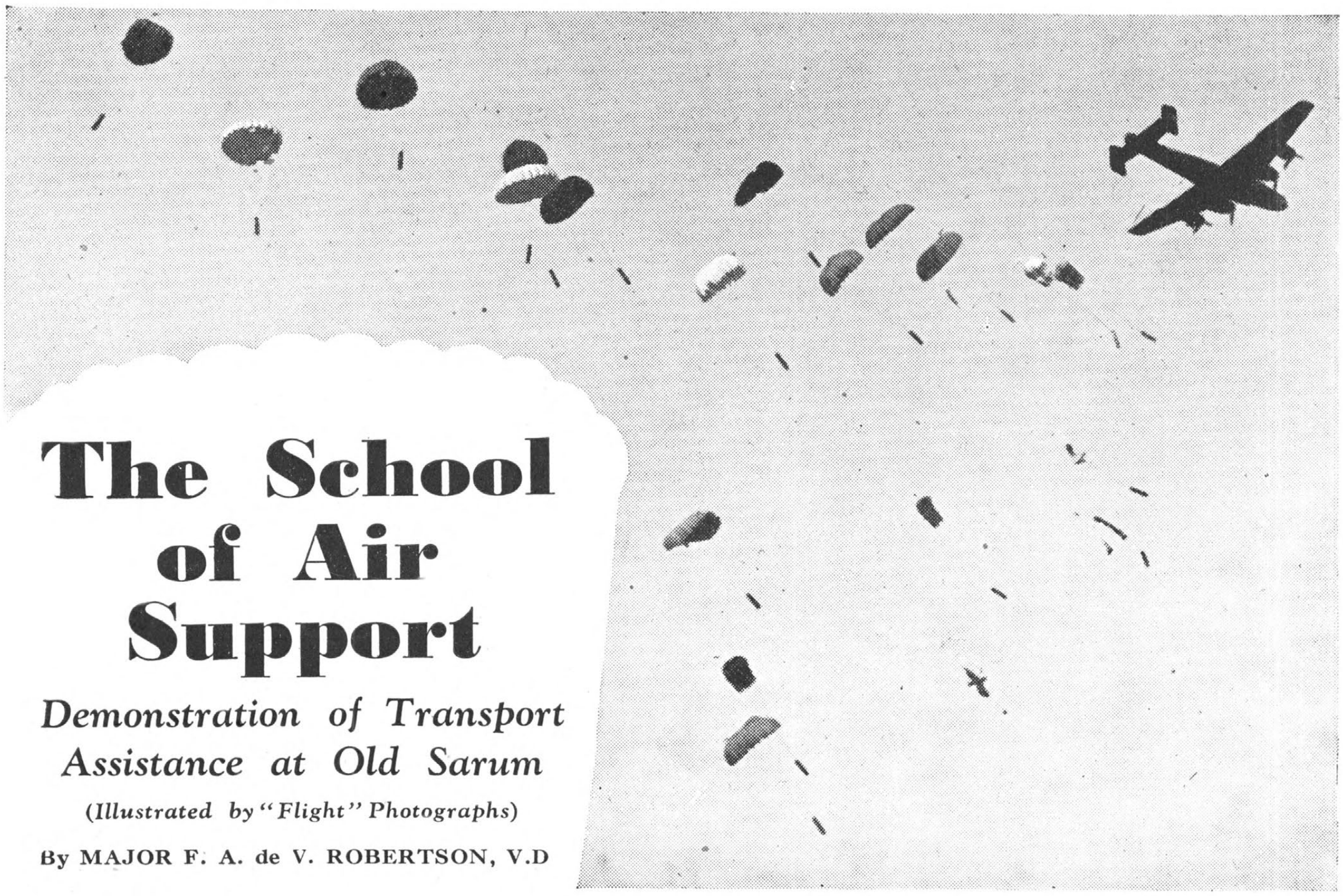


AND NOW THE AVRO LINCOLN

The War's final development in heavy bombers—The Avro Lincoln, carrying even bigger loads at greater speeds for longer distances than the world-famous Lancaster. These essential factors of load, speed and range, plus ecomony and comfort, will be found in the Avro Air Liners of to-day and to-morrow, on the Air routes of the world.

ONE OF THE SUPERPLANES BY AVRO

A. V. ROE & CO. LIMITED, MANCHESTER (BRANCH OF HAWKER SIDDELEY AIRCRAFT CO. LTD.)



The School of Air Support

Demonstration of Transport Assistance at Old Sarum

(Illustrated by "Flight" Photographs)

By MAJOR F. A. de V. ROBERTSON, V.D

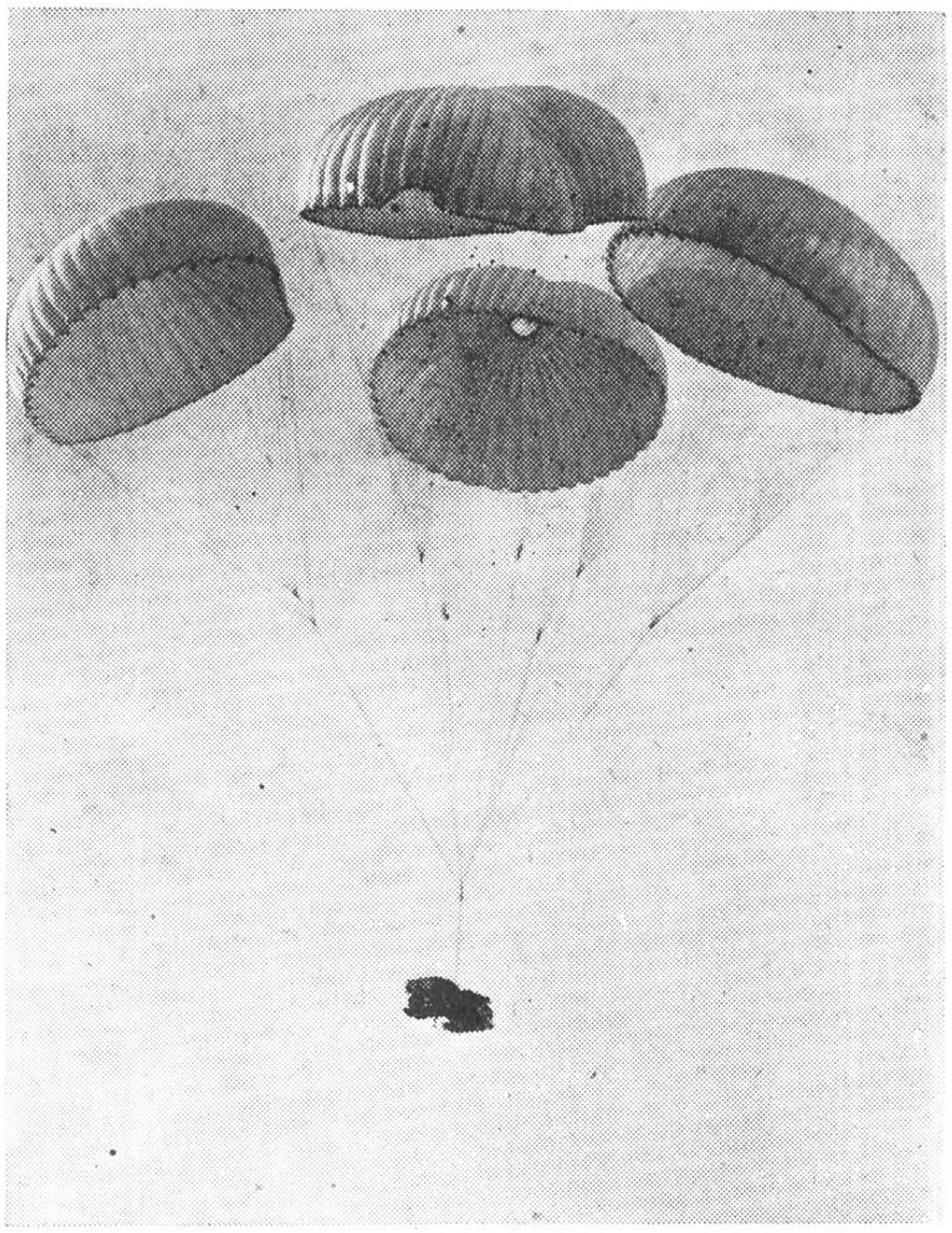
A Halifax dropping 22 containers. Another dropped a jeep, a 6-pounder gun and four containers.

MORE than once in the past have representatives of *Flight* visited Old Sarum and seen the work done at its School. It was then called the School of Army Co-operation, and the work which it did was very efficiently planned and carried out. But its scope was limited. The name suggested that it covered all forms and descriptions of Army-Air work; but in actual fact it dealt only with tactical reconnaissance extending up to some 50 miles behind the enemy's lines, and with spotting for the artillery.

When Army manœuvres were held, the custom was for the Command then known as Air Defence of Great Britain to lend a few squadrons of fighters and day-bombers temporarily to the Army to supplement the work of the army co-operation squadrons, which, of course, moved with the Army formations and carried out their regular work. The Army authorities were naturally very much concerned with the reconnaissance work of the A.C. squadrons, whose pilot-observers had been trained at the Old Sarum School; but they did not appear to take very much interest in the work of the fighters and bombers. In fact, no attempt was made in those days to work out a doctrine of Army-Air work. Europe presented the curious spectacle that in Germany and Russia the Air Forces were looked upon almost entirely as an arm of the national Army, whilst independent air offensive was not studied; whereas in Britain almost the exact opposite prevailed. The Air Ministry always had its eye on the possibility of a bomber offensive directed against the war production of the enemy, but nobody took the trouble to work out a doctrine for combined work between the Army and the Air Force.

A Tragic Campaign

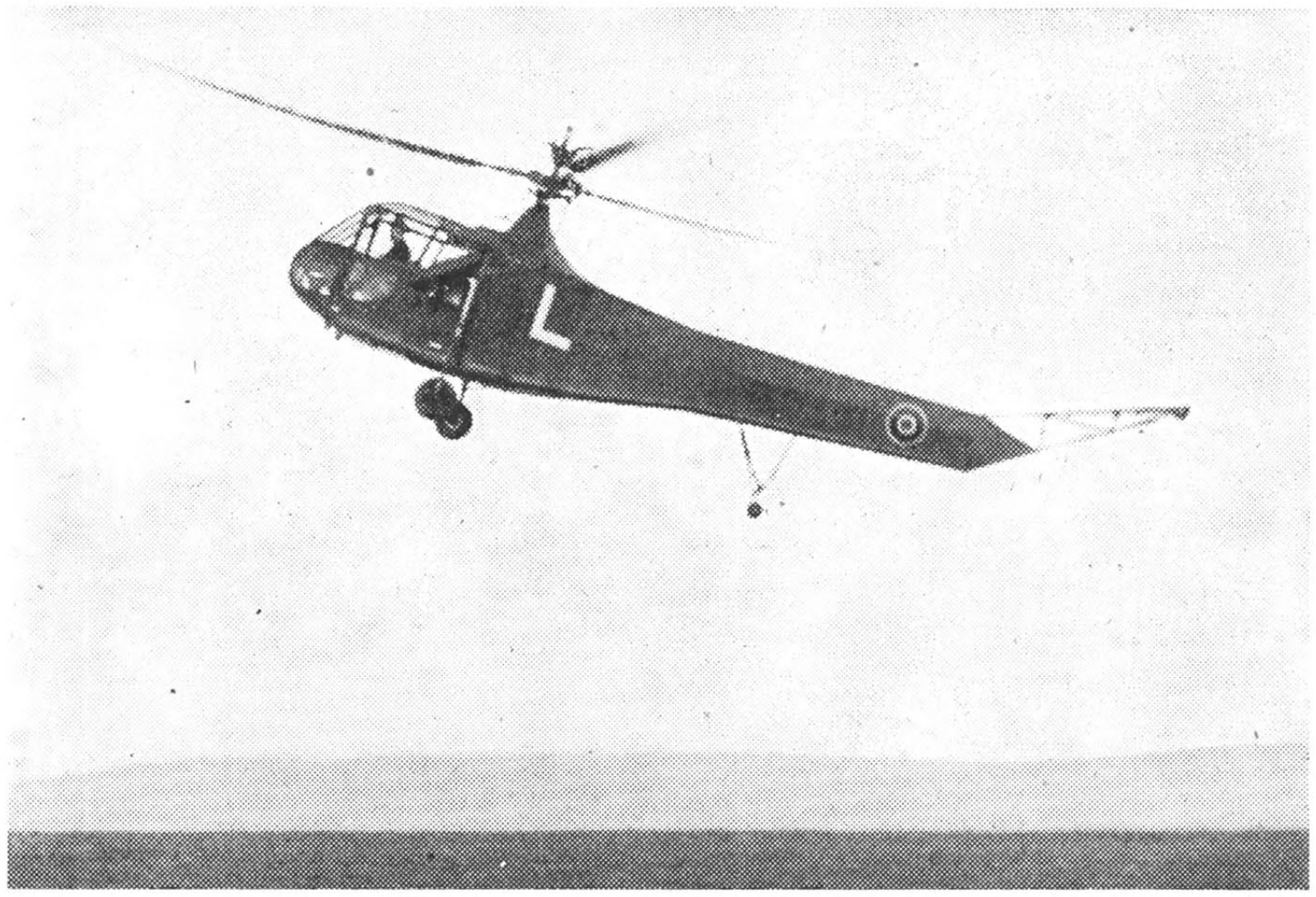
The result of this negligence became apparent during the 1940 campaign in the Low Countries and France. The tactical reconnaissance squadrons, then equipped with Lysanders, needed, but did not get, strong fighter protection against the Me 109s. The Battle bombers also needed fighter protection, and did not get anything like enough of it. The campaign was a tragedy in many respects, and



The jeep made a successful descent. Special shock-absorbers protected the wheels.

from the point of view of inter-Service co-operation it was a fiasco. At Dunkirk the soldiers were very indignant because they did not see British fighters over their heads. As a matter of fact, the fighters were doing their job magnificently, and it is not too much to say that but for their efforts the losses of the Army on the Dunkirk beaches would have been far higher than they were. But few soldiers of any rank had any knowledge of how the R.A.F. did, and ought to do, its work. That by itself was all wrong. Each Service ought to have a general working knowledge of the powers and methods of the other two.

The change came just before Alamein, when the 1st Tactical Air Force was formed. It is a matter of history that things went well from then on. In Britain the 2nd Tactical Air Force was formed, and the American Army formed a Tactical Air Force at the same time. Air Marshal Sir Arthur Coningham was brought from Africa to command the 2nd Tactical Air Force, bringing with him the experience which he had gained in working with the 8th Army. The Army of Gen. Eisenhower learnt how to work with these Tactical Air Forces by doing it, and as the advance went on more was learnt by experience. The Tactical Air Forces, too, learnt to appreciate the problems of the ground troops, and a doctrine was built up as a result of experience.



A wonderful demonstration was given by an R4B helicopter. The anti-torque vanes at the tail revolve so rapidly as to be practically invisible.

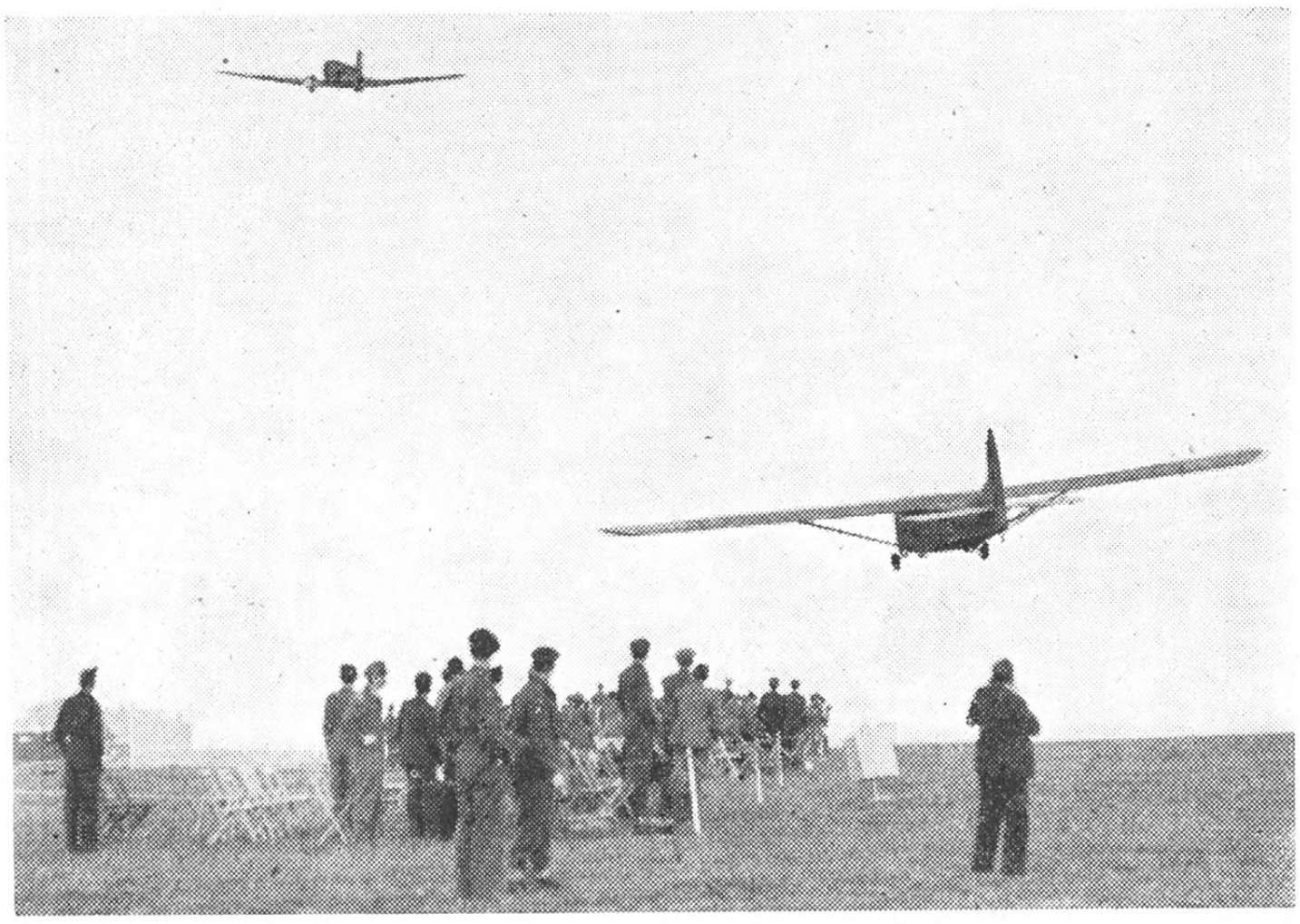
Using Experience

When Germany submitted the Tactical Air Forces were disbanded; but obviously it would have been extreme folly to waste all that experience. There may still be other wars, and we must never start in the parlous condition in which we found ourselves in 1940. Moreover, a new feature of warfare had grown up in the course of the struggles against Germany and Japan, namely, supply and transport by air. A school was needed to crystalise the newly discovered doctrines, to study them, to expand them where possible, and to teach them to officers of all three Services.

