FLIGHT

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"FLIGHT" PHOTOGRAPHS.

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DIARY OF CURRENT AND FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list :—

1928

- **Jan. 26** .... "Schneider Trophy Machine Design. Mr R. J. Mitchell and Capt. G. S. Wilkinson, before R.Ae.S. & Inst.Ae.E.
- **Feb. 1** ... Aircraft in Small Wars." Wing-Comdr. R. H. Peck, before Royal United Services Inst.
- **Feb. 2** .... "Ground Transport for an Air Organisation." Flt.-Lieut. R. E. H. Allen, before R.Ae.S. & Inst.Ae.E.
- **Feb. 7** .... "The Maintenance and Repair of Aero Engines." Wing-Com. J. G. V. Fowler, Joint Meeting R.Ae.S. & Inst.Ae.E., and Inst.A.E.
- **Feb. 16** .... "Experiments on Model Airscrews at High Tip Speeds." Mr. G. P. Douglas, before R.Ae.S. & Inst.Ae.E.

EDITORIAL COMMENT

IT is difficult to understand the *raison d'être* of the book entitled "This Airship Business," by E. F. Spanner. Although obviously antagonistic to airships, the author has not selected his evidence quite so patently one-sided as did "Neon" in the somewhat similar book published a while ago. Mr. Spanner does at least make a pretence at being fair. And yet in places he is most unfair, although his unfairness has the appearance of being unintentional. The book appears at a time which might suggest that its publication has an ulterior motive over and beyond the author's concern for the welfare of those who may be persuaded to risk their lives in this alleged terribly dangerous fashion !

"This Airship Business"

In many ways the book reminds one irresistibly of a certain class of modern novel written by a woman. The author is so anxious to drive home his points that he makes very liberal use of italics. So much, in fact, that about one-third of the book is printed in italics, with the inevitable result that nothing stands out. It is like a speaker hammering home his points by striking fist on fist, but overdoing it to such an extent that every sentence is so emphasised, and he becomes merely tiresome to watch and listen to.

But for the fact that Mr. Spanner has so written his book that it might give the non-technical reader the impression of being a really serious criticism, we should not have dealt with it at such length as we have done in this issue of FLIGHT. Pseudo technical writings, however, are apt to catch the unwary, and to be given an importance far beyond their legitimate value, and for that reason we have thought it necessary to review "This Airship Business" at considerable length. That in so doing we may be playing the part of the clergyman who warns people against a play, and merely succeeds in filling the theatre, cannot be helped. And if our review sells a few hundred extra copies of the book (it will scarcely run into thousands at 25s. per copy) it may at least tend towards spreading "air-mindedness."

Put in the briefest possible form, what Mr. Spanner appears to have done, as regards the technical sections of his book, is to get hold of all the Patent Specifications of the Airship Guarantee Company which he could lay his hands on, and from the fact that certain features have been patented he concludes that they must of necessity be incorporated in the design. On that assumption he bases his criticism, and as, in the great majority of cases, the features criticised are not incorporated, the author is basing his whole case against airships on something which does not exist. The author blames the "secrecy" with which the construction of the new airships has been surrounded, pleading that as the ships are intended for commercial and not for military work there is no point in concealing anything. With that we cannot quite agree, although superficially the argument appears fairly sound. It should, however, be recollected that both airships are of types of construction differing materially from anything that has hitherto been done. The changes are intimately connected with the size of the ships. Forms of construction which would not have been possible on a smaller scale have become available in the larger size, and so forth. Now it must, we think, be agreed that if the airships are a success, these forms of construction, or at least the intimate details thereof, will have a certain not inconsiderable commercial value. Under the circumstances, therefore, it would surely be bad policy to divulge in advance everything to possible foreign competitors. For in spite of Mr. Spanner's contention that other nations are abandoning airships, the contrary is very definitely the case.

FLIGHT has never been unduly enthusiastic over these new airships, and, in fact, when they were first suggested we warned the authorities that a great deal of experiment and research would have to be done before the jump to the five million cubic foot size could be made with reasonable certainty that no unsuspected "snags" existed. We shall not, therefore, by taking up the case, be accused of being "airship enthusiasts." We are personally satisfied that in the years that have elapsed the theory and practice of designing and building the complicated structure of a rigid airship have made such headway that the undertaking is much less of a speculation than it would have been some years ago. Certainly not such a harebrained scheme as Mr. Spanner accuses it of being. That the whole thing is in the nature of an experiment on a large scale we still admit, but we do think that the chances of success are really reasonably good. If the initial flight tests are carried out cautiously, proceeding step by step in testing out the structures, we see no reason to regard the experiments as unduly dangerous. Mr. Spanner admits that naval architects cannot yet calculate the stresses in a surface vessel; but we have no record of him having uttered a timely warning some years ago, before a destroyer broke her back. He points out that a ship which has suffered severe damage manages to limp home. Well, there are cases on record, from the war 1914–18, of German Zeppelins limping home with noses shot away, almost standing on their head, but getting back to their base with their crew safe.

The British Empire is in such need of rapid communications that any means which promises to assist towards that end are well worth trying out. Now, it so happens that the distance from London to the nearest points are rather greater than can be operated with heavier-than-air craft, at least if these are to carry a reasonable amount of paying load. The whole subject is one of geography. If the airship can be proved to be capable of covering the longer distances, and long distances over the sea, then, in spite of Mr. Spanner's rather sneering references, we shall have accomplished something of the greatest possible value to the Empire. We would remind Mr. Spanner of some remarks made during a discussion at the Royal Aeronautical Society. We believe that the occasion was the reading of the paper by Dr. Eckener, to which Mr. Spanner refers. Sir Alan Anderson, the well-known ship owner, said, in effect, that the passenger rates forecast by Dr. Eckener *were too low*. What he meant was that the time saved would render the rates charged of relatively small importance. As an example, Sir Alan quoted his own case. Although he ran ships to Australia, and had great interests there, he had not been to Australia for, we think he said, 20 years. If the airship should prove capable of cutting down the time of the journey in the manner indicated, he would go every year, or every other year. The rates charged would be of very secondary importance. Surely, Mr. Spanner would not claim that a man like Sir Alan Anderson did not, in saying this, know what he was talking about. Moreover, Sir Alan, as a shipowner, would certainly have no incentive to "boosting" airships, which would, presumably, be rather in the nature of competitors.

Mr. Spanner tries to infer that the Dominion Premiers, at the Imperial Conference, were persuaded to agree to the *technical* side of the airship programme. Unless we are very much mistaken, what happened was that, in effect, the Premiers agreed that, if the airships could do what is expected of them, then they would be a very good thing for the Empire. Which is very different from what Mr. Spanner infers.

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King's Cup Race

It is with considerable satisfaction that we learn from the Official Notices of the Royal Aero Club this week, that this year's race for the King's Cup is to be a "Circuit of Britain," in that it will touch all the light aeroplane club centres. FLIGHT has repeatedly emphasised the view that, in the very nature of things, a race for a cup presented by His Majesty should give as large a section as possible of the community an opportunity of seeing the competing machines. A two-days' race of the nature suggested will cover a great deal of ground, and what with minor local meetings arranged at the various aerodromes during the progress of the race, the result should be a very effective piece of "air-mindedness" propaganda.

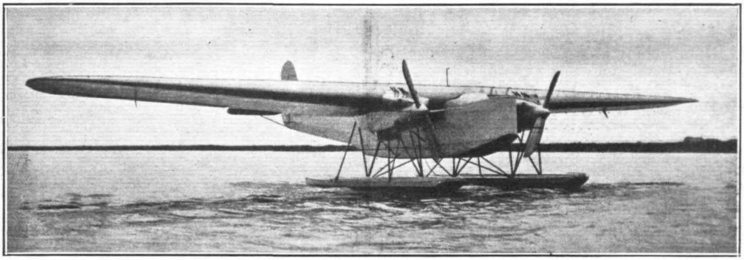
We gather that the original suggestion of racing to a formula has been abandoned as far as the King's Cup is concerned, and that the handicapping will be "on form." Again, we think the decision a wise one. The King's Cup Race should, above all, be calculated to interest the general public, and racing to a formula, with the possibility of a wide separation of the machines, would be likely to fail in doing this. We hope, however, that a race to a formula will still be held, but this should be a much shorter one, and public attendance might have to be treated as a matter of secondary importance. Such a race should be in the nature of a technical event rather than a sporting one, and the formula, if a reasonably satisfactory one can be found, should not, as Mr. Walker has pointed out, be aimed at "fitting" existing machines, but at bringing out the really desirable qualities.