So in December, 1944, the School of Army Co-operation at Old Sarum was transformed into the School of Air Support. The charter of the new school is: (1) to teach a common doctrine in air support by holding courses of instruction for all three Services; (2) to study all matters affecting the air support of armies; (3) to maintain close liaison with its counterparts at home and overseas, and keep them up to date with current developments. The term "Air Support" includes assistance by air (both R.A.F. and R.N.) to the assault, the land battle, airborne operations, air-transported operations, and supply and maintenance of the Army by air.

The School has been organised into two Wings, the Offensive Support Wing and the Transport Support Wing. The Commandant of the School is an Air Vice-Marshal (at present A.V-M. L. O. Brown, C.B., C.B.E., D.S.C., A.F.C., who has served with the Desert Air Force and has commanded No. 84 Group of the 2nd Tactical Air Force). The Assistant Commandant is an Army Brigadier (now Brigdr. P. H. W. Hicks, C.B.E., D.S.O., M.C., who commanded the 1st Airlanding Brigade at Arnhem). The Deputy Assistant Commandant is a naval Commander (now Cmdr. O. N. Bailey, who has commanded a naval fighter squadron and has been Chief Instructor at the Naval Air Fighting School). Each of the two Wings has a Group Captain as Chief Instructor, with officers from the Army and R.A.F. to assist him. The Offensive Support Wing has also two Lieut. Commanders, R.N., as instructors. The three Services are thus well combined at the School. At present the Royal Navy is not concerned with the Offensive Support Wing; but the Commandant is desirous to explore the possibilities of transport support from aircraft carriers. Offensive support from carriers already has a war history, notably at the Anzio landing, as well as in various actions by the Americans in the Pacific. It is an obvious subject for the new School to study.

Recently some visitors, among whom representatives of *Flight* were numbered, were invited to Old Sarum to look over the School and witness a display of supply dropping. There



A Dakota has just "snatched" the Hadrian glider off the ground

THE SCHOOL OF AIR SUPPORT

was much of interest in the lecture rooms and library, especially some model panoramas let into the walls, with mirrors above them, from which one could compare the different aspects of a stretch of country as seen from the ground and from the pilot's seat in an aircraft. It was astonishing how some road tracks which were hardly discernible from the ground showed up in the mirrors which gave the pilot's view. On the other hand, one field gun was easily visible from the ground, but could hardly be spotted from the air, even when one knew where to look for it. There were model operations rooms in which students, particularly Army officers who had not had much to do with air support, were made to work out schemes as if they were Air Officers themselves. French officers have attended the school, and will start a similar one in France.

Technical Unhitch

Presently we went on to the airfield, and three Dakotas in V formation at 600 feet dropped ten panniers each, filled with, one presumed, badly needed supplies. Then three Halifaxes in line astern, at 15-second intervals, dropped 22 containers each. The weight of a container and its goods should not exceed 250 lb. This method, used when air superiority is uncertain, was employed after the crossing of the Rhine. Next came a real sensation. One Halifax dropped a jeep, a six-pounder gun, and four containers from 1,000 feet. The jeep came down according to plan, supported by four parachutes; and the containers also behaved themselves. But the gun, for some reason not disclosed, decided to descend without a parachute. It was rather bent by contact with the ground, and will not be of much further use. Fortunately there is now no urgent need to fire live rounds at anybody in Europe.

A Waco Hadrian glider was towed over the ground and released. It came down in good style, landing quite as near to the spectators as was comfortable. It was followed by a Sikorsky R4B helicopter. When that weird-looking contraption took off again the pilot gave a really wonderful display. Rising slowly from the ground, he flew backwards, and then sideways in each direction, only a few feet off the ground. He pivoted the machine round and round on its own axis; and finally came low and hovered while his mechanic walked up, opened the door of the cockpit, and climbed in without difficulty.

Pull-off

The display ended with the "snatching" of the Hadrian glider. Its Nylon tow-rope was raised over a temporary support looking something like the horizontal bar in a gymnasium. The Dakota lowered a rod with a hook at its end, and swooped down. The hook engaged the Nylon rope and the tug climbed, dragging the glider behind it. In a very short time the Hadrian was airborne, and the pair flew away. The jerk was absorbed by the flexibility of the Nylon and by the Dakota paying out its hook until all was taut. The loudspeaker assured everyone that a man in the glider, if he happened to be drinking a glass of beer, would not spill it when the glider was "snatched." It is not always possible to rescue gliders after they have made a landing in war; but if the glider is undamaged this "snatching" can be carried out without the tug having to land—an obvious advantage when the enemy may be round about and when the glider is on a clearing in the jungle which could not be honoured with the title of airfield.

For Valour

—*in the Face of Close-range A.A. Fire : R.A.F. and Naval Air Arm* V.C.s

TWO remarkable feats of valour having certain points of similarity though performed in very different circumstances have resulted in posthumous awards of the Victoria Cross to an R.A.F. Dakota pilot and to a Naval Air Arm pilot.

The Dakota pilot was Flt. Lt. David Samuel Anthony Lord, D.F.C., of No. 271 Sqn. On the afternoon of September 19th, 1944, at the height of the desperate Arnhem fighting, our Airborne troops had been surrounded and were being pressed into a small area heavily defended by A.A. guns. Flt. Lt. Lord's aircraft was one of a number detailed to drop supplies to the force. At the briefing crews were warned that the flak over the area would be intense; nevertheless, they must fly at 900ft. to ensure accuracy in dropping.

Approaching the area at 1,500ft., the Dakota was twice hit in the starboard wing, and the engine on that side set on fire. Flt. Lt. Lord (says the official citation) would have been justified in leaving the main stream of supply aircraft and continuing at the same height or even abandoning his aircraft. But on learning that his crew were uninjured and that the dropping zone would be reached in three minutes he said he would complete his mission, as the troops were in dire need of supplies.

By now the starboard engine was burning furiously. Flt. Lt. Lord came down to 900ft., where he was singled out for the concentrated fire of all the anti-aircraft guns. On reaching the dropping zone he kept the aircraft on a straight and level course while supplies were dropped. At the end of the run he was told that two containers remained.

Although he must have known that the collapse of the starboard wing could not be long delayed, Flt. Lt. Lord circled, rejoined the stream of aircraft and made a second run to drop the remaining supplies. These manœuvres took eight minutes in all, the aircraft being continuously under heavy fire.

His task completed, Flt. Lt. Lord ordered his crew to abandon the Dakota, making no attempt himself to leave the aircraft, which was down to 500ft. A few seconds later the starboard wing collapsed and the aircraft fell in flames. There was only one survivor, who was flung out while assisting other members of the crew to put on their parachutes.

The citation concludes: "By continuing his mission in a damaged and burning aircraft, descending to drop the supplies accurately, returning to the dropping zone a second time and, finally, remaining at the controls to give his crew a chance of escape, Flt. Lt. Lord displayed supreme valour and self-sacrifice."

This is the twenty-second R.A.F. V.C., or twenty-seventh if the Dominion Air Forces are included. It is the first to be awarded to a member of Transport Command.

The Naval Air Arm pilot was Temporary Lt. Robert Hampton Gray, R.C.N.V.R. The citation records that His Majesty the King has approved the award for "great valour in leading an attack on a Japanese destroyer in Onagawa Wan on August 9th, 1945. In the face of fire from shore batteries and a heavy concentration of fire from some five warships, Lt. Gray pressed home his attack, flying very low in order to ensure success, and, although he was hit and his aircraft was in flames, he obtained at least one direct hit, sinking the destroyer. Lt. Gray has consistently shown a brilliant fighting spirit and most inspiring leadership."

This is the second Victoria Cross to be awarded to a member of the Naval Air Arm. The first was that of Lt. Cdr. E. Esmonde, won in the Channel action against the *Scharnhorst*, *Gneisenau*, and *Prinz Eugen*.

JETTISONING BY INTENT

IT appears that the Martin-Baker hood incident—mentioned in our continuation report of the Farnborough display in last week's issue—was by no means as simple as it appeared. Mr. Greensted did not "lose" the hood of the fighter during his demonstration—he discarded it intentionally after the cockpit had suddenly filled with smoke towards the end of his show. The engine had rebelled in its own way under the influence of 25 lb. of boost and had suffered a damaged piston. It is not always that a jettisoned hood departs from an aircraft as quickly and concisely as it did in this case, and the incident might have had its demonstration value in less urgent circumstances.

The contra-rotating airscrew of the Martin-Baker fighter, incidentally, was a D.H.

Refuelling in Flight

Further Examination of the Possibilities of Sir Alan Cobham's System in Application to Trans-Atlantic Airlines

By C. H. LATIMER-NEEDHAM,
M.Sc. (Eng.), B.Sc. (Eng.), F.R.Ae.S., F.Z.S.

WHEN considering the possibilities of any project in which flight refuelling is to form part of the scheme, it is first necessary to make an investigation of the route in order to determine the best operational arrangement, taking into account such factors as unrefuelled range and pay-load capacity of the airliner, available airfields for airliner and tanker, weather conditions, wind, alternative airfields and other considerations.

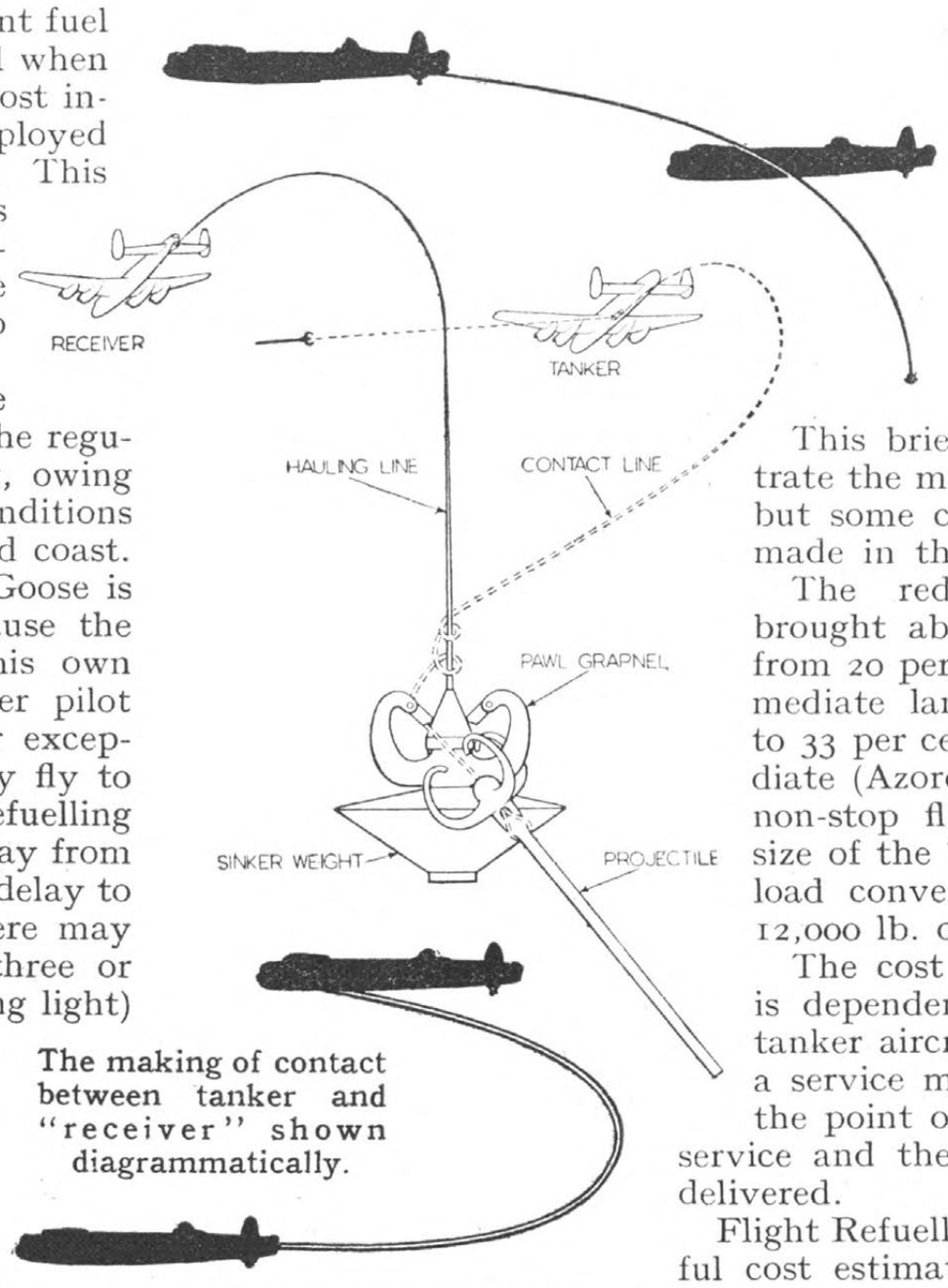
For instance, a trans-Atlantic airliner has to be designed to carry sufficient fuel to overcome a 50 m.p.h. headwind when flying westward, which means almost inevitably that it must be employed uneconomically on the return trip. This handicap disappears, or at least is greatly reduced, by the introduction of refuelling in flight, since the number of refuellings is adjusted to suit the wind conditions.

Again, an airfield such as Goose may be considered unsuitable for the regular operation of passenger aircraft, owing to the high incidence of foggy conditions that obtain over the Newfoundland coast. But a tanker service based upon Goose is a very different proposition, because the tanker pilot would get to know his own airfield as familiarly as a sea-liner pilot knows his river; moreover, under exceptionally adverse conditions he may fly to an alternative base after the refuelling operation (carried out above or away from the fog bank) without causing any delay to the airliner service. Any risk there may be is faced by a crew of, say, three or four in the case of a tanker (landing light) as compared with the greater risks to which fifty, one hundred, or more occupants of the airliner are subjected.

Consider now the North Atlantic route from London to New York: eight possible arrangements are given in Table I on the opposite page. Wind has not been taken into account. The various arrangements are illustrated in Fig. 1. It may be mentioned that where a tanker station (island or mainland airfield) lies directly on the route, the refuelling point will be *beyond* the station if it is situated less than halfway from the starting base to the terminus (or next refuelling point), but will be *over* the station if the distance is greater than half the total just defined. The overruling condition is that it shall always be possible for the airliner to return to its own base, the tanker's base, or an alternative airfield, in the event of the refuelling operation being abortive. When the tanker station lies to one side of a route, the optimum refuelling point may be offset from the station (see Route 3), so that the airliner's route is caused to deviate as little as possible from the great circle route.

The route analysis (Table I) shows that, neglecting wind, non-stop flight is possible between London and New York, with aircraft having a range as small as 1,350 statute miles, by means of three flight refuellings (Route 8), or a range of 1,560 miles with two refuellings (Route 7). The latter is considered to be a practical proposition, for it must be remembered that, other factors being equal, the lower the fuel load (range required) the greater the payload.

Routes 2 and 5 call for long range together with long route distances, and can therefore be discounted. Route 6 shows no improvement over 3, despite an additional refuelling, and can also be ignored.



The making of contact between tanker and "receiver" shown diagrammatically.

Routes 3 and 4 offer suitable southerly routes if an alternative to the great-circle route is desired for the winter months: the required ranges differ little from that of the northerly route, but the total route distance of 4 is high.

This brief analysis is intended to illustrate the most promising alternative routes, but some compromise would probably be made in the final selection.

The reductions in range required, brought about by flight refuelling, vary from 20 per cent. in the case of two intermediate landings (Azores and Bermuda) to 33 per cent. in the case of one intermediate (Azores), and to 51 per cent. for the non-stop flight. For an aircraft of the size of the Tudor, these reductions of fuel load convert to between 3,000 lb. and 12,000 lb. of payload.

The cost of operation of aerial tankers is dependent upon the size and type of tanker aircraft, whilst the cost of running a service must depend on the distance to the point of rendezvous, the frequency of service and the quantity of cargo fuel to be delivered.

Flight Refuelling, Ltd., have made very careful cost estimates for a tanker organisation operating aircraft of the Lancaster, Halifax or Stirling type on the Atlantic routes. These estimates take into account all possible items of expense, including cost of aircraft, maintenance, spares, insurance, crews, establishment costs and others too numerous to detail here.

The cost per operation, for a once-daily service, varies according to the tanker's flight distance, and is given below for the three refuellings called for on the London-New York non-stop route.

The total cost for the three operations called for on the out-and-return trip is therefore seen to be £750, or an average of £250 per operation.

Let us first see what can be done with an aircraft the size of the Tudor II, of gross weight 76,000 lb. Even

IN "Flight" of August 23rd, 1945, there appeared an illustrated description of Sir Alan Cobham's system of refuelling in the air. In the issue of October 4th Mr. C. H. Latimer-Needham (who is chief engineer of Flight Refuelling Ltd.) examined various aspects of the fuel problem in trans-ocean airline flying, and in this article he discusses the practical application of the system to the Atlantic routes.

Rendezvous	Cost of Operation
560 miles W. of Rineanna	£400
Over Gander	£150
220 miles E. of Gander	£200

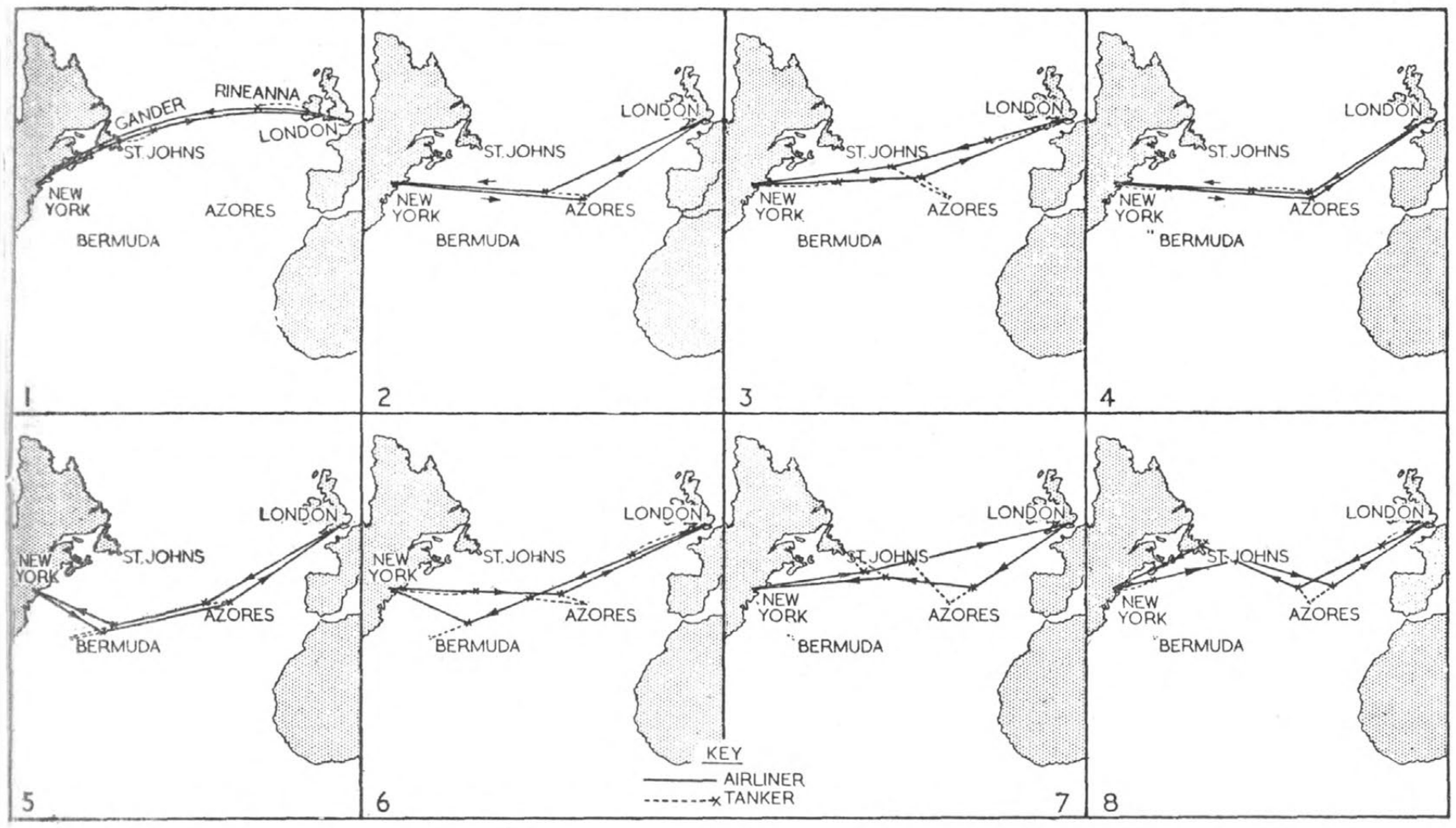


Fig. 1. Refuelling points along various possible routes between London and New York.

Table I.—Main Features of London-New York Air Routes

Route No.	Itinerary	Refuelling Points		No. of Refuellings	Mean Route Distance, Statute Miles	Range Required, Statute Miles	Remarks
		Out	In				
1	Great-Circle route	Off Rineanna, over Gander	Off Gander	2 Out, 1 In	3,450	1,685	Suitable northern route
2	Azores	Off Azores	Over Azores	1 each way	4,184	1,930	Long range required
3	Azores	Off London, off Azores	Off New York, off Azores	2 ,, ,,	3,585	1,730	Suitable southerly route
4	Azores	Over Azores, off Azores	Off New York, over Azores	2 ,, ,,	4,045	1,650	Suitable southerly route
5	Azores, Bermuda	Off Azores, off Bermuda	Off Bermuda, over Azores	2 ,, ,,	3,930	2,460	Range too great
6	Azores, Bermuda	Off London, off Azores, off Bermuda	Off New York, off Azores	3 Out, 2 In	3,695	1,720	No improvement on (3), but additional refuelling
7	Azores, St. Johns	Off Azores, off St. Johns	Off St. Johns, off Azores	2 each way	3,838	1,560	Suitable for short-range aircraft
8	Azores, St. Johns	Off London, off Azores, off St. Johns	Off New York, off St. Johns, off Azores	3 ,, ,,	3,918	1,350	Suitable for short-range aircraft

We have considered, for convenience, the London-Gander stage only, but by means of flight refuelling it is seen to be possible to convey an additional load of passengers and freight as far as Gander, and they can then be transported over the further stage to New York. With an unrefuelled service, having a restricted payload, it is very unlikely that additional payload could be picked up at Gander, and therefore the airliner is forced to continue to run uneconomically all the way to New York. In other words, the cost figure of £15 per additional passenger could be assumed to cover the whole distance from London to New York.

Before concluding this section, mention should be made of a further improvement which becomes possible with a flight-refuelled service. It has been shown that the fuel aboard the airliner at take-off and after refuelling should be equal in order to obtain the maximum payload, and it is this factor which determines the refuelling point. On the westward flight the refuelling operation is arranged 580 miles west of Rineanna, but if, instead, refuelling takes place over the tanker's airfield, the airliner will be given an overload at that point (not

with no payload, such a machine is incapable of flying non-stop from London to New York, but for the expenditure of £750, as detailed above, the full complement of 20 sleeping passengers at 175 lb. each, plus personal luggage at 100 lb. per passenger, can be carried, together with full freight load of 5,300 lb., giving a total payload of 10,800 lb.

Atlantic Comparison

In order to obtain an idea of the relative merits of an unrefuelled and a flight-refuelled service, the stage from London to Gander may be examined. The weight schedules are given in Table II.

In this case the refuelling point is 580 statute miles west of Rineanna when westbound and 596 miles east of Gander on the return flight.

The first point that becomes apparent is the large payload discrepancy between the two unrefuelled trips and the comparative uniformity of payload when flight refuelled. The payload increases are 153 per cent. and 39 per cent. respectively; on the eastbound trip the benefits are not so great, and since unrefuelled the payload is not much less than on the refuelled, westbound flight, the return refuelling could be dispensed with. However, for the sake of comparison we will retain both refuellings. The costs of the refuelling operations are £400 and £450 respectively, for which the payload increments are seen to be 6,607 lb. and 3,597 lb. This works out at £15 and £31 per additional passenger (246 lb.) for the journey, or 1.31 pence and 2.72 pence per passenger mile.

Table II.—Weight Schedule

Item (lb.)	Refuelled	Unrefuelled
London to Gander		
Fuel	14,114	20,721
Oil	1,260	1,260
Day passengers at 246 lb.	(34) 8,364	(16) 4,936
Food at 20 lb. each ...	680	320
Freight	1,872	53
Total disposable	26,290 lb.	26,290 lb.
Total payload	10,916 lb.	4,309 lb.
Gander to London		
Fuel	12,114	15,711
Oil	1,260	1,260
Day Passengers (34) ...	8,364	8,364
Food	680	680
Freight	3,872	275
Total disposable	26,290 lb.	26,290 lb.
Total payload	12,916 lb.	9,319 lb.

Tanker operation	Tanker fuel		Cargo fuel		Total fuel load
	Galls.	lb.	Galls.	lb.	lb.
Rineanna	1,320	9,580	2,680	19,430	29,010
Gander (westward)	410	2,970	2,334	16,920	19,890
Gander (eastward)	511	3,706	2,925	21,206	24,912

REFUELLING IN FLIGHT

at take-off) amounting to approximately 615 gallons, or 4,460 lb. This is an overload of 5.9 per cent. only, and cannot be considered unreasonable. The tanker journey is reduced by approximately 1,000 statute miles, and the cost of the operation drops immediately from £400 to £130, or the absurdly small figure of £4.6 per additional passenger, and 0.4 pence per passenger mile!

The picture is not yet complete. For our example we took an airliner of 76,000 lb. gross weight, in which case the cargo fuel carried by the tanker for the London-New York route amounts to roughly 1,000 gallons, or 7,250 lb. Now, as will be shown in a later section, the Lancaster or Lincoln, used as an aerial tanker, is capable of carrying 2,000, or even 3,000, gallons of fuel for the required distance, which means that these tanker aircraft could be operated with airliners of twice or three times the size of the Tudor II, and since the cost of operating the tankers remains substantially unchanged, the cost of conveying the additional payload, already absurdly low, may be divided by two or three with the advent of larger airliners.

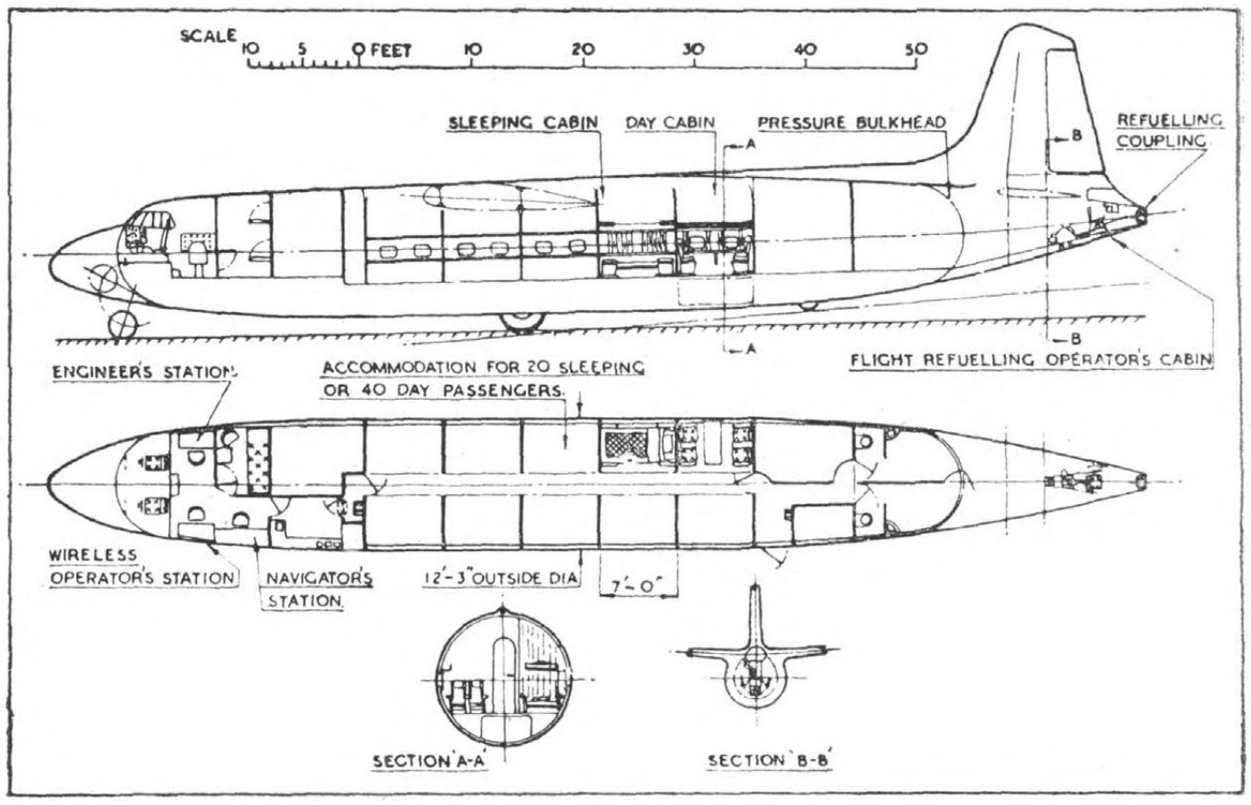


Fig. 2. Cabin layout of the F.R.10, with accommodation for 20 sleeping or 40 day passengers. Four R.-R. RM.14 SM engines. Gross weight 70,000 lb.

Handicap

Until now all aircraft fitted for flight refuelling have been adapted for the purpose. This has not only made installation difficult (for instance, in the Lancaster installation all fuel tanks, hose unit, controls and operator's cabin had to be cramped into the bomb bay and to be removable in a matter of hours!), but has precluded the realisation of anything like the full potential advantages.

Flight Refuelling, Ltd., has prepared designs for aircraft of various passenger capacities which would be suitable for use on a flight-refuelled service over the London-New York great-circle route, or via the Azores, and also for the difficult stage Vancouver-Honolulu on the route from England to New Zealand and Australia. These three types have accommodation for 20, 50 and 100 sleeping passengers respectively: the first is based largely on the Brabazon IIIA specification, now cancelled; the second is designed to meet the requirements of the Brabazon I specification; whilst the third represents what is considered to be an airliner suitable for the transport of 100 passengers (sleeping) over long distances. All these types allow for two refuellings on the non-stop flight from London to New York and one refuelling on the return.

The three airliners are illustrated in Figs. 2 to 4 and the main features are tabulated in Table III.

Table III.—Main Particulars of Flight-Refuelled Passenger Airliners

Type No.	F.R.10	F.R.11	F.R.12
Engines	4 R.R. Merlin, 14 SM	6 R.R. 14 SM	6 Bristol Centaurus 57
Passenger capacity—			
Sleeping	20	50	100
Seated	40	100	134
Component Weights, etc.			
Gross weight, lb. ...	70,000	117,000	185,200
Passenger load, lb. ...	3,500	8,750	17,000
Freight load, normal, lb	4,100	8,550	14,200
Total payload, lb. ...	7,600 (10.85 per cent.)	17,300 14.96 per cent.)	31,200 (16.84) per cent.)
Structure weight, lb. ...	21,430 (30.64 per cent.)	34,800 (29.86 per cent.)	63,285 (34.17 per cent.)
Power plant weight, lb....	13,400 (19.15 per cent.)	22,650 (19.44 per cent.)	30,760 (16.62 per cent.)
Disposable weight, lb. ...	25,849 (36.93 per cent.)	42,860 (36.8 per cent.)	68,575 (37.03 per cent.)
Fuel capacity, gallon ...	2,000	2,850	4,600
Main Dimensions.			
Span, ft.	120	150	195
Length, ft.	99	129	146
Wing area, sq. ft. ...	1,450	2,340	3,800
Aspect rates	10.0	9.62	10.0
Wing loading, lb./sq. t....	48.25	50.0	49.0
Brief Performances.			
Maximum speed, m.p.h....	322	310	300
Cruising speed, m.p.h. ...	235	257	242
Landing speed m.p.h. ...	81	83	82
Maximum range, miles ...	2,400	2,400	2,320 at 242 m.p.h.
Take off to 50 yds. ...	1 000	1,110	1,438
Power loading, lb./b.h.p.	10.5	11.7	12.25

The wing loading has been made approximately 50 lb./sq. ft. in each case, since this figure is representative of current British airliners and strict comparison is therefore possible. In other words, the possible advantages of higher wing loadings now being adopted in the U.S.A. have not been exploited, although it is at once realised that refuelling in flight offers the additional and considerable benefit of assisting the heavily laden aircraft at the initial period of take-off and climb (see p. 372 of previous article in *Flight*, October 4th).

The payloads of Table III have been plotted against gross weight in Fig. 5, and on the same diagram is shown the curve giving the payload of current types, designed to fly the Atlantic unrefuelled; the design shows at once the tremendous improvement that can be effected by means of flight refuelling.

Payloads, as percentages of the gross weight, have also been added to Fig. 5, and these curves are perhaps more enlightening than the pay-

REFUELLING IN FLIGHT

load curves, for it is seen that whereas the unrefuelled payload remains constant at about 5 per cent. the flight-refuelled percentage figure increases rapidly with gross weight and tends to stabilise at about 18 per cent. for the bigger size of aircraft. Therefore not only does flight refuelling multiply the payload by 3 or 4, but we have already seen from the previous paragraph that the cost of a flight-refuelled service shows a rapid fall as the quantity of cargo fuel, i.e., the size of the airliner, increases. Thus *the economy brought about by this means is doubly enhanced as we go to larger types of aircraft.* In fact, *the additional cost of refuelling in flight becomes a negligible part of the operational costs of an airline service* when viewed in a proper perspective.

Passengers Plus

It is possible to convert the payload to the approximate number of passengers carried, and to use this as the scale instead of pounds weight. The weight of passengers, plus baggage, plus additional freight, plus food, varies to some extent in different aircraft, but a figure of 325 lb. per passenger is a fair average. This figure has been used for constructing the scale of passengers carried as an alternative to the payload weight scale shown in Fig. 5.

Avro Lancasters have already been fitted out as aerial

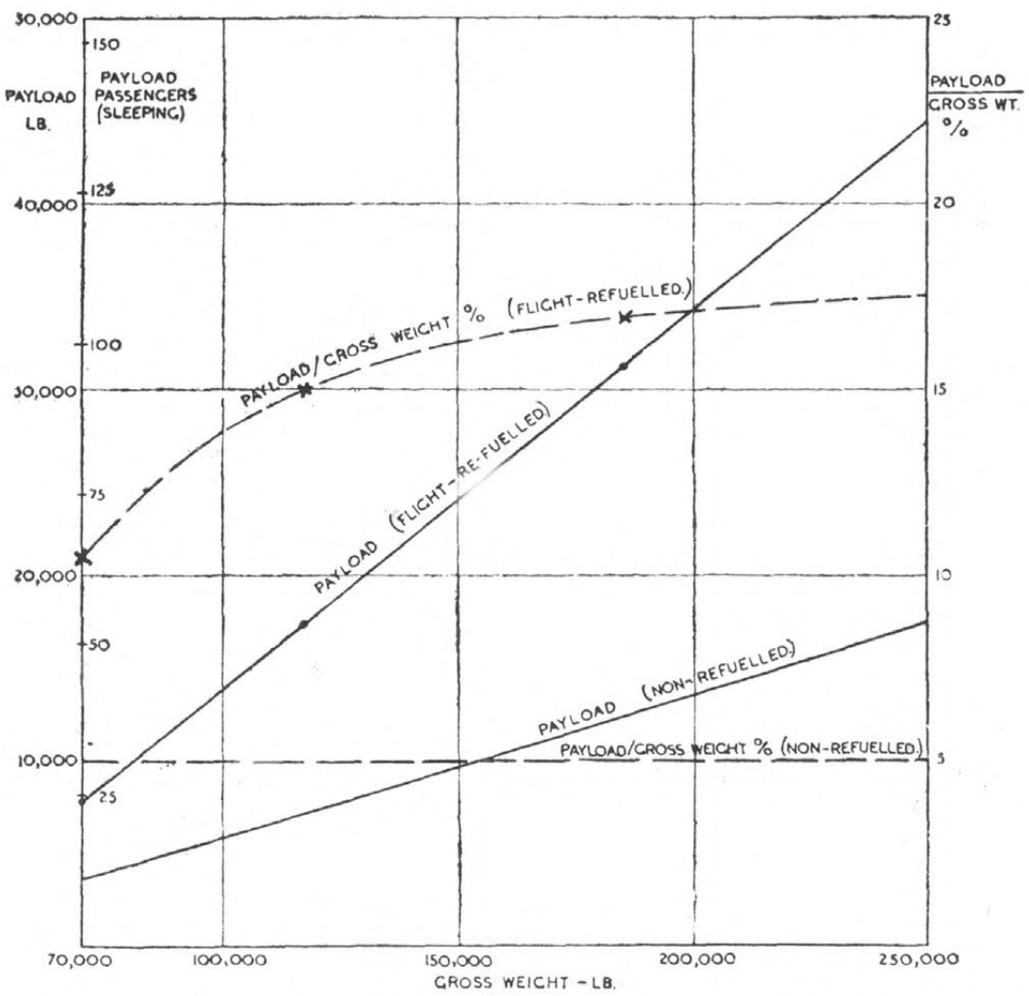


Fig. 5. Passenger payloads carried by flight-refuelled and non-refuelled airliners

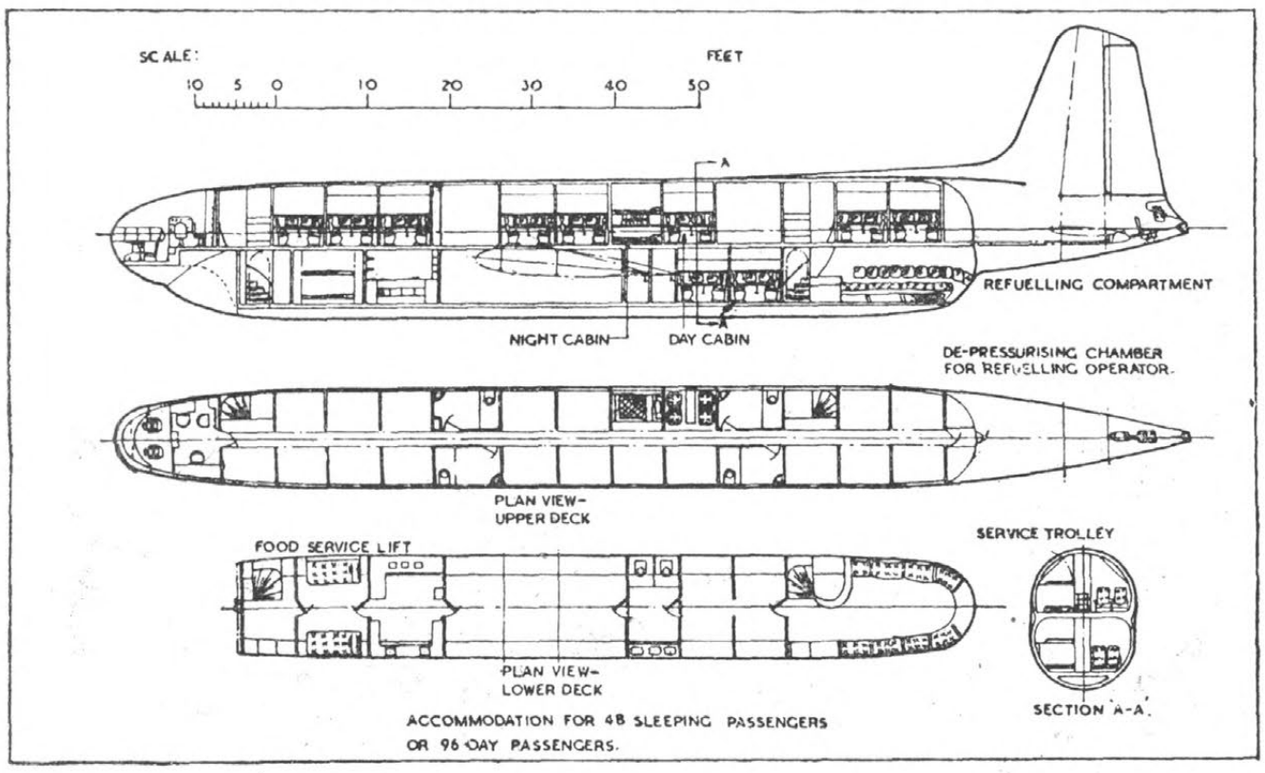


Fig. 3. F.R.11 cabin layout : 50 sleeping or 100 day passengers. Six R.-R. RM.14 SM engines. Gross weight 117,000 lb.