THE FOKKER T. IV SEAPLANE

A Twin-Engined Torpedo or Bombing Monoplane

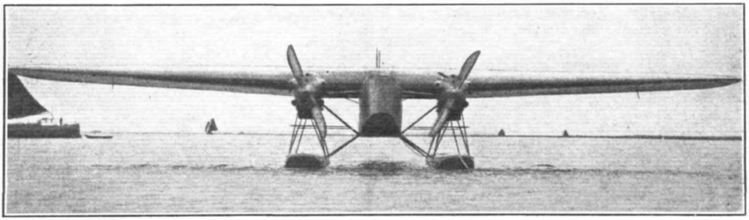
ONE of the latest products of the well-known Dutch firm of Fokker is the T. IV Seaplane, which forms the subject of our description this week. We understand that this machine is being employed by the Dutch Royal Air Force for use in the Dutch East Indies.

The T. IV seaplane is a twin-engined, twin-float cantilever monoplane with the wing on top of the fuselage. Although designed primarily as a bomber or torpedo carrier, it can nevertheless easily be employed as a commercial machine by making a few alterations to the fuselage and fitting a cabin. Also, if desired, the two floats may be replaced by wheel landing gear. A clear space under the fuselage, between the floats, is provided for the mounting of torpedoes or bombs.



THE FOKKER T. IV SEAPLANE: Three-Quarter front view of the new Fokker bombing or torpedo monoplane, fitted with two 450 h.p. Lorraine-Dietrich engines.

Contrary to the method usually employed in other Fokker monoplanes of fixing the wing to the fuselage by means of four bolts, the wing of the T. IV is not directly attached to the fuselage. Although the wing of the T. IV lies on the fuselage —as in the case of the Fokker F. VII and F. VIII—actually it is affixed, by four bolts, to a steel-strut structure or cabane, above each float, which is built-up with and welded to the fuselage. This structure, as may be seen from our illustrations, comprises a series of inverted V-struts extending upwards from the floats, with additional struts extending top and bottom to suitable points on the fuselage.



THE FOKKER T. IV SEAPLANE: Front view, showing space available for carrying a torpedo.

Constructionally, the T. IV wings follow usual Fokker practice, comprising two box spars with profile section ribs slid on to them, the whole covered with plywood covering. They also taper sharply from root to tip, both in thickness and in plan form. Small aluminium doors have been hinged on to the covering at intervals to permit the aileron control cables being examined.

The ailerons, which are of wood throughout, are of high aspect ratio and are unbalanced. The tail surfaces are mounted on the top of the fuselage high up out of the way of the water, and are constructed of steel tubes covered with fabric. Elevators and rudders are balanced, and the vertical surfaces are of large proportions. Both the horizontal stabilising surface and the vertical fin are adjustable during flight from the pilot's cockpit. Dual control is provided.

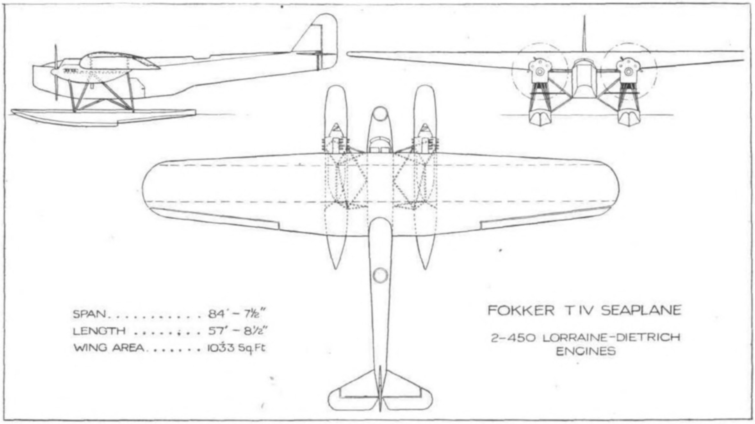
As with other Fokker machines, the fuselage of the T. IV is constructed with seamless drawn welded steel tubes, braced in the forward part by steel tubes, and in the rear part by piano-wire. The fuselage is divided from stem to stern into the following sections—front observer's cockpit with gun post; pilots' cockpit; bomb room; rear observer's cockpit with gun post; and the tail.

Each compartment is connected up with the other and on each side of the bomb compartment are strong joists or supports, to which are welded the struts carrying the wings and undercarriage.

The front gunner's cockpit provides an uninterrupted view over a wide area, giving a large field of fire. It is also very large, there being sufficient room for installing various instruments such as bomb sight, navigation instruments, etc. A passage, passing under the pilot's cockpit, communicates with the central bomb compartment.

Immediately in front of the leading edge of the wing is the pilot's cockpit, which is provided with two seats side by side, sufficiently high so as to enable the pilots to look over the engines to the wing tips. In addition to being adjustable both seats are collapsible, so as to give free access between the front observer's cockpit and the bomb room.

The pilot's cockpit contains the usual navigation and engine instruments as well as the controls for engines and radiators, ignition switches, and the cranks for adjusting the stabiliser and fin.



THE FOKKER T. IV SEAPLANE : General arrangement drawings.

The bomb room, which measures 4 ft. 6 in. by 4 ft. 6 in. by 7 ft. 9 in., is constructed with racks for different-sized bombs (four 200 kg. bombs and 18 of 50 kg.), carried inside the fuselage. If no bombs are carried, provision is made for carrying a torpedo on a specially-constructed carrier under the fuselage. In the floor is a diamond-shaped opening, 4 ft. 6 in. wide and 8 ft. 6 in. long; on either side of the bombs there is ample room to pass from the front and rear cockpits.

Finally, the rear observer's cockpit, measuring 4 ft. 4 in. by 4 ft. 4 in. by 14 ft. 4 in., provides adequate room for carrying a variety of equipment, such as cameras, wireless installation, reserve cases of ammunition, signalling gear, etc. About half-way along the length of this compartment there is a fairly sharp rise in the bottom of the fuselage, which enables a machine gun to be mounted, firing downwards and astern. There is also a machine gun ring, with an extremely large field of fire, on the top of the fuselage.

It should be mentioned that the fuselage is constructed in such a way that if any of the welded steel tubes should sustain damage, through an airscrew breaking, etc., there is still inherent strength enough to allow flight being continued.

The " broad-arrow " type 450 h.p. Lorraine Dietrich engines, with reduction gear, are fitted, but it is also possible to install any other air or water-cooled engine of not less than 450 h.p.—such as, for instance, the B.M.W. VI, Hispano Suiza, Napier " Lion," Bristol " Jupiter VI," Isotta Fraschini Asso, etc.

Each of the engines are mounted above the floats, on two bearers, which are attached to the cabane structure previously mentioned, while there are three struts extending from the engine (at approximately the c.g. of the latter) to the floats. At the side the engine is supported by a strut slanting up from the fuselage. Each engine is enclosed in a streamline cowling of aluminium plates, which connects up with the leading edge of the wing, and which is continued over the wing in cases where the exhaust pipes of the engine are at a distance of less than 50 cm., or 20 in. from the wing.

The fuel tanks, which have a total capacity of 1,500 litres (330·75 gals.), are installed in the centre of the wing, between the spars. The oil tanks, which are in the leading edge of the wing, contain about 40 litres (8·8 gals.) each. Under each engine is a tubular radiator, regulated by retraction.

The floats, each of 6·15 cu. m. (47·2 cu. ft.) capacity, are of duralumin throughout. They are divided into six sections separated by watertight bulkheads; each section is provided with a lid for inspection purposes, and there are also man-holes in the deck. Bollards are provided for towing purposes.

The principal characteristics of the T.IV are :—

Span	84 ft. 7½ in.
O.A. length	57 ft. 8½ in.
O.A. height	19 ft. 8 in.
Wing area	1,033 sq. ft.
Weight, empty	9,150 lbs.
Useful load	5,300 lbs.
Total weight	14,450 lbs.
Weight per sq. ft.	14 lbs.
Weight per h.p.	16 lbs.
Speed range	60—125 m.p.h.
Cruising speed	103 m.p.h.
Range	7½ hrs. or 750 miles
Climb, 1,000 m. (3,280 ft.)	6·8 mins.
,, 3,000 m. (9,840 ft.)	29 mins.
Ceiling (service)	12,150 ft.
,, (absolute)	14,450 ft.
" Everling Quantities."	
High-speed Figure	16
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Altitude Figure (ceiling) ..	7·6

Turning Wood into Metal

BRITISH AIRSHIPS, LTD., inform us that they have secured the complete world's rights of a new metal process invented by Mr. Wladimir J. Einstein, which is widely adaptable, particularly for aircraft. When certain material is treated with this process, it assumes the qualities of metal. For instance, three-plywood can be given a rigidity, strength, durability and appearance of metal, for the metal does not merely coat the wood, but is thoroughly absorbed by it in every fibre. Thus, it is claimed that floats, monocoque fuselages, ribs and all three-ply parts used in aircraft could be treated and practically have the quality of metal construction. Fabric, too, comes within the range of the process, which will stiffen it and strengthen it most effectively, besides making it fireproof, as with wood. Airship fabric so treated is claimed to have 10 times the strength for an additional weight of only 40 per cent. British Airships, Ltd., would like to hear from those seriously interested in this process. Incidentally, their chairman is Admiral Sir Henry Pelly, K.C.V.O., C.B.

The Barros Stall Warning Device

MR. J. BARROS, whose stall warning device was described and illustrated last week, asks us to state that communications to him concerning this device should be addressed to him at Room 17, 52, Queen Victoria Street, London, E.C. Telephone: Central 6431. Telegraphic Address: Bassanio, Stock., London.

AIRSHIPS

"THIS AIRSHIP BUSINESS."*

PROBABLY every reader of FLIGHT has at some time or other met someone who has said "I do not believe in airships." When questioned, this person is invariably hard put to it to defend the faith which is not in him. He has no "case." He merely repeats a pious "Non credo." Further cross-examination usually elicits the fact that he has not studied the subject closely and does not know much about the facts. He vaguely regards airships as rivals to aeroplanes, and has never considered that if and when airships carry mails to Egypt, India, Australia, New Zealand, South Africa, and Canada, there will inevitably arise such a popular demand for internal aeroplane lines in those countries as has never been known before. Successful airship lines will, in fact, be the best friends that aeroplane operators have ever had.

It is not impossible that many of the anti-airship school will read Mr. Spanner's book with avidity, and hail it with delight, as providing them for the first time with serious grounds for attacking airships in general and the Government's airship policy in particular. It is even possible that arguments based upon this book may find their way into the popular press and may do harm to the whole cause of aerial transport (in which aeroplanes and airships must be complementary to each other) by promoting a feeling of panic. One could hardly blame the general public or even the man with a little knowledge, if he said to himself, "Here is a technical man, a naval architect, who assures us that the new airships are bound to break up in the air and kill everyone on board. I for one shall not venture, and I shall do my best to dissuade all my friends." For that reason it is proposed to deal with the book at some length, although to do so imparts to it an importance which intrinsically it does not deserve.

The book must be divided into two parts, the general sections and the technical sections. The latter will be dealt with by the technical staff of FLIGHT. The former, however, are not without their importance, as showing the methods used by Mr. Spanner, and the type of mind which he has brought to bear upon his subject.

In the first place, the date of publication is remarkable. It was, if I remember right, in 1923 that the Government of the day decided to take action on the basis of Commander Burney's proposals. For four years or so careful and elaborate research on airship problems has been carried out at the National Physical Laboratory and elsewhere. Hurry would have been criminal and parsimony would have been equally criminal. There has been neither. At length we may expect that within a few months the two new airships, R.100 and R.101, will be completed and will be tested in the air. A few more months, and we ought to have received practical proof whether airships (not necessarily either of the two present ships) are a technical success or not, and whether or not they have a commercial future. Then, as the hymn says, "Faith will vanish into sight"—or otherwise. One would have thought that the most trenchant critic would have held his hand and possessed his soul in patience. Yet Mr. Spanner has selected this moment for publishing a book in which he calls upon the country to cut its loss and abandon the whole experiment.

On the face of it such a proposal, coming at this juncture, could only be justified by the most unassailable criticism of our airship designers on technical grounds; and Mr. Spanner has attempted to provide this criticism in Section iv (pages 102 to 254), which is dealt with below. Unless that case is made good, it is only the barest common sense that the experiments must go through and settle *ambulando* the question for good and all. The prize for success is great, and if there is failure from some inherent cause, common not only to these two ships but to all airships, then we shall be the richer by that knowledge. But not to make the trial would be the most expensive line of all to follow.

Mr. Spanner does not delay long in giving specimens of his mentality. On page 5 he says that Commander Burney will have but few friends "*if one of such ships meets with disaster* due to her inability to survive attack from natural forces of the air" (his italics). On the next page he admits that "no precautionary measure that it has been possible to devise has rendered ships (*i.e.*, surface ships) immune from heavy weather damage." Now, what is sauce for the airship goose must be sauce for the seaship gander. But does *one* disaster due to natural forces of the sea damn the whole cause of marine transport? Such obviously fallacious arguments would weaken any case.

On page 7 Mr. Spanner says that it is only the expenditure of public money which has prompted his attack upon Commander Burney's schemes. It was, as a matter of fact, the Government which insisted upon undertaking the research and experiment itself; and certainly many people will hold that, considering the issues at stake, this decision was not unwise. It is a political point, on which Mr. Spanner is entitled to his own opinion, but is not a supreme authority.

Another political point is introduced on page 18. Mr. Spanner objects to putting non-technical men, such as Sir Samuel Hoare and Lord Thomson, in charge of technical Government departments. "It is an entirely wasteful and dangerous practice," he says. Nevertheless, it is one of the canons of the British Constitution, and it has survived many better-directed attacks. But Mr. Spanner is not fair to Lord Thomson on page 28, where he says that the late Air Minister set his experts to work to build airships to cover 5,000 miles in a single trip. The stages proposed are actually in the neighbourhood of 2,500 miles. An error of 100 per cent. is not a trivial matter.

The reader may next be referred to a contrast between pages 36 and 159. On the former the author says: "If Mr. Campbell had had the fuller aerodynamic knowledge which is available today, R. 38 would have been designed very much more heavily, etc." On the latter he says, "In my opinion, the aerodynamic information upon which R.100 and R.101 are being, or have been designed is very little less 'sketchy' than was the information available to Mr. Campbell." Either more information is available now, or it is not. Mr. Spanner cannot have it both ways.

The chapter entitled "Air Ministry Experts," if one considers its general trend, amounts to this—that in 1920 very little airship research had been done anywhere, that since that time knowledge has been accumulating, and that Mr. Southwell and others have modified some previous views in the light of greater knowledge. Mr. Spanner seems to think that this does them some discredit—a view which will not be universally shared. He also throughout the book discounts the qualifications of Col. V. C. Richmond and Maj. G. H. Scott in connection with airship design. However, it is reassuring to find on page 165 a quotation from Mr. Southwell himself which pays handsome tribute to "the ingenuity of the design staff at Cardington" in the matter of stress calculation. Airship research entered upon an entirely new phase, if indeed it cannot be said altogether to date from the disaster to R.38; and since then there is reason to believe that the subject has been studied more deeply in Great Britain than elsewhere. The Germans have more experience in construction and operation, but theoretical design is a different thing. Dr. Eckener, for example, is not a designer; but throughout the book his opinion, or that of any German or American, is frankly preferred by Mr. Spanner to the opinion of a British airship man.