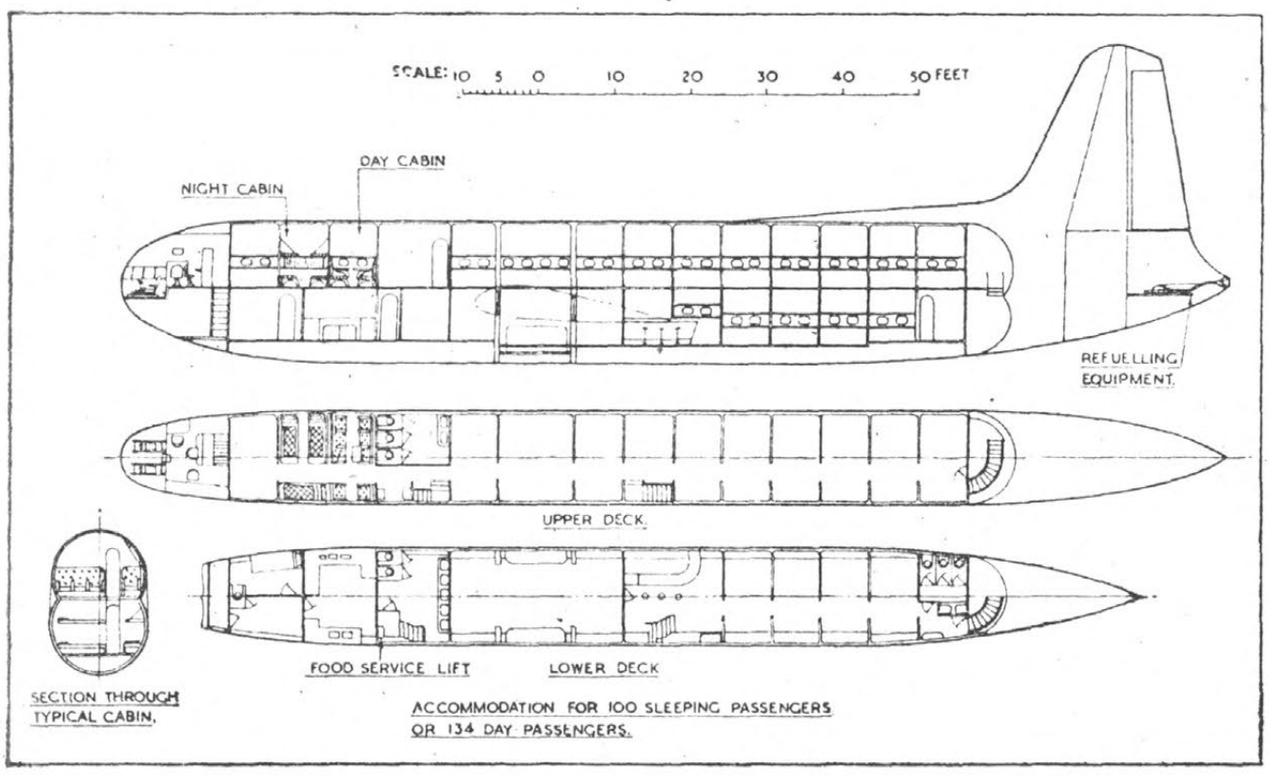


Fig. 4. F.R.12 layout : 100 sleeping or 134 day passengers. Six Centaurus 57 engines. Gross weight 185,200 lb.

tankers (see *Flight* of August 30th, 1945). The purpose for which they were required called for a cargo tank capacity of 1,200 gallons, and this is carried in two tanks housed in the forward part of the bomb compartment.

The large airliner considered in these notes, the F.R.12, requires a maximum amount of fuel of 2,925 gallons for the refuelling east of Gander, when the airliner is flying eastward, and the cargo tank capacity should therefore be not less than 3,000 gallons. An analysis of tanker fuel requirements is summarised in the table below.

The consumable fuel carried by the tanker at take-off is a maximum of 1,320 gallons for the Rineanna operation, and this is well within the capacity of the Lancaster (normal fuel tank capacity 2,154 gallons). It should be noted that the consumable fuel, and hence total tanker fuel, could be reduced if the refuelling takes place over the tanker's base instead of at the "optimum" point, as described.

The maximum total tanker fuel load is seen to be 29,010 lb., and this gives a weight schedule for the Lancaster tanker as follows:—

Lancaster tanker, tare	34,500 lb.
Cargo tanks (3,000 galls.)	1,530 lb.
Flight-refuelling equipment ..	900 lb.
Oil (full 140 galls.)	1,260 lb.
Crew, 4 at 200 lb.	800 lb.
Total fuel	29,010 lb.
Gross weight	68,000 lb.

The Lancaster tanker is at present fitted up with two tanks in the bomb bay with a cargo fuel capacity of 1,200 gallons. A third tank of 600 gallons capacity can also be accommodated in the bomb bay, and these three containers, together with the two inboard wing tanks, give the desired total cargo fuel capacity of 3,000 gallons. The four remaining wing tanks give the Lancaster the fuel range that is required for these tanker services. The total weight of the Lancaster tanker with these quantities of fuel is within the maximum permissible take-off weight, and thus it is seen that no

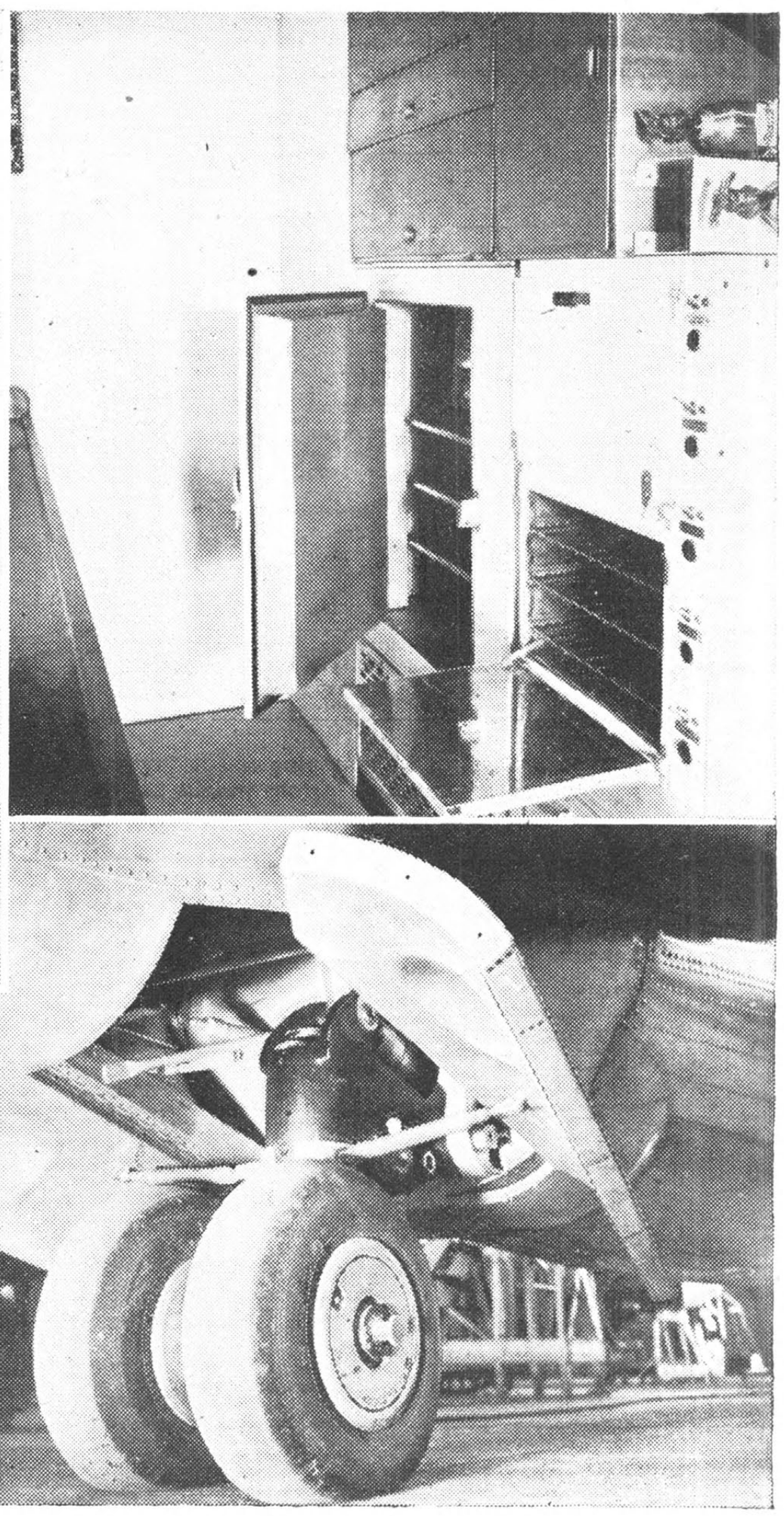
REFUELLING IN FLIGHT

difficulty is likely to be experienced in the provision of tanker aircraft for the next few years.

These notes have been written in an attempt to show, beyond all doubt, that refuelling in flight is not a palliative for certain weak features that may exist in present-day aircraft, nor may it be regarded as being anything in the nature of a "stunt." It is undeniably a sound fundamental principle that passengers, or goods, cannot be transported economically over long distances if, at the same time, vast quantities of fuel are also to be carried. The essence of flight is speed, while the unavoidable cost of speed is high fuel consumption, and until fuel, other than petrol and the like, weighing $7\frac{1}{4}$ lb. per gallon, can be produced, the payload of aircraft cannot comprise more than a negligible proportion of the all-up weight of a long-distance aircraft. The answer to the problem is simple: the fuel must be taken on board at convenient intervals. The mechanical difficulties have been demonstrably solved; the economics are indisputable, and the materials are at hand waiting to be employed.

It has been shown that the costs of flight refuelling are negligible when viewed in their proper perspective, and the scales are weighted still more heavily in favour of flight refuelling by the economies effected by so many by-products, the values of which are very real but difficult to evaluate. Several of the most important features have been dealt with in this study and include such items as assisted take-off, with its accompanying diminution of risks; saving of aerodrome space and reduction of wear and tear of engine and aircraft; the saving again of wear and tear of engine and undercarriages, by virtue of each landing rendered unnecessary by refuelling in the air, together with the elimination of landing risks, and the saving of time or increase in overall speed; the avoidance of premature landings due to shortage of fuel; the operational flexibility of aircraft conferred by the unlimited extension of range; the equalisation of payload over all stages; and the defeat of the adverse effects of wind on out-and-return payload.

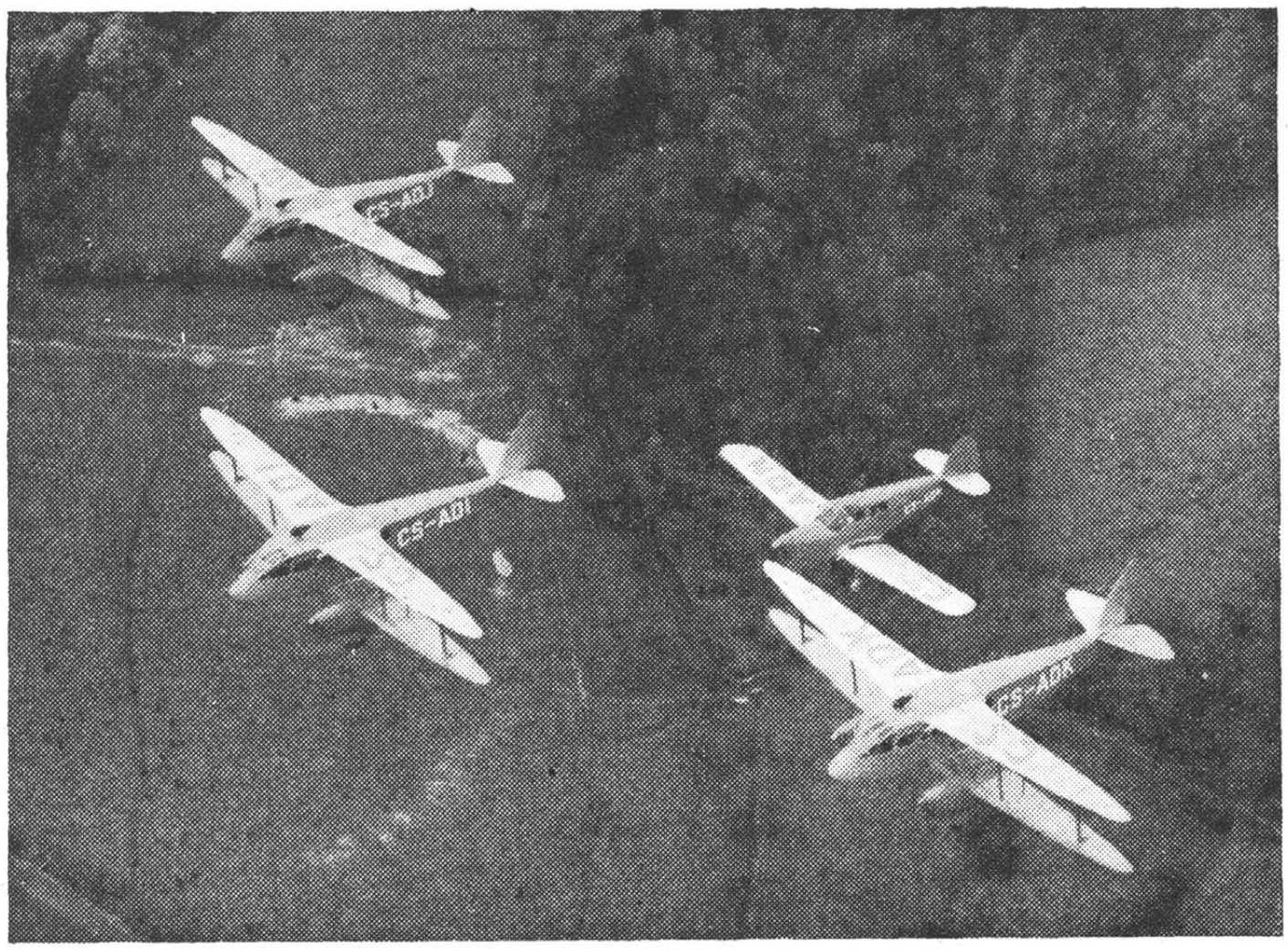
Finally, it should be mentioned that the war has left us with a great paucity of civil airliners, but with an abundance of redundant bombers which can be readily converted to excellent tanker aircraft. Here there is a golden opportunity of solving our immediate problem, and, in doing so, to lay the sure foundations for the future of British long-range civil airlines.



AVRO TUDOR I INSTALLATIONS

(Above) Two views of the galley looking forward. The refrigerator, by Frigidaire Ltd., has a capacity of $5\frac{3}{4}$ cu. ft. and weighs less than 130 lb. Both the grill boiler and hot cupboard are made by G.E.C. and operate from the aircraft's 24-volt D.C. supply. The Jackson electric urn has a half-gallon capacity, which is supplied from two ten-gallon water tanks under the fuselage floor. (Right) The Tudor tail wheel unit is designed and built by Dowty Equipment Ltd. It is fully retractable and the mechanical linkage for closing the doors behind the wheels can be seen in the photograph.

CIVIL AVIATION NEWS



MAKING AN EXPORT START: The three D.H. Rapides and one Percival Proctor which have been purchased by the Portuguese operating company C.T.A. and were flown out to Lisbon a fortnight ago. These are probably the first civil-registered aircraft to be sold by ordinary commercial contract since the start of the war.

THE SPRINGBOK SERVICE

IN *Flight* of November 8th it was announced that B.O.A.C. and South African Airways were reopening the service between this country and Johannesburg. The first York, which left Hurn on November 10, reached Johannesburg 68 hours later. The reverse service from Johannesburg completed the run in 63 hours.

It may be remembered that the through South African air mail and passenger service was first opened in 1931 and ran without interruption until June, 1940, when Italy entered the war and the Mediterranean was closed. In the immediately pre-war years Short Empire boats were used for the whole run, using Durban, where the traffic was taken over by the South African Airways, as the African terminal. Some of the Short boats are still being used on the "Horseshoe" route between Durban and Karachi.

STOCKHOLM-U.S.

THE first transport flight between Sweden and Canada was completed last month when an aircraft of the Swedish Inter-Continental Air Lines section of A.B. Aerotransport landed at Montreal on October 11. The aircraft, a converted B-17 Flying Fortress, was one of a number which made forced landings in Sweden after U.S. bomber raids on Germany.

Since early June, Sweden has been operating two converted Fortresses on six services a month each way between Stockholm and New York, via Iceland and Mingen, Quebec. In due course, when A.B.A. is equipped with Douglas C-54 Skymasters, the service will, writes a Montreal correspondent, be operated daily.

Meanwhile, in Europe, A.B.A. are now operating ten services, using a fleet of eight Douglas DC-3s, five Ju-52s and three converted Boeing B-19 Fortresses—apart from the two Boeings at present being used on the Atlantic service. The longest regular runs made are those between Stockholm and Paris (four times weekly), Geneva and Prague (each once weekly) and London and Croydon (four times weekly). In the first half of 1945 A.B.A. carried 25,586 passengers, in comparison with the 10,165 carried in the second half of 1944. Although the services are naturally used mainly by V.I.P.s, quite a few seats are available for ordinary travellers. The London office of A.B. Aerotransport (Swedish Air Lines) is now at 57, Grosvenor Street, London, W.1 (Mayfair 2064/5).

P.I.C.A.O. IN ACTION

AFTER completing the necessary preparatory work, the Provisional International Civil Aviation Organisation has now started to function as a fully-fledged concern. It came officially into being on June 6th, 1945, after the acceptance, by twenty-six nations, of the Interim Agreement at the Chicago Conference, which provided for the setting up of such an organisation to deal in detail with international regulations and to continue the work of the conference. Headquarters have been established at Montreal.

The principal business of the second conference was that of making definite decisions on the suggestions of the various committees and sub-committees. For instance, the committee on air transport has been gathering general data on such subjects as subsidies and operating costs, while a committee on air navigation has taken over the work of formulating and recommending standards and practices covering technical aspects such as load limitations, qualifications, measuring unit standardisation, and rescue organisation.

Mr. A. C. Campbell Orde, of B.O.A.C., has, incidentally, been recently elected chairman of the technical committee of the International Air Transport Association.

TRADE BEGINNINGS

THE Portuguese operating company, Companhia de Transportes Aereos (C.T.A.), has recently purchased three D.H. Rapides and one Percival Proctor, and these aircraft have been flown out from this country by Portuguese airline pilots. These four are probably the first civil registered machines to be sold by commercial contract and to be exported since the beginning of the European war.

The company is based at Lisbon, and the first route to be opened will be that to Oporto, carrying passengers, freight and newspapers. As and when other airfields become available in Portugal, a network of internal airlines will be built up, and it is hoped that there may even be international extensions in due course. The company's technical director will be remembered by those in aviation in pre-war days—Senor Carlos Bleck, who was the D.H. representative in Portugal for many years.

ARGENTINIAN SUNDERLANDS

THE first of the Sunderland fleet purchased by Compania Argentina de Navegacion Dodero, S.A., was due to leave Poole for the Argentine early this week. The route to be followed, as already stated in *Flight*, will be Lisbon, Bathurst, Natal, Rio de Janeiro and Buenos Aires.

This first boat was christened *Argentina* by Senora Dodero at Belfast on November 1. The second boat is to be named *Uruguay*.

Both these boats have 45 seats, and a high state of passenger comfort for short domestic journeys has been provided. The third and fourth boats will have fewer seats for conversion into sleeping berths.

For his operations, Senor Dodero has engaged fifteen ex-R.A.F. crews on a temporary basis, after which Argentine-born trainees are to be recruited. It is surprising to know that there are more than three hundred such aircrews in the R.A.F., so that there should be plenty of experience available. B.O.A.C. are training the first group of crews, who will go out to the Argentine at the end of the year, and they are also "lending" their despatch and route arrangements to cover the delivery flights.

The deliveries themselves and the crew arrangements are, as already recorded, the responsibility of Air Cdre. G. Powell, whose newly formed company, British Aviation Services, Ltd., is acting as general agent for the Dodero Company. Capt. Dudley Travers has been loaned by B.O.A.C. for the first delivery, and Air Cdre. Powell himself will be taking one of the later boats.

From the Australian Viewpoint

Mr. Hudson Fysh Delivers the First Commonwealth and Empire Lecture to the R.Ae.S. : Need for World Co-operation in Air Transport : The History of Australian Services

BECAUSE the text itself was so considerable in its scope and would, if read in entirety, have involved the listeners in an all-night session in the lecture hall, Mr. W. Hudson Fysh, D.F.C., the managing director of Qantas Empire Airways, gave only a brief summary of his lecture on "Australia in Empire Air Transport." He dealt with the general air transport situation in Australia and elsewhere, and then continued, with the help of lantern slides, to a summary of the history of Australian air transport. The lecture was the first of the new Commonwealth and Empire series to be delivered and was, therefore, of special interest.

In the printed version of his paper Mr. Hudson Fysh dealt first of all, and at length, with the history of human communications, leading on to early efforts at air-mail delivery, and describing in comparative detail the pioneer work in Australia. More recent Australian air history started with Sir Ross Smith's flight in a Vickers Vimy, in a matter of twenty-eight days, from Hounslow to Darwin, and, in some ways, the even more outstanding flight by Capt. (now Air Vice-Marshal) Wrigley and Lt. (now Air Commodore) Murphy in a B.E. 2E across Australia to meet the Vimy at Darwin.

As a consequence of these flights Mr. Hudson Fysh and Lt. McGinnis were asked to survey by car a route across Australia. In 1920 these two pioneers, with Mr. Fergus McMaster, started Queensland and Northern Territories Aerial Services (Qantas) as a joy-flying and taxi concern using surplus Avros. In the same way West Australian Airways was formed by Major Norman Brearley, a concern which later started the first subsidised service between Geraldton and Darby—to be extended eventually to a run from Perth to Adelaide. A little later, in 1922, Qantas obtained a subsidy for a service between Charleville and Cloncurry, using A.W. F.K.8s and a D.H.4, and doing the journey in two stages. The difficulty then was to find an aircraft which could fly satisfactorily in the hot, thin air and which would provide the passengers with something resembling comfort.

Passenger Comfort

The first successful aircraft to improve on the "cap and goggle" passenger arrangements was the D.H.50, and Qantas later converted this type for use with a Bristol Jupiter, which greatly improved its performance. Later still, the D.H. 61 arrived, with a lavatory and an "aisle" for the eight passengers. Progress was being made. More modern still were the Vickers Viastra used by West Australian Airways and the Avro Tens used by the original Australian National Airways, which was founded by the late Sir Charles Kingsford Smith, but was later liquidated and re-formed by Holymans and other shipping interests. Guinea Airways showed what could be done in carrying heavy and useful loads over the wildest country.

Australian National Airways, using American aircraft, eventually provided new standards in passenger comfort and a high degree of "utilisation"—round which revolves the whole economy of airline operation. Under the impetus of war, the Qantas Short Empire boats were eventually flying 2,500 hours a year, but even this figure did not match that obtained from the American types.

After describing the internal airline development and the pioneering side of the Empire services, Mr. Hudson Fysh continues in his paper to deal with the genesis of these services in relation to Australia and to show the events which led up to the Empire Air Mail Scheme and to the combined operations of Imperial Airways and the new Qantas Empire Airways. In the through service, Qantas took over from B.O.A.C.—or Imperial Airways—at Singapore, using D.H.86 aircraft for this difficult section until they took delivery of Short Empire boats. After Tasman Empire Airways had been formed in 1940 two of these boats carried on with the Sydney-Auckland service throughout the war and during the period when sea-borne transport was almost non-existent.

SOME JOURNEY TIMES

. . . and a dip into the future

1830	London—Edinburgh ...	Mail coach (399 miles)	42½ hr.
1870	London—Melbourne...	Clipper sailing ship	70-90 days
1910	London—Melbourne...	Steamship ...	30 days
1945	London—Sydney ...	Avro Lancastrian service ...	62 hr.

"That the future lies in the utilisation of the gas turbine, jet, the rocket and even newer sources of propulsion is certain . . . some form of ballistics will be the order of the day."

Fortunately an engine-overhaul workshop had been established at Sydney, otherwise there would have been great difficulties in re-planning the operation of the Empire route after the outbreak of war. B.O.A.C. were then very short of flying staff and maintenance facilities east of the broken Mediterranean link, and Qantas carried through to Karachi until the Japanese war started. Thereafter Qantas paid the price of war in the loss of nearly all their boats, directly or indirectly as a result of enemy action. The Australian civil airline pilots and operators did tremendous work during the period when the Japanese were nearing the shores of Australia.

Indian Ocean Epic

Very little has ever been written about the Indian Ocean service between Ceylon and Perth during the days when Japan held the East Indies. Mr. Hudson Fysh described the operation of the Catalinas—assisted later by a couple of Liberators—over this 3,513-mile crossing. For it the Catalinas were loaded up to a figure more than 8,000 lb. greater than their normal all-up weight of 27,000 lb., yet an average payload of 1,000 lb. was carried. Radio silence had, of course, to be maintained and the meteorological situation was specially involved since sea and rough air conditions had to be correctly predicted for that part of the run during which the Catalinas were heavily overloaded. A special technique of take-off was perfected by the pilots, and extreme range was obtained by progressively reducing the power while maintaining a constant air speed as the aircraft became lighter. Three or four trips were also made to the Cocos Islands. This flight, without radio aid, demanded the utmost accuracy in D/R and astronomical navigation. The Catalina-Liberator service formed a fitting prelude to the regular Lancastrian service which was started this summer.

The Chicago Conference, in Mr. Hudson Fysh's view, did splendid work in laying the foundations of agreement on technical matters and, even if it did leave questions of international operation much "in the air," it allowed a vital ventilation of views based on the famous Five Freedoms. Out of this conference came the Provisional International Civil Aviation Organisation (P.I.C.A.O.), charged with a continuance of the work of the conference,

FROM THE AUSTRALIAN VIEWPOINT

while the old International Air Transport Association (I.A.T.A.) was revived as an operators' forum, with the Commonwealth Air Transport Council (C.A.T.C.) and Commonwealth Air Transport Operators' Committee (C.A.T.O.C.) to deal with our own Empire problems. These four organisations, and the numerous sub-committees concerned, have made a good start. As Mr. Hudson Fysh remarks, it is better to keep people talking than fighting.

Every one of these new organisations carries a tremendous responsibility. People can no longer stand alone and to help in the work of co-operation it is essential that the Empire shall be kept going as a unit. The need for this co-operation is particularly pressing in air transport. Australia will play her part with those on whom will fall the task of working out an international plan. The ideal was the establishment of an international air transport authority which would be responsible for the operation of air services on prescribed international trunk routes and which would own the aircraft and equipment employed, while leaving each nation free to handle its own internal transport.

In Mr. Hudson Fysh's opinion the furthest point to which this Utopian ideal can be taken will decide the span of future world peace. You cannot have international control without international operation. Mankind will only become friendly over a lasting period when bound together by a single economic organisation which provides an equal economic standard for all.

TWO NEW "ORDERS"

For passengers travelling by Catalina from Ceylon to Perth—average time, 27 hours: "The Rare and Secret Order of the Double Sunrise."

For passengers on Liberator Kangaroo service over the same route—average time 17 hours: "The Order of the Longest Hop."

Australian air transport development is at an interesting stage. After the pioneer period Australia is now challenged by lack of population and wealth—in fact, by under-industrialisation. The post-war level of air traffic depends on the level of prosperity, and a post-war plan of internal operation had been provisionally devised to provide for maximum "utilisation" and economical operation. For this scheme it was estimated that 28 aircraft, each flying 3,600 hours a year, will be necessary, with another 28 aircraft to deal with feeder-line and charter services. The Vickers Viking appears to have the correct characteristics for the regular services, with the addition of a special freighter type and something on the lines of the D.H. Dove for the branch lines. To Australia will also go the work of developing the services to local overseas territories. For the Australia to New Zealand service the most suitable type to be envisaged at present is the Avro Tudor II or Handley-Page Hermes, though Mr. Hudson Fysh considers that flying boats would be ideal if comparable in economy and cruising speed. Outside the Australasian area air transport would be a matter for Commonwealth co-operation, with the United States coming into the picture on the Pacific side.

There is, he thinks, a distinctly useful market in Australia for a private-owner type of aircraft which is both practical and as nearly fool-proof as possible. Where transport types are concerned, though the Empire must naturally endeavour to use her own aircraft, Australia will be wise to concentrate on a limited number of types and even to import aircraft where necessary. Since the greatest chances of future air transport are in operations between large centres of population, Mr. Hudson Fysh is not sure that Australia is quite such a good field for aviation as it is generally considered to be. Though aircraft are a vital transport need when a comparatively few people are spread over vast and uneconomic spaces, their operation may not necessarily be such a paying proposition as in the case of operation between thickly populated centres.

Australia wants to take her place as a unit of our Empire and in the world councils in order to share in the shaping of the evolution of a transport system which means so much to the future of civilisation.

POINTS FROM THE PAPER

During the siege of Paris in 1870, 66 balloons left the capital with 66 aircrew, 102 passengers, 409 carrier pigeons and 9 tons of mail.

During 1940 a total of 380,121 passengers used the inter-city air services of the United States.

No spot on earth is more than 60 hours from your local airport.

"I have seen a Gipsy Moth come in for repairs with dog chains for centre section wires and an iron bedrail wired along a broken wing spar."

Aircraft for the Pacific route will probably be either the Canadian-built D.C.4 with Merlin engines or the Tudor II.

"GOD IS MY CO-PILOT"

YEARS of cinema-going, mostly in the capacity of professional critic, teach one not to take too much notice of film titles. Most of us, no doubt, can think of many a film which turned out to be far better than its ill-chosen label led us to expect. So I went to see "God Is My Co-Pilot" quite undismayed by this sanctimonious tag; it would, I assured myself, no doubt turn out to be just another of those curiously inapt titles which somebody in Hollywood imagined would help to give the girl in the box office a busy life. How wrong I was!

Religion is a very difficult matter to handle on the screen; it needs a complete understanding of the subject and the characters to which it is applied, and a skill approaching genius in its application. In this film it has received neither, and the result is a mawkish sentimentality which, at best, is not in very good taste. The trouble, I suspect, is that the film has probably been made by persons who, comfortably remote from the grim realities of war, have only met the fighting man on leave with his family; they know nothing of the canteen or the crew-room.

Fighter pilots may often have secret misgivings about wholesale killings and the effect on their souls, but they do not talk about it—not even American pilots! In any case, I cannot imagine a less suitable moment for a parson to recite pretentious verse over a pilot's shoulder than when the latter is busy dodging mountain peaks in a blinding rain-storm. And when this rhyming appeal to the Almighty produces a miracle of clear visibility like a rabbit out of a hat, it almost borders on blasphemy. If the parson had greeted the fortuitous sunshine with a "Hey-presto" I should not have been surprised.

The story, which matters very little, is about a U.S.A.A.F pilot who swops his Skytrain for a P-40 with the Flying Tigers in China (the said P-40 changing from an Allison-engined model to a Merlin-engined type during a take-off, which was lucky for him, at that!). But most of the flying scenes are very well done and quite exciting. Nevertheless, I find it a bit difficult to imagine American pilots and their Jap adversaries indulging in wisecracks, even of the unfriendly kind, over the R/T during a dogfight. The shooting-up of a Jap convoy on the Burma road is realistically thrilling, and another excellent shot is a belly-landing by a wounded P-40 pilot, followed, unfortunately, by one of those death-bed scenes which just never happen on active service. No, this is not one of Warner Brothers' best efforts.

N. D. R.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

NORTH PACIFIC ECONOMICS

Oblique Mercators and Polar Gnomonics

CONGRATULATIONS to Mr. E. T. House for his article in *Flight,* November 8th. Now that the Air Age is here and that this Air Age has "altered the shape of the earth," it is refreshing to see one more convert to the theory that the earth is round.

It is a pity, however, that Mr. House has not considered that a route from Singapore to New York is desirable. His early illustrations of Polar Gnomonics can be shown. These are far better than Oblique Mercators in that they "look more reasonable." I feel sure that potential traffic on this route is heavy, for it would tap centres of population a little more important than Okhotsk and Markovo.

A. C. LORAINE.

CAMPAIGN AWARDS

Flying Instructors are Rarely Rewarded

IN view of repeated assertions that instructors have received honours in proportion to their exertions (*Flight,* November 1st, W/O Wakeford), we should like to state categorically that the receipt of any decoration is the exception rather than the rule.

Although certain fortunate C.F.I.s got well-deserved awards in a matter of months, and after a few hundred hours' instructional duties at most, the vast majority of junior instructors strove for as much as three years and put in thousands of instructional hours without any recognition.

They are now democratically gouged to the same scale as the undecimated "ground types" (though many of these latter warriors sport the M.I.D. and/or O.B.E.).

TWO EX-INSTRUCTORS.

AIRCRAFT ENGINEERS

Varied Demands of War and Peace

QUOTATION of a resolution passed at a meeting of the Aeronautical Engineers' Association and published in *Flight,* November 8th, seems to me deserving of more comment.

The resolution apparently "condemns most vigorously the policy of the Air Ministry in accepting the principle that only pre-war 1939 apprentice-trained men are skilled aircraft-maintenance engineers." On the surface, this would appear to be a very unfair policy—if true—and in actual fact I think there does exist, unfortunately, quite a bit of "feeling" on the matter between the pre-1939s and the post-1939s.

The crux of the problem seems to lie in the definition of a "skilled maintenance engineer." In most trades it is understood that if a man is classed as skilled he must have reached a certain predetermined standard of workmanship and ability, and is entitled to be paid accordingly. In aircraft maintenance, however, another factor looms up, a very major factor—that of the responsibility of the engineer for the airworthiness of the aircraft—and, in consequence, for the safety of passengers and crew.

It is possibly upon this factor that the split in outlook occurs.

Nobody who has worked on aircraft both before and during the war can have failed to notice, with "half an eye," that the standard of safety on the maintenance side has been lamentably lowered. This was undoubtedly a wartime expedient when the essential factor was a compromise between time, speed of operation, and airworthiness.

In peacetime conditions, however, the accent has to be—and absolutely rightly—on safety, first, last and all the time. The old motto used to be, "If in doubt, *don't* let it go." The wartime cry appears to have been, "If in doubt, let it go!" Well, this type of school could hardly be described as the best ground for training peacetime maintenance engineers.

As everyone knows, a whole host of regulations exist covering the safety and maintenance requirements for civil aircraft, and great stress was laid by the A.R.B. before the war—and, no doubt, still is—on a sound working knowledge of these regulations before a G.E.'s licence was issued, and the oral examinations held then were as much a searching test of an engineer's sense of responsibility as anything.

The practice of these safety regulations and the knowledge of what is and is not "permissible" can only come with experience of the maintenance and operation of aircraft under civil conditions.

As regards actual engineering skill, given natural ability and keenness, four or five years in the trade is quite long enough to have resulted in a very large number of maintenance men appearing on the market as genuinely skilled aircraft engineers.