In this connection it may be remarked that a great deal of the book is devoted to quotations from patents taken out by Commander Burney and Mr. Wallis. Mr. Spanner has displayed great industry in searching the files of the Patent Office. He ignores, however, what seems fairly obvious from reading his selection of quotations, that in the circumstances it was only natural for those gentlemen

* "This Airship Business." By E. F. SPANNER, Royal Corps of Naval Constructors (retired), Member of Institution of Naval Architects, etc., etc.—Williams & Norgate, Ltd. 25/-.

to take out numerous patents to cover all sorts of contingencies, and that a list of those patents gives very little clue as to the actual design of R.100. Some of Mr. Spanner's comments are amusing, but there is little real argument in them.

Section III of the book deals with the political aspect. Mr. Spanner flounders in this subject and soons gets out of his depth. He forces one to the conclusion that on the whole it really is better to have non-technical men at the head of Government departments. On page 54, speaking of German Zeppelins, he writes, "Those great airships . . . were so hard put to it to avoid attack by aeroplanes that their military value was reduced to precisely nil." If one uses the word "military" in its strict and narrow sense, the above statement is correct. But the *naval* value of the Zeppelins, and of British airships likewise, remained very high throughout the war. The chapter ends with the words, "They were designed as weapons. They failed —and the Germans, to all intents and purposes, entirely discarded them." One must repeat that as weapons they did not fail; they were invaluable naval scouts. As for discarding them, Mr. Spanner ought to know as well as anyone else that the Treaty of Versailles forbade Germany to build large airships without special permission. As a specimen of ill-conceived special pleading this passage must be nearly unique. Not less incorrect, however, is the statement on the same page, "Neither he (Dr. Eckener) nor any other of the Zeppelin directors, who have been actively engaged in urging forward rigid airship construction in various countries, have so far succeeded in gaining any appreciable measure of public support." But perhaps Mr. Spanner would not admit the subscription of thousands of pounds by the German public to help on Zeppelin construction, the purchase of ZR.3 (Los Angeles) by the United States, or the Spanish order for a Zeppelin (now nearing completion) to run a service between Spain and South America, as "appreciable measures of public support."

In the chapter "Present Aims" commencing on page 57, Mr. Spanner makes easy fun of some words of Lord Thomson— but the airship case does not stand or fall by the words of one man. We cannot yet say what measure of success awaits the airship as a troop-carrier or as an aeroplane carrier, but both those possibilities must be explored. It seems obvious, however, that in a war, provided the navy denied the seas to hostile aircraft-carriers, an airship could, especially if carrying aeroplanes, make short work of a raider such as the "Emden." And one would like to know on what authority Mr. Spanner asserts that "the Navy does not want airships." There are several good reasons for believing the contrary.

The chapter "Dominion Interests" takes Mr. Spanner still further into the political quagmire. He assumes that the last Imperial Conference approved the *technical* aspects of the Empire airship scheme—at least it is difficult to put any different interpretation on the chapter. Most certainly the Imperial Air Communications Special Sub-Committee of the Conference could not and did not do anything so foolish. The position undoubtedly was that the Air Ministry said in effect, "We believe that airships can accomplish so-and-so. If so, do you consider airship services a good thing for the Empire?"

The reply was an emphatic affirmative, and Canada and South Africa at once undertook to build mooring masts, while all the Dominions have agreed to provide meteorological services. Despite this very striking expression of opinion, Mr. Spanner (page 68) "cannot, for a moment, imagine that a few days saved *very* occasionally, on a *very* long journey by a *very* few people, can have any real bearing on world or Imperial affairs" (His italics). On page 277 he repeats "I do not believe that the Dominions want these airships at all." One may feel obliged to Mr. Spanner for these expressions of his disbelief, but the Dominion Premiers have at least an equal right to express their opinions, and they have done so.

Just as a minor example of his omniscience, Mr. Spanner on page 69 when putting in a word (with which we will not quarrel) for the small fast airplane (*sic*), says "We are playing with airships and seaplanes, while the French, the Italians, and the Americans have sighted, and are pursuing, the most promising road." One would very much like to hear Signor Mussolini's comments on that remark.

Not even the Schneider Cup can be left alone. Mr. Spanner (page 70) fails "to see that the country has obtained value for the very large sum which must have been expended upon the obtaining of that particular trophy." Give us time, Mr. Spanner; and in the interim you might ask the Curtiss Company for the history of a certain order for 30 Felix engines placed soon after the American win in 1923.

We find another excellent example of bad argument on page 98:—"There have been minor technical successes with small airships, but never a single commercial success even on a small scale." To which the obvious reply is that so far no large commercial airship has ever been built; and now that we want to make the experiment, Mr. Spanner asks us not to. It is really rather unkind of him. Yet Mr. Spanner is consistent. Frequently in the book he deprecates experiment. We have learned only so much, and we must not be allowed to learn any more. Moreover, experiment may be dangerous and there is a big responsibility on the Air Ministry, and so forth. It is a specious argument, but if pushed to its logical conclusion it would end nearly all transport progress. Every test pilot who takes up a new type of aeroplane runs some risk. The history of aeroplane development is indeed sadly marked with casualties. The same is true of the early days of railways, and surely the first mariners were not immune. The plea is only sound if Mr. Spanner can prove—which he has failed to do—that in developing airships the risk is much greater than it has been in the early days of any other form of transport.

It is when one reaches page 360 that one's opinion of Mr. Spanner sinks to the lowest level. He actually writes:— "Of one thing only I am quite definitely certain, and that is, that the Air Ministry *do not intend to fly their own ships until they have either broken Burney's airship or else proved that all the criticisms advanced against airships are wrong*," etc. (His italics.) This passage contains an unworthy imputation, which denies to the Air Ministry authorities both ordinary common sense and the ordinary sentiments of gentlemen. Such imputations can only recoil upon the writer's own head.

I must just trench for a moment on the technical section before handing those chapters over to the technical staff. On page 313, Mr. Spanner says: "There will be no chance of repairing either R 100 or R 101 *outside of this country*, until arrangements have been made to erect, or otherwise provide for, sheds of sufficient size to contain them." (His italics). Yet most newspapers in this country have stated, repeatedly, that such a shed is under construction at Karachi. But the Press is "a source of information which does not stand very high in the regard of the technical man." Then, on page 159, occurs Mr. Spanner's champion example of convincing argument. It refers to the pressure-plotting flights of R 33. Had these flights not been carried out there might have been justification for doubting the wisdom of carrying on the airship programme. These flights made a great difference to the whole position. Mr. Spanner dismisses them thus:

"We have made one or two full-scale measurements on R 33 subsequent to the loss of R 38. But what are (*sic*) the real value of those experiments? Have they established beyond question the relation between wind tunnel measurements and the forces to be withstood by the full-size airships of which the models have been tested?

"Of course they have not!"

If Mr. Spanner desired his book to be regarded with respect, surely, above most other things, it was incumbent on him to deal fully and convincingly with the pressure-plotting flights of R 33. To dismiss the question in five words of contemptuous denial is a method of pleading which would damage Mr. Spanner's cause with any impartial jury. Such methods should, in fact, tend to reassure any who were beginning to doubt the future of airships. F. A. de V. R.

The Technical Aspect

When he comes to discuss the technical side of "this airship business," Mr. Spanner is, perhaps, most dangerous, because there he treats his subject in a pseudo-scientific manner that might easily catch the non-technical reader. Mr. Spanner himself has no doubts as to the merits of this section of his book. In the preface to it he says: ". . . the real worth of the book lies in the particular section to which this is a preface." After such an introduction one expects to find airships demolished by sound technical argument, and Mr. Spanner concludes this preface with the sentence: "The worth or otherwise of this book depends entirely upon the solidity of the case I have set out in this section." After reading the section in question, *i.e.*, Section IV, chapters I to XII, of the two alternatives "worth or otherwise," one is inevitably forced to vote for the latter. The section bristles with mistakes and misapprehensions. To deal with this section of the book item by item, would obviously be outside the scope of a review in FLIGHT, since it would require a volume as large as that of Mr. Spanner. Some outstanding cases will, however, be referred to, and at the outset it may be pointed out that the whole "case" against airships is based upon wrong or insufficient information. The Air Ministry, as usual, has refused to make any statement on the subject, but as we are, perhaps, in rather closer touch with air matters than is Mr. Spanner, we feel sure he will not mind us putting him right on various points. Mr. Spanner assumes all sorts of features in the design of the airships, and then proceeds to criticise them as unsound. As the great majority of the assumptions are wrong, the author is merely beating the air.