One of the most skilled men in sheer craftsmanship and technical ability that I ever met was a pre-1939 carpenter directed into aircraft in 1940, and I knew him in 1942! If the older type of G.E. feels that he has got "something the others haven't got," he certainly has in the shape of a nearly thorough grounding in basic aircraft-engine practice and rigging. Also he can nearly always turn his hand efficiently to the 101 odd jobs that fell to the lot of a club G.E. before the war, such as a compass to be swung here, a bit of welding to be done there. The more recent type of G.E. is right up to date on aircraft development—a specialist, brought up on boost and hydraulics.

I have noticed a tendency in conversation among war-trained men to dismiss the pre-war G.E. as being almost antediluvian and incapable of recognising one end of a Halifax from the other, but I also know many wartime engineers who would look pretty silly in front of a Tiger Moth.

In future aviation surely there will be room for the experience of both types, as, obviously, heavy aircraft will require more and more specialised maintenance, while the "light stuff" operators will still need a more versatile type of engineer.

PATRICIA PARKER.

[Although we are not prepared to comment on the relative skill and experience of pre- and post-1939-trained engineers, we do not think that our correspondent is fair in the suggestion that a "when in doubt let it go" attitude was prevalent in war conditions. Production aircraft were necessarily less well-made, but the testing and final checks were as thorough as they have ever been and the same conditions obtained when the aircraft reached the A.S.U.s.—ED.]

THRUST AND GROUND SPEED

Jet's Advantage When Taxying

YOUR "Tyro" correspondent (*Flight,* November 1st) raises an interesting question. I am afraid, however, that his argument is fallacious

All aircraft propulsion systems obtain their thrust from the reaction to a change of momentum in the working fluid, which in the cases of the airscrew and the gas turbine jet propulsion unit (which I presume "Tyro" had in mind) is air.

The means by which the change of momentum is brought about is relatively unimportant. Suffice it to say that an accelerating force is applied to the air to bring about an increase in momentum. The reaction to this force is made available in the form of forward thrust. In the case of the airscrew no great change in the physical condition of the air takes place, whereas the gas turbine increases the air temperature considerably.

Since air is necessary to the working of a turbo-jet engine, such a unit will not function in a vacuum. A rocket-propulsion unit will do this, as it carries all the necessary ingredients (including oxygen) for the manufacture of its own propulsive gases, and is entirely independent of the surrounding atmosphere. Such a unit obtains its thrust in basically the same manner, i.e., by imparting a momentum to a quantity of gas evolved within the unit.

Now let us examine "Tyro's" question. Does a headwind have the same effect on a jet-propelled aircraft as upon one driven by an airscrew?

Imagine two aerodynamically similar aircraft, one being powered by a turbo-jet engine, the other by a normal engine-cum-airscrew combination. For a given flight condition in still air, the same power output will give the same thrust, and therefore the same airspeed in both instances. Now should a headwind be blowing, with otherwise similar conditions, airspeeds will still be equal, and ground speed will be reduced by the value of the wind speed.

Should the aircraft be stationary or taxying into wind, though, it would appear that the turbo-jet has a slight advantage over the airscrew. The air will enter the intakes at a higher velocity when a wind is blowing, and this may have a beneficial effect on compressor efficiency, and therefore on

CORRESPONDENCE

fuel consumption for a given thrust. In the case of the airscrew no such effect will occur, the airscrew providing the same change of momentum and the same thrust as before.

The magnitude of the efficiency-increase in the turbo-jet will probably depend on the intake ducting. Having never seen any relevant data I cannot say; perhaps others may like to express an opinion.

R. E. T. HACK.

A Fundamental Principle Involved

AS another non-technician, I have read with interest the argument put forward by your correspondent "Tyro" (*Flight*, November 1st) that since the forward movement of a jet-propelled aircraft is due to pure reaction, a headwind would not have the same effect on ground speed as in the case of an aircraft driven by an airscrew.

It appears to me that the fallacy in this argument lies in the fact that "Tyro" has ignored the fundamental principle that for a state of equilibrium thrust must be equal to drag. Consider a jet-propelled aircraft travelling in still air, both groundspeed and airspeed being 400 m.p.h. By some magic a 40 m.p.h. headwind suddenly springs up, increasing the airspeed to 440 m.p.h. This immediately increases drag by exactly the same amount as in the case of a conventional aircraft, and to maintain the new airspeed (which must be done to avoid reducing groundspeed) a corresponding increase in thrust is required. If more thrust is not provided airspeed must fall to the original figure of 400 m.p.h. so as to reduce the drag to its former value of parity with thrust, and groundspeed becomes 360 m.p.h. just as if an engine and airscrew had been the means of turning the energy of the fuel into propulsive effort.

It would have been as reasonable to suggest that the speed of a bullet (which, like the "jet," is not provided with an airscrew) would be unaffected whether the projectile was travelling against a headwind, in still air, or even *in vacuo*. Without the least knowledge of ballistics it seems obvious to me that the increased drag involved by a higher muzzle velocity *relative to the air* would cause the bullet to lose groundspeed more quickly and fall to earth in a shorter distance. Apart from the fact that a bullet derives its motion from a momentary reaction of burning gases and is thus subject to continuous deceleration, whereas a jet- or rocket-propelled aircraft in flight is in a state of equilibrium, there is no difference between the two cases.

LINDSAY R. GLEGG.

Ingenious but Fallacious Argument

I'M afraid that "Tyro" has fallen into the old trap and confused air speed and ground speed, though I admit that he has done it quite ingeniously! I should like to try to put his mind at rest.

Let us consider the case of two similar aircraft, one orthodox and one reaction-propelled, having the same weight and the same lift and drag characteristics.

When the effort needed to drag an aircraft through the air is the same as the thrust developed by the propelling agent, the aircraft is in equilibrium (as far as its speed in level flight is concerned) and the air speed will remain steady. If the thrust increases, the air speed will remain until the drag of the airframe and aerofoils once more exactly equals the thrust, and the air speed remains steady at a higher figure. Therefore, if both our hypothetical aircraft are being driven by a thrust of 2,000 lb., they will both attain an air speed such that the drag of their airframes is equal to 2,000 lb., and since we have chosen two aerodynamically similar aircraft, they will attain the same air speed. If we now subject them to a head wind, their ground speeds will be reduced equally. Obviously, to have the same ground speed, they must have the same air speed. If the jet aircraft had a greater ground speed (and therefore a greater air speed) we should be getting something for nothing because the drag of the aircraft would have risen with the increased air speed without any increase of thrust.

The fallacy of "Tyro's" statement that the orthodox aircraft is "slowed down" because it has to claw its way into a head wind is shown by the logical extension of that argument, which would hold that its air speed would increase in a tail wind.

And is it reasonable, "Tyro," that two aircraft flying in a beam wind could have the same air speed and drift and that their ground speeds would differ if they altered course into wind? If that were so, our two aircraft under discussion might fly from Manchester to London in formation, but arrive at different times!

D. J. MASTERS, Flt. Lt.

LONG-RANGE ROCKETS

Square-cube Law and Acceleration

IT is refreshing to be able at last to see authentic details of the V.2 in print (*Flight*, November 8th), but the calculations of Mr. Perring with regard to winged rockets appear very far-fetched. He seems to take little account of the tremendous stresses involved in fitting wings to a rocket, or of the stability problems which arise in considering vertical flight with wings. The gliding angle of the "New York rocket," 1 in 80, is ridiculous, and it is noticeable that the other projects have much steeper flights downward.

On the other hand, he seems unduly pessimistic about the range of the ordinary V.2 with boosters. It seems to me reasonable to take it that boosters can be designed up to a weight of about 90 tons with a similar proportion of structure weight, fuel weight and "payload." But the weights of the engine and accessories will be much less, thus offsetting the weight of the parts carrying the V.2 inside. Owing to the square-cube law drag will go down to less than half the value for the V.2, so that a steady acceleration to about 4,500 m.p.h. at a height of 38 miles is possible.

From here the V.2 takes over in almost dragless conditions and reaches a final velocity of rather over 9,000 m.p.h., 150 miles along its flight path at an altitude of 133 miles, pointing at 45 degrees to the vertical for maximum range, and touching ground 1,050 miles from starting point, allowing for drag on entering the lower atmosphere. If the 2,150 lb. warhead is replaced by a 400 lb. atom bomb and its apparatus and the remainder made up with fuel, the initial speed goes up to nearly 10,500 m.p.h., and the range to 1,450 miles.

It is worth noting that, with the high α now achieved, the reason for the great change in range corresponding to a small change in α lies more in the reduction of load carried than in the increase of the acceleration period. Above all the range varies as the square of the maximum speed.

Perhaps some reader will explain the effect of the earth's curvation on range as I am not sure how great this is. Account must, of course, be taken of centrifugal force.

I. G. HENRY.

ECONOMICS OR EXTRAVAGANCE?

What to Do With Surplus Parachutes

CERTAIN sections of the tax-paying community are beginning to feel very concerned about the disposal of Government surplus equipment, judging by remarks made by the public at large and some of your correspondents in particular. Not an unnatural instinct to display, is it? From an aeronautical aspect it is especially provoking to visualise the loss of equipment to private and club flying which could actually constitute a better and cheaper form of subsidy than perhaps the Ministries realise. As has been proved by "Indicator" and others, this country reaped a dividend from the efforts of amateur aviators in this last war out of all proportion to the meagre benefits so generously (?) distributed in earlier days.

Will history repeat itself?

I do not intend to pursue the ramifications of this theme *ad lib.* for obvious reasons. Rather would I attempt to draw attention to one small but important feature I would consider worth driving for in any debate involving equipment disposal.

The inconsistency of our law demands mechanically perfect aircraft on the grounds of safety, but does not compel the addition of a parachute. I am not suggesting it *should* become compulsory, but I do think it should be *encouraged*. It seems probable that amongst the different Services there must be a considerable number of serviceable but redundant parachutes.

An effort should be made, therefore, to earmark a quantity of these, NOT for manufacture into ladies' "wotnots," etc., but for *free distribution* to the light aeroplane and soaring clubs.

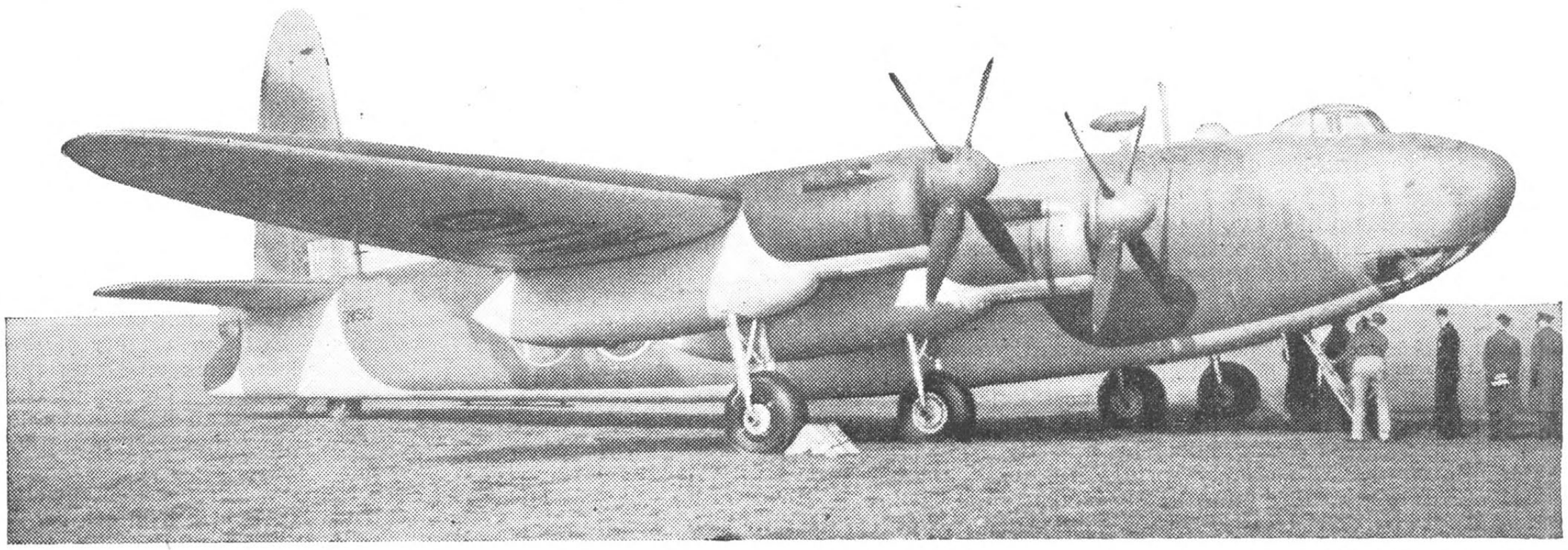
The majority of these clubs could not afford to buy such necessities before the war, and are hardly likely to change now. Hence the manufacturers will not lose any customers, and it would be a fine gesture of mutual confidence if the Ministries involved were to adopt such a measure which would assuredly repay big dividends—intangible perhaps in a material sense—but of value to the community nevertheless in so many ways.

Neither should it prove difficult to assess a fair method of distribution, based on the needs and integrity of the clubs making application.

As the B.B.C. would say: "Think on these things."

G. A. CHAMBERLAIN.

SERVICE AVIATION



"Flight" photograph.

WEYBRIDGE WARRIOR : The Wellington ancestry of the Windsor is apparent in this view of the new bomber. Appearance suggests that conversion to transport work might be easier than it is with some contemporary types.

Royal Air Force and Naval Air Arm News and Announcements

Honour for Air Marshal Baldwin

AIR MARSHAL SIR JOHN EUSTACE ARTHUR BALDWIN, K.B.E., C.B., D.S.O., has been appointed a Deputy Lieutenant for the County of Lincoln. Air Marshal Baldwin commanded the Tactical Air Force of Eastern Air Command formed in 1943.

Awards

Royal Air Force

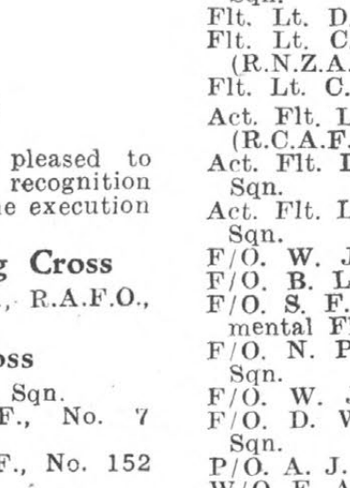
THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations :—

Bar to Distinguished Flying Cross

Act. Wing Cdr. F. W. SNELL, D.F.C., R.A.F.O., No. 82 Sqn.

Distinguished Flying Cross

F/O. M. N. SCOTT, R.C.A.F., No. 52 Sqn.
Act. Sqn. Ldr. P. C. LAL, R.I.A.F., No. 7 (R.I.A.F.) Sqn.
Flt. Lt. K. G. ALLINGTON, R.N.Z.A.F., No. 152 Sqn.
Flt. Lt. D L. CLOW, R.N.Z.A.F., No. 64 Sqn.
Flt. Lt. D. GALE, R.N.Z.A.F., No. 117 Sqn.
Flt. Lt. C. E. PAPPS, R.N.Z.A.F., No. 681 Sqn.
F/O. R. A. EGLEY, R.N.Z.A.F., No. 137 Sqn.
W/O. E. P. STOCKER, R.N.Z.A.F., No. 159 Sqn.
Maj. D. DUNN, S.A.A.F., No. 44 Sqn.
Flt. Lt. G. G. MCKENDRICK, R.A.F.V.R., No. 209 Sqn.
Flt. Lt. H. W. PEARSON, R.C.A.F., No. 436 (R.C.A.F.) Sqn.
W/O. D. G. PARKER, R.C.A.F., No. 436 (R.C.A.F.) Sqn.
F/O. D. E. YEOMANS, R.A.F.V.R., No. 209 Sqn.
Sqn. Ldr. R. W. CAMPBELL, R.A.F. (Lt., Tank Corps), No. 175 Sqn.
Sqn. Ldr. I. F. MCCALL, R.A.F.O., No. 605 Sqn.
Act. Sqn. Ldr. A. HUDSON, R.A.F., No. 570 Sqn.
Act. Sqn. Ldr. M. JACKSON, R.A.F.V.R., No. 296 Sqn.
Act. Sqn. Ldr. R. A. JONES, R.A.F.V.R., Fighter Interception Development Sqn.
Act. Sqn. Ldr. T. C. WOOD, R.A.F.V.R., No. 29 Sqn.
Flt. Lt. C. A. BAILEY, R.A.F.V.R., Fighter Interception Development Sqn.
Flt. Lt. P. E. BARNS, D.F.M., R.A.F., No. 21 Sqn.
Flt. Lt. G. E. CASSIE, R.A.F.V.R., No. 283 Sqn.
Flt. Lt. G. H. DAVIS, R.A.F., No. 129 Sqn.
Flt. Lt. A. W. DEAN, D.F.M., R.A.F.V.R., No. 487 (R.N.Z.A.F.) Sqn.
Flt. Lt. A. C. DUNN, M.B.E., R.A.F.V.R., No. 487 (R.N.Z.A.F.) Sqn.
Flt. Lt. T. ENTWISTLE, R.A.F.V.R., No. 181 Sqn.
Flt. Lt. L. EVANS, R.A.F.V.R., No. 29 Sqn.
Flt. Lt. W. R. C. SMITH, R.A.F.V.R., No. 21 Sqn.
Flt. Lt. D. H. SPURGEON, R.A.F.V.R., Fighter Interception Development Sqn.
Flt. Lt. J. N. STANIFORTH, R.A.F.V.R., No. 603 Sqn.
Flt. Lt. R. C. STOCKBURN, R.A.F.V.R., No. 274 Sqn.
Flt. Lt. E. A. TENNANT, R.A.F.V.R., No. 263 Sqn.
Flt. Lt. D. B. WEBB, R.A.F.V.R., No. 161 Sqn.
Flt. Lt. C. D. B. WHITE, R.A.F.V.R., No. 487 (R.N.Z.A.F.) Sqn.
Flt. Lt. C. J. WOODWARD, R.A.F., No. 161 Sqn.
Act. Flt. Lt. J. E. HOWELL, R.A.F.V.R., No. 418 (R.C.A.F.) Sqn.
Act. Flt. Lt. C. F. PEARCE, R.A.F.V.R., No. 274 Sqn.
Act. Flt. Lt. H. E. TURNEY, R.A.F.V.R., No. 222 Sqn.
F/O. W. J. JORDAN, R.A.F.V.R., No. 21 Sqn.
F/O. B. LENSON, R.A.F.V.R., No. 193 Sqn.
F/O. S. F. MELLOY, R.A.F.V.R., Fighter Experimental Flight, Central Fighter Establishment.
F/O. N. POUNTNEY, R.A.F.V.R., No. 487 (N.Z.) Sqn.
F/O. W. J. SMITH, R.A.F.V.R., No. 98 Sqn.
F/O. D. W. C WORSLEY, R.A.F.V.R., No. 297 Sqn.
P/O. A. J. COSGROVE, R.A.F.V.R., No. 184 Sqn.
W/O. E. A. DAY, R.A.F.V.R., No. 295 Sqn.
W/O. J. R. ISHERWOOD, R.A.F.V.R., No. 184 Sqn.
W/O. A. WHINCUP, R.A.F.V.R., No. 21 Sqn.
Flt. Lt. R. G. CLEMESHA, R.A.A.F., No. 453 (R.A.A.F.) Sqn.
Flt. Lt. J. HARRISON, R.A.A.F., No. 193 Sqn.
Flt. Lt. J. B. O'HALLORAN, R.A.A.F., No. 180 Sqn.
Flt. Lt. K O. SIMES, R.A.A.F., No. 464 (R.A.A.F.) Sqn.
Flt. Lt. F. S. STEVENS, R.A.A.F., No. 456 (R.A.A.F.) Sqn.
F/O. J. M. HASLOPE, R.A.A.F., No. 165 Sqn.
F/O. J. C. JENNISON, R.A.A.F., No. 180 Sqn.
P/O. A. C. INGLIS, R.A.A.F., No. 274 Sqn.
Act. Wing Cdr. D. B. ANNAN, R.C.A.F., No. 418 (R.C.A.F.) Sqn.
Act. Wing Cdr. R. F. HATTON, R.C.A.F., No. 409 (R.C.A.F.) Sqn.
Sqn. Ldr. T. H. HOARE, R.C.A.F., No. 127 Wing.
Flt. Lt. R. B. BARKER, R.C.A.F., No. 412 (R.C.A.F.) Sqn.
Flt. Lt. V. J. BLAKE, R.C.A.F., No. 644 Sqn.
Flt. Lt. R. A. BROWN, R.C.A.F., No. 438 Sqn.
Flt. Lt. E. F. J. CLARK, R.C.A.F., No. 430 (R.C.A.F.) Sqn.
Flt. Lt. R. J CUTTING, R.C.A.F., No. 414 (R.C.A.F.) Sqn.
Flt. Lt. J. B. FRIEDLANDER, R.C.A.F., No. 247 Sqn.
Act. Flt. Lt. W. H. GODFREY, R.C.A.F., No. 400 (R.C.A.F.) Sqn.
Flt. Lt. B. E. INNES, R.C.A.F., No. 402 (R.C.A.F.) Sqn.
Flt. Lt. G. R. PATTERSON, R.C.A.F., No. 416 (R.C.A.F.) Sqn.
Flt. Lt. J. G. PENFIELD, R.C.A.F., No. 245 Sqn.
F/O. R. N. M. BROWN, R.C.A.F., No. 245 Sqn.
P/O. G. S. JOHNSTON, R.C.A.F., No. 418 (R.C.A.F.) Sqn.
Act. Wing Cdr. H. M. MASON, R.N.Z.A.F., No. 135 Wing.
Act. Flt. Lt. A. W. BURGE, R.N.Z.A.F., No. 64 Sqn.
Flt. Lt. W. G. MART, R.N.Z.A.F., No. 222 Sqn.
Flt. Lt. C. J. MCDONALD, R.N.Z.A.F., No. 486 Sqn.
Flt. Lt. G. D. THORPE, R.N.Z.A.F., No. 487 (R.N.Z.A.F.) Sqn.
Flt. Lt. J. C. WORTHINGTON, R.N.Z.A.F., No. 605 Sqn.
F/O. M. L. CREQUER, R.N.Z.A.F., No. 161 Sqn.
F/O. F. A. FRIAR, R.N.Z.A.F., No. 605 Sqn.
F/O. L. D. GILBERTSON, R.N.Z.A.F., No. 487 (R.N.Z.A.F.) Sqn.
F/O. G. J. HOOPER, R.N.Z.A.F., No. 486 (N.Z.) Sqn.
F/O. W. G. MCCONNOCHIE, R.N.Z.A.F., No. 603 Sqn.
F/O. A. T. POWELL, R.N.Z.A.F., No. 127 Sqn.
F/O. E. P. SCOTT, R.N.Z.A.F., No. 183 Sqn.
F/O. J. H. WETERE, R.N.Z.A.F., No. 184 Sqn.
P/O. A. H. LETHABY, R.N.Z.A.F., No. 182 Sqn.
P/O. J. E. WOOD, R.N.Z.A.F., No. 486 (R.N.Z.A.F.) Sqn.
Lt. J. I. A. WATT, S.A.A.F., No. 137 Sqn.
F/O. P. CLARKSON, R.C.A.F., No. 436 (R.C.A.F.) Sqn.
F/O. J. A. FERGUSON, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
F/O. A. V. FOORD, R.C.A.F., No. 436 (R.C.A.F.) Sqn.
F/O. D. MACDONALD, R.C.A.F., No. 406 (R.C.A.F.) Sqn.
F/O. N. J. MCILHONE, R.C.A.F., No. 60 Sqn.



Badge of No. 350 (Belgian) Squadron, R.A.F. — "Belgae Gallorum Fortissimi" (Belgians Bravest of the Gauls)

Distinguished Flying Medal

Flt. Sgt. (now P/O.) M. A. POTTER, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
Sgt. (now W/O.) A. J. COCKADAY, R.C.A.F., No. 424 (R.C.A.F.) Sqn.
Flt. Sgt. W. S. ALLAN, R.A.F.V.R., No. 159 Sqn.
Flt. Sgt. G. V. DAVIS, R.A.F.V.R., No. 11 Sqn.
Sgt. (now P/O.) J. H. EDWARDS, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
Sgt. A. E. DUNSTER, R.A.F.V.R., No. 99 Sqn.
Flt. Sgt. L. T. HARMAN, R.A.F.V.R., No. 635 Sqn.
Flt. Sgt. W. C. HUME, R.A.F.V.R., No. 60 Sqn.
Flt. Sgt. L. JACKSON, R.A.F.V.R., No. 35 Sqn.
Flt. Sgt. A. P. MACKENZIE, R.A.F.V.R., No. 42 Sqn.
Flt. Sgt. L. A. HOWES, R.A.F.V.R.
Flt. Sgt. R. G. MEALE, R.A.F.V.R., No. 209 Sqn.
Flt. Sgt. N. THORPE, R.A.F.V.R., No. 209 Sqn.

Naval Air Arm

THE KING has been graciously pleased to approve the following award :—

B.E.M. (Mil.)

Air Mech. (A) G. A. NOSSITER, for outstanding gallantry in the rescue of an airman whose plane burst into flames after take-off at Carnoustie on June 15th, 1945.

Army

THE KING has been graciously pleased to approve the following award in recognition of gallant and distinguished services in the field:—

O.B.E. (Mil.)

Lt. A. E. BAKER, The Parachute Regt., Army Air Corps.

Roll of Honour

Casualty Communiqué No. 550.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list, 187 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. R. L. Bagley; Sgt. R. Barnes; Flt. Sgt. G. A. Bassett; Flt. Lt. N. V. Borland; F/O. P. H. Hemsley, Flt. Lt. R. H. Ireland, F/O. L. R. John, Sgt. G. W. E. Keeble; P.O. F. E. McLoughlin; Flt. Lt. W. R. Mitchell; Flt. Sgt. A. Naylor; Flt. Sgt. E. M. Rodwell; Flt. Sgt. G. R. Tuckett; F/O. A. Turnbull, D.F.C.; F/O. J. W. Whitehead.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. M. H. Broden; Sgt. P. J. Brown; Sgt. A. R. Burley; Sgt. N. A. B. Cooper; Act. F/O. R. Davies; F/O. J. D. Mackie; Sgt. T. J. Minns; Flt. Sgt. E. Newman; Sgt. L. Phillips; P/O. L. J. Phipps; Sgt. E. M. P. Rice; Flt. Sgt. C. D. Richards; F/O. E. W. Sawyer; Sgt. H. V. Ward.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. R. W. Athey; Flt. Sgt. A. E. W. Ayre; Flt. Lt. B. G. Bensted; W/O. K. S. Biggs; Flt. Sgt. J. G. S. Boanson; Sgt. R. S. Bond; Sgt. J. C. Booth; Sgt. H. G. Brady; Sgt. A. G. Brooks; P/O. J. N. Brown; Sgt. R. D. Burns; P/O. C. L. Burrage; Act. Sqn. Ldr. W. R. Butterfield, D.F.C.; Flt. Sgt. P. Cashin; P/O. C. C. Chitty; Sgt. W. Cockshott; Sgt. H. G. Colwell; Flt. Sgt. S. F. Cooper; Sgt. R. B. Corkill; Sgt. S. W. Courtenay; Flt. Lt. H. W. Cowan; Flt. Sgt. W. A. Crawford; Sgt. J. A. Cunningham; F/O. W. R. Cuthbertson; Sgt. G. W. Dalton; Sgt. J. V. Dew; Sgt. J. N. D. Dewar; Flt. Sgt. L. Diggle; Sgt. N. J. J. Dobson; Sgt. A. G. Dollery; W/O. H. J. Dowse; Sgt. C. S. Drew; Sgt. G. MacK. Edwards; Flt. Lt. R. W. Evans; Sgt. R. E. Fielder; Sgt. A. Fisher; Flt. Lt. R. T. Forgan; P/O. H. A. Foster; F/O. J. D. Foster, D.F.C.; Sgt. W. Freeman; F/O. K. B. Freer; Sgt. P. Froud; Sgt. T. Gilmartin; Flt. Sgt. A. L. Goulding; Flt. Lt. P. C. Granger; P/O. E. G. Graves; Flt. Sgt. K. G. E. Graves; Sgt. J. B. C. Gray; Flt. Sgt. R. T. Green; P/O. R. W. Griggs; Flt. Sgt. T. W. Grisdale; Sgt. R. Guile; Flt. Sgt. R. C. Guy; Sgt. G. W. Haswell; P/O. M. C. Hennessey; Sgt. M. H. Hewes; Flt. Lt. D. Hewitt, D.F.C.; Flt. Sgt. R. H. Heydon; Sgt. G. Hodder-Williams; Flt. Sgt. S. Hodgkins; Sgt. R. Holmes; Sgt. H. W. F. Howe; Flt. Sgt. A. Ife; Flt. Sgt. G. R. Irving; Sgt. A. Jenkins; Sgt. A. D. Jones; Sgt. R. H. Knowles; Flt. Lt. R. Korer; Sgt. A. E. Lee; P/O. T. E. Leggett; P/O. M. F. Lombard; Sgt. T. Lyth; W/O. D. B. McFarlane; Sgt. R. A. McKeand; P/O. A. Mabon; Flt. Sgt. S. Mansfield; P/O. R. P. Maude; Flt. Sgt. D. M. Maughan-Taylor; Sgt. R. E. Miles; Sgt. P. E. Millintgon; Sgt. J. A. Moore; Flt. Sgt. S. E. Morgan; Sgt. J. Murgatroyd; F/O. H. R. Murray; Sgt. J. P. Murray; Sgt. W. Offord; W/O. E. W. Preston; Sgt D. K. Ray; W/O. F. J. Reid; P/O. E. F. Richardson; Sgt. F. J. Richardson; P/O. H. A. Riddle; Sgt. J. M. Robertson; Sgt. H. Russell; P/O. P. Shaw; Sgt. J. L. Sheahan; Flt. Sgt. P. A. Shepherd; P/O. T. S. Smiley; Sgt. E. G. Smith; Sgt. A. P. Soper; Sgt. F. E. Spinks; Sgt. R. D. J. Sutherland; Sgt. J. A. I. Sutton; Sgt. J. M. Thomas; Act. Flt. Lt. T. M. Thomas; F/O. C. H. Tidby; Sgt. F. G. Tomlinson; F/O. R. W. Tovey; P/O. L. A. Veary; W/O. J. Walmsley; Flt. Sgt. K. R. Ward; F/O. S. C Ware; Sgt. R. C. West; Sgt. W. J. White; Sgt. F. Wilcock; Flt. Sgt. R. J. Willis; Sgt. R. H. Wright.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Lt. F. Bolton; Sgt. S. Gilder; F/O. R. A. Newton; F/O. R. A. B. Slee; W/O. A. Thomason.

WOUNDED OR INJURED IN ACTION.—P/O. M. J. Odlum.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Lt. C. W. Knell; F/O J. M. Simpson.

MISSING.—W/O. K. Atkinson; Sgt. F. Brookes; Sgt. T. A. Cotter; F/O. E. G. Draper; Flt. Sgt. F. Dyson; Flt. Sgt. D. O. Grady; F/O. J. G. Hallowell; F/O. J. Heggarty; F/O. G. Horsaman; Flt. Sgt. C. T. Jones; Sgt. T. R. Jones; Flt. Sgt. G. V. Knowler; Flt. Sgt. S. Larcombe; Sgt. A. W. Scott; F/O. B. W. Smith; Sgt. R. Sperling; Sgt. H. V. Stokes; Flt. Sgt. A. Storey; Sgt. P. R. Tomlinson; Flt. Sgt. F. Vernon; Flt. Lt. L. Whiteside; F/O. V. R. M. Williams.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. D. E. Beynon; F/O. H. Brown; Sgt. C. R. Hamlin; Sgt. R. A. Hanney; F/O. H. Lewis; Sgt. D. Luman; Sgt. R. F. McLean; W/O. W. Parry; Sgt. K. M. Smith.

KILLED ON ACTIVE SERVICE.—Sgt. J. Aldred; Flt. Sgt. P. Antrobus; Flt. Lt. D. J. Barrett; Wing Cdr. R. H. Bunker, D.S.O., D.F.C.; Act. Sqn. Ldr. A. P. S. Chipling, D.F.C.; F/O. G. F. Elkington; Flt. Sgt. L. W. Evans; Sgt. K. G. Gardiner; Flt. Sgt. M. J. C. Garrett; Flt. Sgt. F. S. Holmes; Sqn Ldr. J. R. Johnson; Flt. Sgt T. W. Johnson; Sgt. F. C. King; F/O. H. Macauley; L.A/C. H. S. Mansfield; Flt. Sgt. J. W. Petch; F/O. J. Robinson; P/O. S. A Sulsh; F/O. G. R. T. Taylor; Sgt. C. I. Walker; Flt. Sgt. E. Watkins.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. N. Atkinson; Flt. Sgt. L. Brewer; W/O. S. Brumhead; P/O. W. Charters; Flt. Lt. K. G. Elliott; Flt. Sgt. R. Ferguson; Sqn. Ldr. R. H. Harper, D.F.C.; Flt. Sgt. W. H. Lillywhite; F/O. G. W. Lucas, D.F.C.; Flt. Sgt. G. S. Marshall; Flt. Sgt. R. Peats; Sgt. D. R. Sharman; W/O. E. A. Walker.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. A. G. Johnston; F/O. R. W. Shepherd.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—F/O. J. B. Cuthbertson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED ON ACTIVE SERVICE.—A/C.1 A MacLaren.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. L. H. Bennett; Sgt. W. G. Carter; Cpl. W. C. Jenner-Akehurst; F/O. B. C. Johnson; L.A/C. D. G. Noakes.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—F/O. G. Chapman; Sgt. G. L. Morphew; Sgt. R. L. Stratford.

DIED ON ACTIVE SERVICE.—L.A/C. A. E. Alexander; L.A/C. J. Barnes; Act. Sqn. Ldr. M. C. Corner; L.A/C. S. G. Cond; Sgt. R. E. Davies; A/C.1 J. Gibbons; L.A/C. E. Greenwood; L.A/C. A. C. Hurley; Cpl. A. E. Milward; L.A/C. R. C. W. Powell; Flt. Lt. H. Sawdon.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—L.A/CW. W. Hutchison.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/CW. M. MacLean.

DIED ON ACTIVE SERVICE.—Cpl. E. M. Burdon.

Royal Australian Air Force

KILLED IN ACTION.—W/O. G. R. Adam; W/O. K. B. Nunn-Patrick; W/O. G. R. Saville.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. A. T. Field; W/O. R. A. Hart; Flt. Sgt. L. Toomey.

Badge of H.Q. No. 80 Wing, R.A.F.—"Confusion to Our Enemies."

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. D. F. Bickford; P/O. C. Dickson; Flt. Sgt. H. H. Forden; Flt. Sgt. O. S. Furniss; P/O. C. G. Hill; W/O. E. R. F. Macleod; Flt. Sgt. E. R. Moore; Flt. Sgt. J. A. Nicholson; Flt. Sgt. R. H. Osborne; Flt. Sgt. L. G. Paxman; Flt. Sgt. R. Thurlow; Flt. Sgt. W. J. White.

MISSING, BELIEVED KILLED IN ACTION.—F/O. T. J. Higgins; W/O. R. S. Jack; W/O. A. J. Mirow.

MISSING.—W/O. G. M. Bagshaw; F/O. A. D. J. Ball; Act. Flt. Lt. P. E. Cawthorne; F/O. J. W. Duffy; Flt. Sgt. N. V. Evans; F/O. M. Frank; W/O. T. Reid; Flt. Sgt. J. M. Tait; W/O. R. R. Taylor.

KILLED ON ACTIVE SERVICE.—W/O. C H. Shepley.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—W/O. A. A. Cook; P/O. D. P. L. Hawkins.

Royal Canadian Air Force

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Lt. W. J. Anderson; Flt. Lt. W. G. Davis.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—P/O. E. F. Christy; F/O. R. B. Learn.

MISSING.—W/O. G. Anderson; F/O. R. A. Brown; Sgt. R. H. Bruce; Flt. Sgt. L. Cockerham; Flt. Sgt. J. L. Cook; P/O. G. D. Dickie; F/O. L. A. Dunn; F/O. G. P. Haliburton; F/O. W. McD. Hunt; F/O. G. A. Hyland; F/O. R. O. Johnson; Flt. Lt. J. B. Kennedy; W/O. W. J. Kinsella; F/O. T. S. Lewis; Sgt. R. L. McCaskil; Flt. Sgt. C. C. McDonald; Flt. Sgt. G. Matuszewski; Flt. Lt. H. A. Metivier; F/O. E. F. W. Mitchell; Flt. Sgt. E. E. Morphy; Sgt. J. A. Neilson; W/O. E. J. O'Rourke; Flt. Sgt. G. J. Peden; F/O. D. G. Rathwell; Flt. Sgt. G. J. Rude; P/O. W. M. Sommerville; F/O. J. E. Suttak; F/O. J. Todd; Flt. Lt. T. W. Trewin; Sgt. H. S. Tulk.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—F/O. T. B. Atkinson; Flt. Sgt. G. L. George; F/O. D. J. McL. Robertson.