On the subject of fineness ratio Mr. Spanner has a good deal to say. It may interest him to know that the German airship "Bodensee" was not, as he appears to believe, unstable. She was in fact very stable, but was over controlled, and as the helmsman had been used to the earlier ships with much less efficient controls, he not unnaturally moved his control surfaces through too great an angle, and got the impression that the ship was unstable. The Zeppelin company are now building an airship of as large diameter as their shed will permit, shed size being the limiting factor, and not fineness ratio. Mr. Spanner's references to the "sensitiveness" of plump ships really refer to drag, although he assumes them to refer to stability.

Mr. Spanner quotes from a patent on "resiliently mounted" control surfaces, describing them as ridiculous. Well they are not being used, and patenting them can scarcely endanger the safety of R.100.

Section IV of the book has a great deal to say about factors of safety, and again Mr. Spanner defeats his own ends by not defining what is meant by that expression. A factor of safety of two, if that two was in relation to stresses under normal flying conditions, would admittedly be too low, but if the factor is based upon the worst stresses to be met, and not upon normal stresses, then a very different state of affairs obtains.

On the subject of tubular construction Mr. Spanner complains that this prevents the possibility of examining 50 per cent. of the surface of the girder structure. Apart from the fact that the tubes used are closed at the ends, and that therefore the supply of oxygen, which is the cause of corrosion, is very limited, surely he does not imagine that even on a Zeppelin airship, where a large percentage of the girder surface is exposed, it is practicable to examine every square inch? There are probably several miles of strip in such an airship, and it would be quite impracticable to examine the entire surface carefully.

Mr. Spanner says that "it is courting disaster to expect a panel of fabric about 1,800 sq. ft. in area to stand up to heavy wind and air pressures. *This point has been entirely overlooked* by the new airship "experts" (the italics are Mr. Spanner's). No, Mr. Spanner, the point has not been overlooked. It merely does not occur. Contrary to what Mr. Spanner assumes intermediate girders *are* used. Consequently what with 15 main longitudinals and 15 intermediate, there are 30 sides as against 25 sides of the Zeppelins which Mr. Spanner holds up as representing all that is good and beautiful.

The gas bags come in for serious criticism. It is admitted that of all the components of an airship, the gas bags are, perhaps, the least satisfactory. But not for the reasons which the author infers. In older airships, which had radial wires in the transverse frames, it was sometimes found that during the first few flights gas bags would get pinched in the angle of the radial wires. Another source of trouble was that a partly deflated bag would rub or "saw" on the edge of the keel girder. In R.101 for example there are no radial wires. The bags cannot touch anything rigid (there is no keel girder), and this particular trouble does not arise. Once the gas bags of the older ships had "settled down" they gave very little trouble, and we believe that in one gas bag failure on record this was due to a member of the crew falling *through a bag*. That is scarcely an argument against the bag as a gas container.

The "catenary" suspension system of the bags, which Mr. Spanner treats with contempt, has, in fact, a number of advantages. Some have already been referred to. Others are that, with the transverse frames used there are no radial wires. Consequently the gas bags cannot distort the frames by a difference in the pressures in adjacent bags. On the contrary, if one bag is slightly deflated, the adjacent bags expand into the space (within limits), and this without any ill-effect on the transverse frames. Instead of the bags exerting a pressure on the longitudinals, all the loads from the bags are taken to frame joints and turned into pure longitudinal loads in the girders.

Fire risk is admittedly one of the serious problems of airship operation, but it is defensible to express the view that this will be reduced to a very small risk indeed. Practical airship people agree that the greatest risk comes not from the hydrogen, which is so light that immediately upon being released it rushes upward and away (very effective measures having been taken to ensure good ventilation). Petrol fumes on the other hand, have a habit of "hanging about." It is possible to get rid of them, and the thousands of miles flown by airships seem to prove that even with petrol-driven ships the danger is not as great as it is generally imagined to be. Commander Burney has decided to use at the start petrol engines because he could not get the newer type engines he wanted, but as he does not propose to fly East with his ship, there is not likely to be trouble on the score of using petrol during the early stages. In R.101 the Beardmore heavy-oil engines are being used, and these, although somewhat heavy at the moment, should at least do away with all fire risk from fuel. Moreover, their consumption is so low that on a long flight the saving in fuel will go a long way towards balancing their greater specific weight. That they will be built lighter in future there cannot be the slightest doubt.

Lack of reserve buoyancy is another complaint of Mr. Spanner. He seems to have overlooked the fact that an airship has a good deal of dynamic lift when travelling pitched, and that actually this may easily amount to more than the lift of the largest gas bag in the ship. Also there is to be taken into account the fact that as the fuel is being consumed so the airship becomes gradually lighter. Also it is possible, in an emergency, to jettison not only water ballast but fuel, and thus lightening the ship by a far greater amount than by merely discharging water ballast.

Numerous other points in the book could be answered, item by item, but for that we have not the space. We believe, however, that we have said enough to show that the most serious of Mr. Spanner's criticisms are based upon assumptions which do not apply to the actual airships. Had the author realised that for commercial reasons it is often, and indeed always, advisable to patent many more features or combinations of features than it is intended to incorporate, he would have saved himself a lot of trouble, and would not have been compelled to assume the Don Quixote rôle which his lack of knowledge of the actual facts has forced upon him.

That the construction and operation of these large airships are by way of being experiments on a large scale we have always maintained, and still admit. That their chances of success are as remote as Mr. Spanner would have us believe we dispute very strongly. Everything indicates that there is a very good chance of success, at least a sufficient chance to make the experiment not only defensible but also worth while.

Manx Air Line?

IN view of the possibility of Imperial Airways inaugurating an air service between Liverpool and the Isle of Man, the Ramsey Town Council decided at a meeting on January 19 to select sites for an aerodrome near the town and have a report made on landing facilities.

Blackpool Aerodrome

AT a meeting at Blackpool on January 24 of the Corporation Committee concerned with the proposed aerodrome and motor racing track, the Mayor, Councillor G. Lumb, stated that, having secured the endorsement of the ratepayers and the goodwill of the Air Ministry, they were promoting in Parliament an Improvements Bill for the carrying out of this scheme. They had secured a site of about 600 acres near Stanley Park which would give every facility for the taking off, etc., of aircraft, and for a track which would accommodate some tens of thousands of spectators. As soon as they receive sanction from Parliament they will get to work on the construction of the aerodrome and track, which will cost nearly £120,000.

Air Force to Control Aden

THE Air Ministry is to be responsible for the defence organisation at Aden in place of the War Office. In April, a R.A.F. officer will be appointed to the new command of Aden Garrison.

Air Force in Action

THE R.A.F. is helping to round up the rebels among the Nuers in the Nuer country who were responsible for the recent murder of Capt. Fergusson, District Commissioner of the Province of Bahr el Ghazal, in the Sudan.

The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

RACING COMMITTEE

REPORT of the meeting of the Racing Committee held at the Royal Aero Club on January 18.

Present.—Air Vice-Marshal Sir Sefton Brancker, in the chair; Captain R. J. Goodman-Crouch; Captain W. Dancy; J. F. Leeming; R. J. Parrott; Colonel The Master of Sempill. *In attendance.*—H. E. Perrin, secretary; B. Stevenson, assistant secretary.

King's Cup Race.—It was decided to hold the race for the King's Cup in the month of July. The race will occupy two days and will be over a circuit of approximately 1,000 miles. The circuit will include the aerodromes of practically all the light aeroplane clubs, where the competitors will make compulsory stops for re-fuelling.

Siddeley Prize.—Mr. J. D. Siddeley has presented to the Royal Aero Club a Challenge Trophy and prizes of £250 for a competition amongst the light aeroplane clubs. For the year 1928 Mr. Siddeley has agreed that the Competition should be included in the Race for the King's Cup. The Competition is open to aircraft, the weight empty not to exceed 1,000 lbs. Weight empty means the total weight of the aircraft in flying order. The following weights are not included:—Petrol, oil and crew. The weight of water in the radiators shall count in the weight empty. The aircraft must be owned by a club or member of a club. The pilots must be members of the club entering, and in the case of privately-owned aircraft the owner must be the pilot. Paid pilot instructors are excluded.

ASSOCIATED CLUBS' GENERAL COUNCIL

REPORT of meeting of the General Council held at the Royal Aero Club on Wednesday, January 18, 1928, at 11 a.m.

Lord Thomson, chairman, presided. The following delegates were present:—

Royal Aero Club: Lord Thomson; Lieut.-Col. M. O. Darby; Lieut.-Col. M. O'Gorman.
Bristol and Wessex Aeroplane Club: Col. D. C. Robinson.
Halton Aero Club: F./Officer W. F. Shaylor.
Hampshire Aeroplane Club: R. J. Parrott; O. E. Simmonds.
Lancashire Aero Club: J. F. Leeming; A. R. Goodfellow.
London Aeroplane Club: The Hon. Lady M. Bailey; Captain A. G. Lamplugh.
Newcastle-on-Tyne Aero Club: B. M. Dodds; P. F. Heppell.
Nottingham Aero Club: Cecil R. Sands.
Yorkshire Aeroplane Club: H. S. Chamerlain.

In attendance:—Harold E. Perrin, secretary; B. Stevenson, assistant secretary.

Official Aviation Race Meetings.—The following dates for the Official Aviation Race Meetings in the Provinces were approved:—

Western Area	Bristol	Saturday, May 5.
Southern Area	Hamble	Monday, May 28.
Midland Area	Castle Bromwich	Saturday, June 9.
Northern Area	(Place not fixed)	Saturday, July 7.

These dates are subject to arrangements to be completed with the Air Council.

The pooling scheme, whereby all Associated Clubs participate in any profits was agreed. This scheme only applies to Associated Clubs represented on the General Council on January 1, 1928.

Air League Challenge Cup.—The race for the Air League Challenge Cup will be held in the Eastern Area, probably from Norwich on Monday, August 6, and the organisation is in the hands of the Norfolk and Norwich Aero Club.

Society of British Aircraft Constructors' Challenge Cup.—An Inter-Club Competition will be held at each of the Official Race Meetings, open to aircraft registered in the name of the club and flown by *ab initio* pilots. Marks will be awarded as follows:—5 for a win; 3 for a second, and 1 for a third.

The club gaining the most marks will be awarded the Challenge Trophy and Cash Prize of £75 offered by the Society of British Aircraft Constructors.

THE AIRSHIP CLUB

THE Airship Club has decided to enter for the Gordon Bennett Balloon Race to be held in Detroit on June 30, 1928. Members wishing to take part are requested to forward their names to the secretary. A fund has been started with the object of assisting in the expenses incurred in sending out the team and balloon to Detroit. The following donations have been received:—Mr. Griffith Brewer, £10 10*s.*; Sqdr.-Ldr. R. S. Booth, £10; The Hon. A. F. de Moleyns, £5; Capt G. F. Meager, £5; Maj. Eustace Moyes, £5.

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W. 1.
H. E. PERRIN, Secretary.

DE HAVILLAND AIRCRAFT IN CANADA

WE are able this week to confirm previous reports in FLIGHT regarding the establishment in Canada of a branch of the de Havilland Aircraft Co., Ltd., of Stag Lane, Edgware. The decision to establish a Canadian branch is the result of the visit recently made to the Dominion by Mr. F. E. N. St. Barbe, the Business Manager of The de Havilland Aircraft Company—to which reference has already been made in FLIGHT.

Canada, as our readers are aware, is making an ever-increasing use of aircraft, especially for air survey and photographic work, forestry patrol, and air mail services to remote districts, while there is promise of considerable development in other branches of aeronautics throughout the Dominion. Mr. St. Barbe was, in fact, greatly impressed by the vast service which light aeroplanes can render to the Dominion, not only for the work mentioned above, but for private travelling, and, as he rightly says, if aviation is to succeed quickly in Canada, it has to be cheap, and cheap flying means cheap aeroplanes. Thus, the establishment of a "Moth Farm" and the breeding of "Moths" on the spot should prove to be a very successful, if not desirable, proposition.

We understand the headquarters will be located at Toronto, a small factory being set up at Leaside Aerodrome, which is situated about four miles outside the city. For the time being, this Canadian branch will take the form of a service station for the large number of "Moths" already operating in Canada, and also as an assembly depot for new machines which will be shipped from the "Mother" Country.; subsequently, it is possible that certain components may be manufactured at the Canadian factory.

The Canadian branch—which will be opened on March 1—will be under the management of Mr. R. A. Loader—the popular and energetic Assistant Business Manager of "D.H.'s," who has been associated with the company in this capacity for over four years. Incidentally, we—and, no doubt, many of our readers will join us—will miss Mr. Loader's presence in this country, but we nevertheless feel certain that our loss will be Canada's gain and that the new venture could not be in better hands

Mr. Loader is taking with him a small staff of expert aircraft mechanics to form the nucleus of personnel for the new branch, which will, in all probability, be registered as a separate company under the title of "The de Havilland Aircraft Company of Canada, Ltd."

Here's every success to the House of D.H. across the water!

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

January 26, 1928

CONTENTS

EDITORIAL VIEWS

In presenting this number of The Aircraft Engineer, the Editor feels justified in expressing the view that it is, perhaps, the most interesting since the first issue, published two years ago.

We have been extremely fortunate in securing for the present number three contributions of more than usual interest, each in its own way dealing with a subject that is very much to the fore at the present moment.

Mr. Pollard, whose experience in metal construction will be well known to most of our readers, commences what we feel sure will prove not only an interesting, but also an instructive series of articles on the development of metal construction. It is probably safe to say that there is not now in the country a single firm which is not devoting its attention to this subject, and as we understand that Mr. Pollard intends to make his articles of direct assistance to those engaged upon such work, we feel greatly indebted not only to him, but to the Bristol Aeroplane Company for permitting him to give our readers the benefit of his experience.

Mr. Dowty concludes his series of articles on brakes in this number, and here again he has not confined himself to "theorising," but has published a lot of valuable data which should be of great assistance to others. We thank him for the articles and hope that before long he will return to our pages with another subject, or perhaps with an elaboration of the present one.

Mr. Evans, who has been associated both with the Handley Page and the Gloster companies, and previous to that with Mr. F. Koolhoven in Holland, commences a series of articles on another very topical subject, that of interference. We have now arrived at a stage where the old summation method of estimating drag is no longer in keeping with modern knowledge of the subject, and where it is known that interference between adjacent parts causes undesirable eddies and increases the drag. Mr. Evans has been making rather a study of this problem, and in the articles to follow he will deal with the subject in more detail, the present instalment being more by way of an introduction.

METAL CONSTRUCTION DEVELOPMENT.

By H. J. Pollard, Wh.Ex., A.F.R.Ae.S.

[Metal construction of aircraft has now come to be accepted as the ultimate form, at any rate for service machines, and every aircraft firm in the country is turning its attention to forms of construction possessing some particular merit, such as efficiency, simplicity, cheapness, and so forth. It is, therefore with considerable pleasure that we are able to publish in the present issue the first of a series of articles on metal construction by Mr. H. J. Pollard, who is now engineer in charge of metal construction at the Filton works of the Bristol Aeroplane Co., Ltd. Mr. Pollard commenced his aeronautical career in Vickers Aeronautical Technical Office, where he worked for two years under Mr. Pierson. He then joined the design staff of Boulton & Paul of Norwich as stress calculator. Later, when the development of metal construction was undertaken by that firm, Mr. Pollard was put in charge of this work under Mr. J. D. North. After a few years with Boulton and Paul, Mr. Pollard joined the Bristol Aeroplane Company as engineer in charge of metal construction under Captain Barnwell, and in that capacity he has had wide experience in detail structure design and manufacture, ranging from the 32 h.p. all-metal "Brownie" monoplanes to monoplanes and biplanes of ten times the weight of the "Brownie." Mr. Pollard is thus well qualified to write on the subject of metal construction.—Ed.]