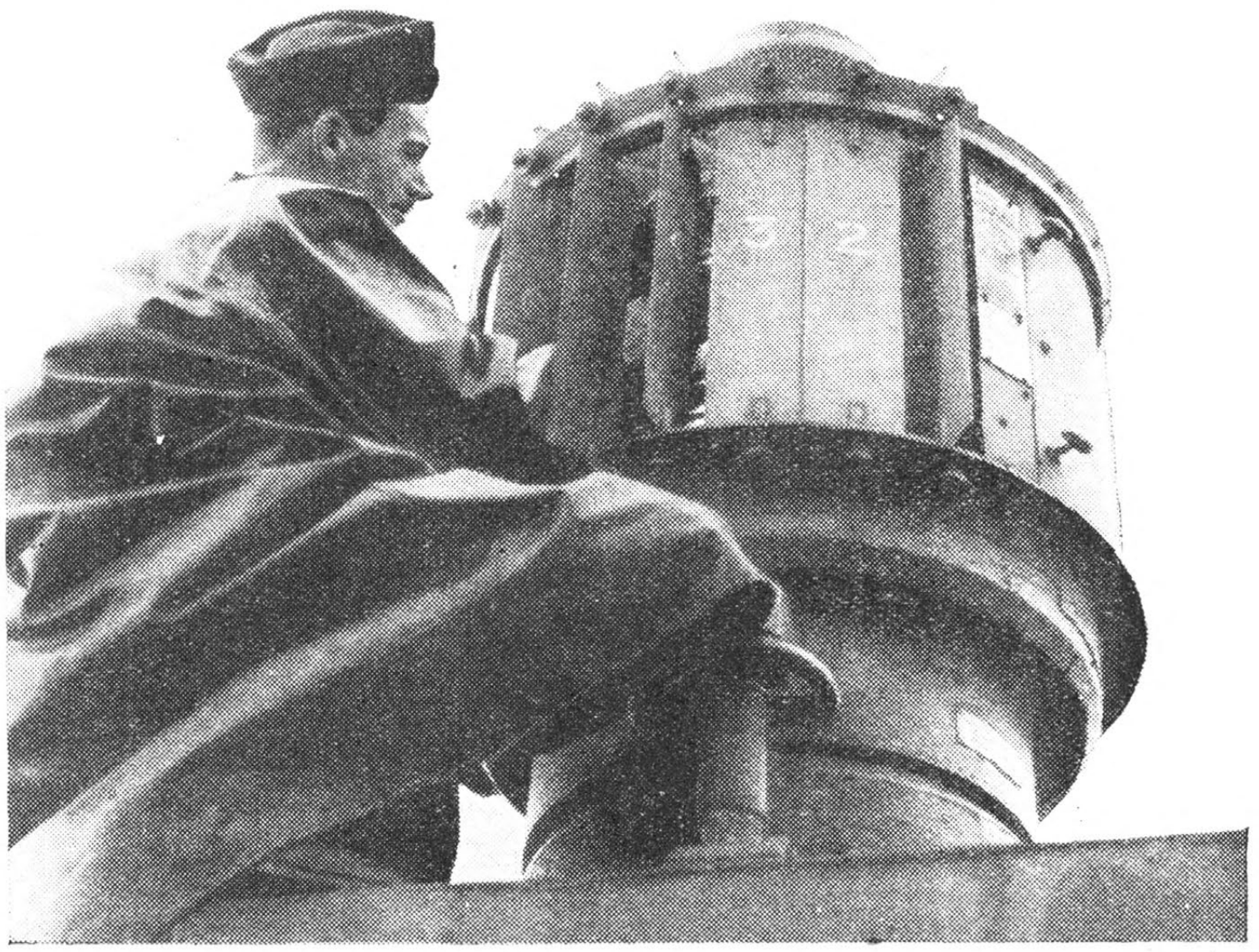
KILLED ON ACTIVE SERVICE.—W/O. F. E. George.

DIED ON ACTIVE SERVICE.—F/O. J. C. Scorer.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. McC. Brigham.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. Wing Cdr. J. F. Barron, D.S.O., D.F.C., D.F.M.; P/O. E. L. Burke; Flt. Sgt. R. H. Grant; P/O. W. J. Green; Act. Sqn. Ldr. H. W. B. Heney, D.S.O.; Flt. Sgt. A. L. Kay; P/O. G. J. Mee; Flt. Sgt. G. W. H. North;



ON THE ISLE OF ISLAY in the Western Isles, ten miles from the nearest village, is an R.A.F. "Occult" site—two mobile lighthouses and wireless apparatus. The lights are a visual warning to aircraft indicating dangerous hills. The site is manned by two men, whose tour of duty varies from two to three months. This view shows L.A/C. Bidwell attending to one of the lights.

SERVICE AVIATION

W/O. R. A. O'Kane; P/O. F. R. Ross; F/O. E. V. Sage; P/O. F. S. Sewell.

MISSING.—Act. F/O. L. K. Driver; Flt. Lt. P. S. Jennings; F/O. R. L. Nugent; F/O. G. G. Parkin.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—W/O. J. A. Newman.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Sgt. D. A. Franklin.

South African Air Force

KILLED IN ACTION.—Lt. A. R. Blacklaws; Lt. P. A. Blatt; Lt. E. P. Carter; Lt. C. L. Cowell; 2/Lt. K. C. Dalton; W/O. L. Stephens; Capt. D. C. Uys; W/O. R. J. Volsteedt; Lt. Wright.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Capt. G. F. Kaufman, D.F.C.

MISSING, BELIEVED KILLED IN ACTION.—Lt. J. S. Lawrence; Lt. J. H. Nixon.

KILLED ON ACTIVE SERVICE.—Lt. F. H. Deyns; Capt. R. S. Douglas; Lt. K. G. Dupre, D.F.M.; 2/Lt. R. E. Gritten; Lt. G. B. Harvery; Flt. Sgt. H. B. Hobson; Flt. Lt. E. F. Kirkman; Lt. C. F. Moolman; Lt. G. D. Roetz.

Casualty Communiqué No. 551

Of the names in this list, 187 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—P/O. J. W. Chambers; Sgt. K. S. Goodman; P/O. C. V. Higgins; F/O. A. E. Jeffs; Flt. Sgt. C. McI. McMillan; P/O. K. C. Mousley; P/O. C. T. W. Perring; Flt. Sgt. G. J. Symonds; Flt. Sgt. W. Thomas.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt W. A. Adams; Sgt. A. L. Chisman; Flt. Sgt. H. G. Clarke; Sgt. H. F. Dott; F/O. L. W. Harding, D.F.C.; P/O. F. C. Hawkins; Flt. Lt. C. J. G. Howard; P/O. R. D. Lucan; W/O. F. McQ. Reid; F/O. D. T. Watkins, D.F.C.; W/O. P. E. Woods.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. J. A. Adams-Langley; F/O. E. Albon; Act. F/O. A. J. Aldridge; Flt. Sgt. R. H. Ames; Sgt. J. Armstrong; Sgt. W. L. Arnold; Sgt. D. Askwith; Flt. Sgt. R. M. Atkinson; W/O. A. P. Baines; Flt. Sgt. P. S. Band; Sgt. E. G. Banks; Sgt. S. G. R. Barham; Sgt. G. G. Barker; Sgt. J. F. MacD. Barson; Sgt. R. G. Beecroft; Flt. Sgt. J. Bengston; Sgt. W. McK. Biehl; P/O. R. G. Blackburn; Flt. Sgt. A. Bouch; Sgt. G. W. Boundary; Flt. Sgt. E. Bryan; Act. Sqn. Ldr. M. Bryan-Smith, D.F.C.; Sgt. T. A. Buckle; Sgt. W. L. Bugg; Sgt. J. R. Burgess; Act. Flt. Lt. C. J. Burnell, D.F.C.; Flt. Sgt. P. J. Butcher; Sgt. C. A. Byng; Sgt. R. J. Campbell; Act. Sqn. Ldr. J. W. Carmichael, D.F.C.; Act. Wing Cdr. E. J. Carter, D.F.C.; Flt. Lt. A. Chambers, D.F.C.; F/O. H. Clark; Sgt. J. P. Cooke; P/O. D. R. Cooles; Flt. Sgt. G. V. Cottrell; Sgt. W. R. Cowan; Flt. Sgt. D. Craggs; P/O. V. B. Crosby; P/O. G. A. J. Curtis; Sgt. K. H. F. De Lengerke; W/O. J. Devlin; Sgt. M. F. Dilkes; Flt. Sgt. A. S. Dott; Sgt. T. D. Duggan; P/O. G. E. Dunning; W/O. L. J. Eardley; Sgt. R. Ellis; P/O. E. Fahy; Act. Flt. Lt. A. Feeley; Sgt. R. Fitchett; Sqn. Ldr. J. G. Fleming, D.F.C.; P/O. H. Fletcher; Flt. Sgt. D. Flett; P/O. D. Flynn, D.F.C.; Sgt. R. Glass; Sgt. G. N. Glithero; Sgt. J. W. Golder; W/O. J. R. Gordon; F/O. K. W. Gray; Sgt. L. J. Guest; Sgt. A. G. Hall; Sgt. K. Hannell; Sgt. A. C. Harding; Sgt. F. R. Hardy; F/O. K. C. M. Hayman; Flt. Sgt. F. A. Hayward; Act. Flt. Lt. J. H. Hewitt, D.F.C.; F/O. H. T. Hills; Flt. Sgt. J. C. Hocking; Flt. Sgt. E. L. C. Howell; P/O. G. R. Howell; Flt. Sgt. E. S. Hutchinson; Flt. Sgt. W. H. Iball; P/O. A. J. Innes; W/O. G. B. James; F/O. H. W. E. Jeffery, D.F.M.; Flt. Lt. D. Johnson, D.F.C.; P/O. D. G. Jones; Flt. Sgt O. Jones; Sgt. F. H. Joy; Sgt. L. L. Kay; P/O. C. W. Keighley; W/O. H. Kitto; Sgt. G. J. Lamb-Shine; Sgt. D. J. Lawler; Sgt. J. B. Lawrie; Flt. Sgt. D. W. Leverington; Sgt. A. R. Lewendon; Flt. Sgt. R. C. L. Lewis; Sgt. V. H. Lusher; Flt. Sgt. C. J. R. MacDougall; Flt. Sgt. J. T. McKeown; Sgt. J. McMinn; P/O. E. V. Magee; Sgt. J H. Maltby; Flt. Lt. D. S. Margach, D.F.C.; F/O. R. Matthews, D.F.C.; Sgt. K. E. Maynard; Sgt. A. L. Mellor; Sgt. C. Moss; Sgt. A. Naylor; Flt. Sgt. C. Nicolson; W/O. W. B. Northall; F/O. G. W. Oldham, D.F.C.; F/O. J. H. Ormrod; P/O. J. N. Papworth; Flt. Sgt. S. Parr; Sgt. F. H. J. Paul; Sgt. R. J. Paul; Sgt. W. S. O. Pearce; F/O. C. E. Pointon; W/O. C. G. Polkey; F/O. D. E. F. Potter; W/O. A. T. Raine; F/O. J. B. Raine; F/O. G. L. Ramsay; Act. Sqn. Ldr. A. W. Raybould, D.S.O., D.F.M.; Sgt. J. J. Read; Sgt. I. Reid; P/O. P. S. M. Robinson; Sgt. W. E. Samler; Sgt. L. Segaloff; Flt. Lt. J. W. Shaw; Flt. Sgt. A. C. Shenton; Act. W/O. W. Smith; Sgt. T. J. B. Stafford; Sgt. P. M. Steers; Flt. Sgt E. E. Stevens; Sgt. A. K. Sutton; Sgt. W. Teape; Sgt. E. Tonge; Flt. Sgt. J. H. Tucker; Sgt. P. B. Tuthill; Sgt. A. M. C. Vine; P/O. D. A. Wadsworth; W/O. W. Waldron; Sgt. G. J. Ware; Sgt. P. H. C. Ware; Sgt. N. P. Warlow; Flt. Sgt. E. J. Waspe; P/O. F. R. Watson; Act. Flt. Sgt. J. E. Watts; Sgt. C. G. Wenyon; Flt. Sgt. C. J. Weston; Sgt. D. L. Whamond; P/O. R. F. Wheatley; Sgt. M. T. Wheeler; F/O. V. R. White; Flt. Sgt. H. P. Whitehead; Flt. Sgt. J. Whittaker; Sgt. G. R. Whittle; Sgt. A. J. Wilmot; P/O. H. L. Wilson, D.F.M.; Sgt. H. J. Wilson; Sgt. J. R. Woodcock; W/O. R. A. R. M. Woodhouse; Sgt. J. G. Woods; Sgt. L. J. Worrall; F/O. L. C. Zeffertt.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. A. S. Chapman; F/O. F. C. G. Debrock, D.F.C.; Sgt. W. D. Piggott; Sgt. W. F. Slatter; Flt. Sgt. R. Smellie; Sgt. W. J. Tucker; Sgt. R. F. H. Viollet.

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. N. J. R. Buchwald.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. P. Adsero.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. W. A. J. Thurston; P/O. E. Tomlinson.

MISSING.—Sgt. J. M. Andrews; Sgt. H. V. Barrow; F/O. C. W. G. Biddlecombe; Flt. Sgt. T. W. Booker; Act. Wing Cdr. R. E. P. Brooker, D.S.O., D.F.C.; Flt. Sgt. C. Brooks; Flt. Sgt. A. E. Bull; Flt. Sgt. J. Cartmell; Sgt. J. T. Chitty; Act. F/O. R. Cluer; Sgt. M. K. Fortin; Flt. Sgt. R. Fosbury; Sgt. J. E. A. Gray; Sgt. A. Higginbottom; Flt. Sgt. A. P. W. E. Hillier; Flt. Lt. L. A. S. Hodge; Flt. Sgt. W. G. Howitt; F/O. F. S. Hughes; Sgt. P. F. C. Jackson; Flt. Sgt. R. A. Jeffery; F/O. A. N. Jennison; F/O. P. W. Kennedy; F/O. A. J. Lewis; Sgt. P. Lipp; F/O. R. G. Lowen; Flt. Sgt. C. McBurney; Sgt. R. McGarvie; Sgt. G. A. MacLennan; Flt. Sgt. R. P. Margetts; A/C.2 D. J. Martin; Flt. Sgt. J. K. Michael; Sgt. A. P. Moreton; F/O. F. J. Naylor; Flt. Sgt. W. H. Ogilvie; Flt. Sgt. J. W. R. Old; Sgt. P. P. Olson; W/O. S. R. Paddick; Flt. Sgt. J. Parkin; Sgt. W. A. Parsons; Sgt. H. A. Paterson; Flt. Sgt. C. Plant; Flt. Sgt. N. G. Reed; F/O. A. S. Seymour; Flt. Sgt. J. E. Short; Flt. Lt. L. Smith, D.F.M.; Flt. Lt. A. J. Spencer; Sgt. L. Squire; F/O. B. E. S. Stagg; Flt. Sgt. S. G. Taylor; F/O. E. G. R. Thatcher; F/O. R. Weldon; Flt. Sgt. R. E. Wilkins; Flt. Sgt. E. Windus; F/O. G. T. Wood; Flt. Sgt. J. F. Woodcherry; P/O. G. C. R. Woodhouse; W/O. D. A. T. Young.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. D. Fishbourne; F/O. J. Hall; Flt. Lt. A. Smith; Act. Sqn. Ldr. A. Stewart, D.F.C.; Sgt. L. Ward.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Lt. R. R. McNair-Taylor; Sgt. C. W. Mathews.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—L.A/C. T. C. Sharp.

MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. S. Foster; Sgt. H. Mariner; F/O. A. R. Pewsey.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. W. J. W. Atty; L.A/C. L. E. King; L.A/C. A. Owen.

DIED ON ACTIVE SERVICE.—F/O. H. Chapman; Act. Flt. Lt. H. W. Clover; Sgt. R. S. Finney; F/O. A. S. Haynes; Sgt. E. C. Johnson; L.A/C. F. C. Tanner.

Royal Australian Air Force

KILLED IN ACTION.—P/O. C. W. Evans; F/O. E. Johnston; W/O. E. G. Murphy; W/O. J. H. O'Keefe.

WOUNDED OR INJURED IN ACTION.—F/O. J. H. Bridekirk; W/O. A. D. Brown.

MISSING, BELIEVED KILLED IN ACTION.—F/O. F. M. Jackson.

MISSING.—Flt. Sgt. C. R. H. Foster; Flt. Sgt. J. H. McGuigan; Flt. Sgt. E. D. Tisdell.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. R. A. Samuel.

Badge of No. 258 Squadron, R.A.F. —"In Medias Res" (Into the Thick of Things).

Badge of No. XV Bomber Squadron, R.A.F. — "Aim Sure."

Royal Canadian Air Force

KILLED IN ACTION.—P/O. J. A. Allen; F/O. T. P. Dollery; W/O. H. A. Fisher; F/O. A. P. Jensen; F/O. J. G. S. J. Livingstone.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—F/O. D. D. Platana.

MISSING, BELIEVED KILLED IN ACTION.—F/O. R. L. Cotnam; Flt. Lt. R. F. Galbraith; P/O. R. J. Grisdale; Flt. Sgt. J. M. Hirak; F/O. W. G. McLeod; Flt. Sgt. D. W. Roberts; Flt. Sgt. F. G. Seeley; F/O. I. B. Zierler.

MISSING.—Flt. Lt. D. Buchanan; Flt. Sgt. M. J. Burns; F/O. H. E. L. Chapman; Flt. Sgt. J. W. Churms; Flt. Lt. E. E. Ettinger; F/O. R. S. Evans; F/O. G. W. Gell; W/O. W. M. L. Green; W/O. W. Henderson; F/O. J. A. R. G. Heroux; F/O. D. H. Johnson; Flt. Sgt. G. J. Jones; Flt. Lt. W. Kroeker; Flt. Sgt. J. C. P. A. Laferriere; Sgt. G. A. Livingston; F/O. C. R. Loft; Flt. Sgt. D. L. Lorenz; F/O. J. A. MacFarlane; F/O. M. R. McKay; Flt. Sgt. C. C. MacLaren; Flt. Sgt. H. A. Mitchell; F/O. C. E. Modeland; Flt. Lt. L. H. Parker; Sgt. J. A. L. Potvin; F/O. H. W. Reid; F/O. J. L. P. Routhier; F/O. W. Semeniuk; F/O. M. F. E. Sergeant; P/O. J. G. L. R. Sicotte; Flt. Lt. W. D. Smith; W/O. D. J. Spence; F/O. L. M. Spry; Sgt. J. Stevenson; F/O. J. E. Stillings; Sgt. J. R. Switzer; Flt. Sgt. D. R. Teevin; W/O. A. F. D. Turner; Flt. Sgt. J. C. Valiquette; Flt. Sgt. A. E. Vardy; F/O. L. E. Veitch; Flt. Sgt. E. R. Wightman; F/O. D. W. Wincott.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. H. C. Daer; F/O. K. V. Dunning; F/O. R. E. Featherstone; F/O. R. J. Glazier; Flt. Lt. H. D. Mackey; Flt. Lt. I. W. Smith.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. H. Crown; W/O. C. D. Lovegrove.

DIED ON ACTIVE SERVICE.—Flt. Sgt. G. B. Stevens.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. L. J. Brennan.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. H. Callow; Flt. Sgt. G. B. Roche; Flt. Sgt. K. E. Smith.

MISSING.—Act. Flt. Lt. J. Currie.

South African Air Force

KILLED IN ACTION.—Lt. N. Bremner; Lt. G. J. A. Van Dam.

MISSING.—Lt. R. Sleep.

THE PERUVIAN COMBINED SERVICES MISSION visited Bentwaters Fighter Command Station and were entertained by Wing Cdr. P. B. Lucas, D.S.O., D.F.C., and Group Capt. Bader, D.S.O., D.F.C., Sqn. Ldr. Benaby acted as interpreter. The members of the Mission were shown Meteors, Spitfires and Mosquitoes.