In reviewing the progress of the construction of aeroplanes entirely in metal it must be noted this comparatively new art has developed slowly. A few aircraft manufacturers have tackled the problem systematically, and those few have made much headway; of the two British aeroplane and building firms who first made a systematic attack on the problem, one firm has had one type of machine in production for a considerable time and the other is about to build one machine in series. The difficulties of the art probably explain the apathy shown by the majority of aircraft constructors to metal construction; it is hoped that the knowledge that the pioneer experimenters are now reaping some of the reward of their endeavours will act as an incentive and cause others to give the subject serious thought.

Consideration of some of the possible reasons for this attitude of indifference will throw light on some of the problems of light metal construction.

Firstly, the manufacturer has had no outside incentive until recently to depart from the older methods of construction since the materials employed have not been considered as of any particular importance by the purchaser; the main conditions have been that the machines should be airworthy, have a certain performance, and be able to do certain useful work. Indeed, in type competitions for which both composite and metal machines were designed, the metal machines were at a distinct disadvantage, since practically untried methods of construction had to compete with well-tried methods. Manufacturers were naturally chary of submitting machines which might periodically be unserviceable because of structural failures, even failures of quite minor importance. With an increase of general knowledge of the behaviour of metal structures under vibration this phase is passing, but the causes mentioned had considerable influence in delaying progress.

A reasonable certainty that production orders, though small, would follow successful metal constructions would have encouraged firms to instal at least the fundamental equipment necessary to the production of metal aircraft. It could scarcely be expected that every firm would be in a position to instal expensive special tools for the purpose of building single machines, and where the essential plant was installed, the very expensive hand work that was inevitable before further special tools were evolved made the first machine so costly that the whole matter was put in a very bad light when a comparison was made with the cost of timber aircraft.

Another reason of delay has been, and even now is, the absence from the machine tool market of machinery suitable for most of the processes associated with metal construction. Either machinery originally designed for totally different kinds of work has been employed or equipment (draw benches, rolling mills, etc.) have had to be specially designed and built for the work required. When there is a serious demand for metal aircraft machine tool manufacturers will doubtless exercise their ingenuity in designing and producing machines suitable, for instance, for automatic assembly of spars. Even in these early days of development such a tool as indicated might be a commercial success; this particular problem has been partly solved by people other than machine tool designers, and the problem should present no difficulty to expert mechanicians.

Again, one expects that a number of firms have held back because the types and methods of construction are many and diverse; they have seen no clear indication as to which is the best construction to follow; and by waiting and gradually collecting information concerning the results of other people's work they have hoped to have the way made perfectly clear for them. Those who adopt that attitude lose heavily in missing the experience that the overcoming of difficulties imparts.

On the other hand, the shortage and cost of suitable timber has done much to assist the advancement of the art, for if timber had been cheap and plentiful it would have been practically impossible to develop metal construction because the clear advantages such as weight saving would be counteracted by all the disadvantages previously enumerated. Even the weight saving is difficult to realise in the early experimental stages; a case illustrating this point will be given later in this series of articles.

It is not necessary to put forward all the many arguments in favour of metal against wood; this has been done many times, and the arguments must be familiar to everyone interested in aircraft.

Wide differences of opinion exist as to the relative merits of steel and duralumin. A comparison of the physical properties of the two metals points to steel as being the more suitable of the two. This comparison has been drawn before, but it is of such fundamental importance that a re-statement will not be out of place in this paper.

Taking 65 and 18 tons per square inch as the compressive stresses that can be developed in steel and duralumin structural members respectively, then dividing these figures by the densities of the materials we obtain a ratio of $1\cdot27:1$ in favour of steel; in other words, for two similar short struts developing the stresses shown, then for the same external loads the steel member should be lighter by approximately 20 per cent.

Before dealing with the next phase of this subject, it is readily acknowledged that in the early stages of metal construction development duralumin is a much simpler metal for the design and building of the structure than steel.

In reviewing the present position, the tendency of the steel constructions and the type of construction which should ultimately give the best results will be described.

There are numerous ways in which steel may be employed in the structure of an aeroplane. Solid-drawn round tubes or square-sectioned tubes may be used, or again, lengths of corrugated strip may be riveted up into tubes having almost any section the designer chooses. Then again, for any chosen form of the main members, the ways of joining may be legion. No attempt will be made to describe details of the numerous methods that have been devised from time to time for the purpose of joining solid-drawn tubes, except that one would say that they range from the simplest joint of all, considered as a manufacturing proposition, that is, the direct welded joint, to joints of extreme complexity in which many machined parts are used.

There are obvious reasons why round or other sectioned solid-drawn tubes should make an appeal. The manufacture and supply of such tubes is no worry to the aircraft builder. A variety of specifications is available and a tube can be supplied for every purpose. If the joints are to be welded, mild steel tubes of eminent suitability are to hand, and at rather more risk of uncertainty in material and make-up the designer may use higher grade alloy steel tubes. Again, if a 100 per cent. reliability job is desired, the designer may choose any of the well-known socketed or pinned joints. With these, at an increased cost as compared with welded joints, something quite certain as regards strength can be realised.

In both the above cases, or a combination of them, it is a fact that no very special experience is needed, no equipment which cannot be easily obtained is required, and no extensive research is required.

It is fairly obvious, however, that in general these methods of construction have very well-defined limitations, both as regards weight and cost. Those who prefer welding are limited to a certain minimum thickness from the very nature of the welding operation. The socketed or wrapt fitting type of construction scores a decided point in the fact that tube may be used which is of not more than half the thickness of tube necessary for safe welding. Against this, a loss of weight is entailed in the case of pinned structures by reason of the weight of fittings, but certainty of strength, and a probable advantage in interchangeability must be credited to the pinned method. The relative importance of these factors must be considered in any particular case before a method of construction is decided upon, but it is certain that no substantial improvements, either as regards weight or cost, will be accomplished over recent practice in these stereotyped methods of construction.

It is to be shown generally, and in one simple case quantitatively, that strip construction can effect a substantial saving of weight over other methods of steel construction, and it will be further demonstrated along what lines detail design should run to make the construction inexpensive.

It will be well to point out at this stage that three essentials are necessary to an aircraft designer and builder before strip construction should be commenced; these points may appear trite and obvious, but lack of a full appreciation of them has, in some cases, led to considerable disappointment, and the great difficulties that have arisen through lack of adequate data and equipment may have been sufficient reason for the abandonment of attempted steel construction and the acceptance of a light alloy as the chief metal.

(1) Proper equipment should be installed, such as a rolling mill or mills, a draw bench, shearing machine, suitable presses, parting-off tools, and a variety of hand tools suitable for the complete assembly of components.

(2) The roll or die design section should have data to enable them to compute accurately and draw the final tool design in order to get the designed shape of section. This is easily obtainable only when fully-annealed steels are being used. (The writer fails to see the need for the use of any metals

other than fully-hardened and tempered ones, but this point will be amplified later.) Certain matters cannot easily be made the subject for formula, such as the correct "lead-in" for a die, or the amount of work that should be done on any one of a series of rolls, but a very little experience gives this knowledge; the subject of "spring-back" is essentially a matter for a semi-empirical formula.

(3) The design department should have some knowledge of the behaviour of thin corrugated and flat strip under various external loads when assembled into various structural members. Suitable formulæ are not to be found in text-books dealing with metal structures at the present time, but a study of some of the works of Professors G. H. Bryan, A. E. H. Love and Mr. R. V. Southwell will furnish information regarding the variables involved. With the help of a few tests on metal spars, the building up of empirical formulæ should not be found a difficult matter, so that with but little experience, the fairly accurate prediction of spar performance should be possible. Although the fundamental variables such as thickness of strip, radii of gyration of sections, etc., are common to all formulæ used in metal spar or strut design, yet the "constants" in the expressions depend on the type of design of spar or strut selected. Where a radical change in spar design is made, it will be found that the "constants" need modifying accordingly.

In this article only a partial general survey of matters affecting the metal construction of aeroplanes has been made, and the articles to follow will deal in detail with matters of actual construction. This, it is hoped, will be of actual assistance to constructors. General surveys, while possibly making interesting reading, do not help the draughtsman very much, and it is not proposed, therefore, to deal at any great length with the subject of metal covered surfaces; that these are eminently desirable if the material of the skin can be made not only to take the various loads, but also to develop its full strength, no one can dispute; so also it is desirable that an engine should be built giving 1,000-h.p., and weighing 500 lbs. The mentality of a person who asks for the latter is on a par with that of the individual who asks for metal covered wings, with metals now available, as light and inexpensive as the best that steel and fabric can give. Metal covered wings are needed, but the future in this direction lies with the metallurgist.

To make this point perfectly clear a simple examination of the necessary thicknesses of both steel and duralumin as coverings in competition on a weight basis with wings as at present constructed will be helpful. These figures will be quite familiar to those who have given the question of metal coverings serious thought, but judging from what is occasionally written and spoken, there are many employed in the aircraft industry who cannot have worked out these simple cases for themselves.

Looking on the metal in the first case purely as a covering for equal weight with doped fabric, the average thickness of duralumin would have to be four-and-a-half to five thousandths of an inch, and for steel one-and-a-half to two thousandths. If the skin is to take the load, then an additional weight of metal equal to the weight of the spars and internal bracing may be added to the skin. Take a single outer wing of a biplane: let the dimensions of this wing be 18 ft. by 6 ft., then for an averaged size two-seater machine the weight of the spars can be taken as 45 lbs. This weight being distributed in the skin of the duralumin-covered wings might bring the average thickness up to from 18 to 20 thousandths of an inch and the average thickness of a steel covering would be 6½ to 7 thousandths of an inch. If such a distribution of metal were made with either duralumin or steel, it would be found that the wings would not support their own weight. With an addition of at least 50 per cent. of metal for corrugation, some stiffness would be obtained; it is quite impossible, however, to say how much stiffer such a structure would be, nor is it likely that it will ever be known since the very obvious difficulties of securing the external bracing and the substantial reduction of the lift/drag ratio are sufficient in themselves to prohibit any such construction being attempted on a competitive basis weight for weight with a two-spar wing fabric covered.

With a certain increase in size, and especially with heavy wing loading, such a construction is possible, and indeed has been made, but such information as is available shows this construction to be very heavy, as is to be expected.

It is the writer's firm opinion that the biplane or multiplane structure having metal-covered wings will never seriously challenge similar structures fabric covered, but that for successful complete metal-covered wings we must look to the deep cantilever structures. Such structures will be arrived at step by step as more knowledge is gained on metal construction.

The difficultes involved in the designing and building of large cantilever monoplanes are well known, and there appears to be a regrettable tendency to exaggerate these difficulties. The inevitable increase in wing weight and loss in torsional rigidity compared with a biplane are always emphasised, but the saving in parasite drag which should be the ultimate end of all aeroplane design is often treated as quite a minor matter. Consideration of a simple comparative case between a biplane and a monoplane may be of some assistance in putting this question in true perspective.

Let us assume the weight of a complete biplane structure to be 1·4 lbs. per sq. ft., and the weight of a monoplane wing 2 lbs. per sq. ft. Take a biplane of 10,000 lbs. all-up weight, having a wing area of 1,000 sq. ft.; then, for the same capacity, the monoplane would weigh 10,600 lbs. To make the comparison as simple as possible, the same basic aerofoil may be assumed in each case. Apart from lifting surface the machines are in every way similar, each with a top speed of, say, 120 m.p.h. If reasonable assumptions are made regarding the sizes of the members of the external bracing of the biplane and allowances made for aspect ratio, it can readily be shown that the effective horse-power required to propel the monoplane at top speed is some 6 to 10 per cent. less than for the biplane, and that at lower speeds there is little difference in the performance of the two machines.

There is need for a full investigation into the relative merits of biplanes and monoplanes, even though such an investigation would be founded largely on conjecture, in so far as large monoplanes are concerned, due to lack of experience of such machines in this country. A report on such an investigation would be of a very voluminous nature, and it would be found that many of the factors introduced would operate in favour of the monoplane. For instance, the dimensions of the biplane structure might easily be such that the K_L would be equal to only $0{\cdot}925\ K_L$ of the monoplane. In the case given above, for the same landing speed, the loading could be 10·8 lbs. per sq. ft., giving a wing area of 975 sq. ft. For a gap-chord ratio unity and aspect ratio of 8, the K_L would be the same in both cases. This point is introduced merely as an example of one of the large number of factors that would have to be included in the investigation. It may be said that, taking an isolated case such as the above is misleading, but a consideration of several such cases from various standpoints should convince the unprejudiced that there is a very real case for the moderately large monoplane.

In the particular case taken, the question that arises is: Can the monoplane wings be made strong and sufficiently rigid for an addition of 600 lbs. or an average weight of 2 lbs. per sq. ft. for an unsupported span of approximately 30 ft., loading of 10 lbs. per sq. ft., and load factor of, say, 5? The answer is that a reliable structure can be so built, weighing probably less than 2 lbs. per sq. ft., by adopting a steel multi-spar construction, the booms of the several spars lying along the contour of the aerofoil, the whole being fabric covered. With the advent of metal alloys lighter than any now commercially obtainable, fabric will have to give place to such material, but only if the covering can be made to operate as a primary structural member.

No sudden revolutionary developments need be expected. The desired end, that is, the aeroplane having lifting surfaces built to contain engines, useful load, etc., with the consequent elimination of parasite drag, will only be attained through the slow drudgery of scientific research, the foundations of which have been laid in the experiments found necessary for the construction of current types of steel aeroplanes.

THE PROBLEM OF AERODYNAMIC INTERFERENCE

By STANLEY H. EVANS, A.F.R.Ae.S., M.I.Ae.E.

(I) THE REDUCTION OF INTERFERENCE DRAG

Introduction.—The problem of mutual interference between the component parts of an aeroplane still offers considerable scope for improvement in performance and ingenuity in aerodynamic design, and it is thought that the present notes may be of some interest to fellow workers in this field ; or at least, sufficiently contentious to open out a discussion of the subject. In the present article it is proposed to confine one's attention, more particularly, to fighting aircraft of the single-seater type, since it is here that optimum performance to a given specification, together with a maximum range of vision for the pilot (otherwise, the elimination of blind areas), is of paramount importance. At the same time, it is believed that a number of the points discussed will have a wider compass and cover a more general range of types.

The Interference Factor.—The conditions of interference may be pictured, in some respects, by a rude analogy to the traffic problem in the metropolis. With an ordered scheme of control at congested centres, delay is cut down to a minimum, whereas without such regulation, resistance to the smooth flow of traffic would increase and become chaotic. In the technique of model testing it is generally well recognised that the component groups of an aeroplane if tested in free air and summed together for the total lift and drag forces, seldom represent a true synthesis for the complete machine, since the influence of adjacent parts of the structure upon each other, such as the connection of wings to body, undercarriage to body, etc., tends to mutilate the normal air flow in those regions and increase the free air parasitic drag by an interference factor, which cannot be neglected in aerodynamic calculations. Actually, in certain special cases, this interference factor may be an outside deciding agent in favour of the monoplane arrangement, in spite of theoretical advantages to the biplane on the score of span loading and induced drag, a point often overlooked by many writers.

In the absence of a complete model test (the only sound method) for the prediction and comparison of performance, it is common practice to neglect any decrease of lift, but to add some 10 to 35 per cent. to the free air drag, the addition representing the *average* interference factor, or interference drag, between the component parts, and varying in amount according to the aerodynamic fineness of the complete design. (It will also vary in some degree over the incidence range, the disturbing effects generally increasing with incidence, but such variations need not be considered at this juncture, any reference to an interference factor being understood to mean an average value for a particular machine, throughout the whole incidence range). Thus the lower end of the scale (10 per cent.) may be taken as a fair average value for a particularly clean monoplane of the cantilever type, wherein the wing roots are carefully faired into the body and engine lines, such for instance as the Supermarine " S-4 " of 1925 ; while the higher figure of 35 per cent. is certainly approached by several multi-engined biplanes with exposed wing engines, radiators, petrol tanks, etc. If we assess an interference factor of 24 per cent. as representative for the modern single-seater biplane fighter of conventional type, the importance of reducing this figure to a minimum will be apparent. It is proposed to treat the influence of interference drag and the corresponding performance aspects of this subject in a later article, after more extensive and conclusive model experiments are concluded, but preliminary results indicate an appreciable gain in lift with decrease in drag, together with promise of a more stable flow in the region of the tail-plane.

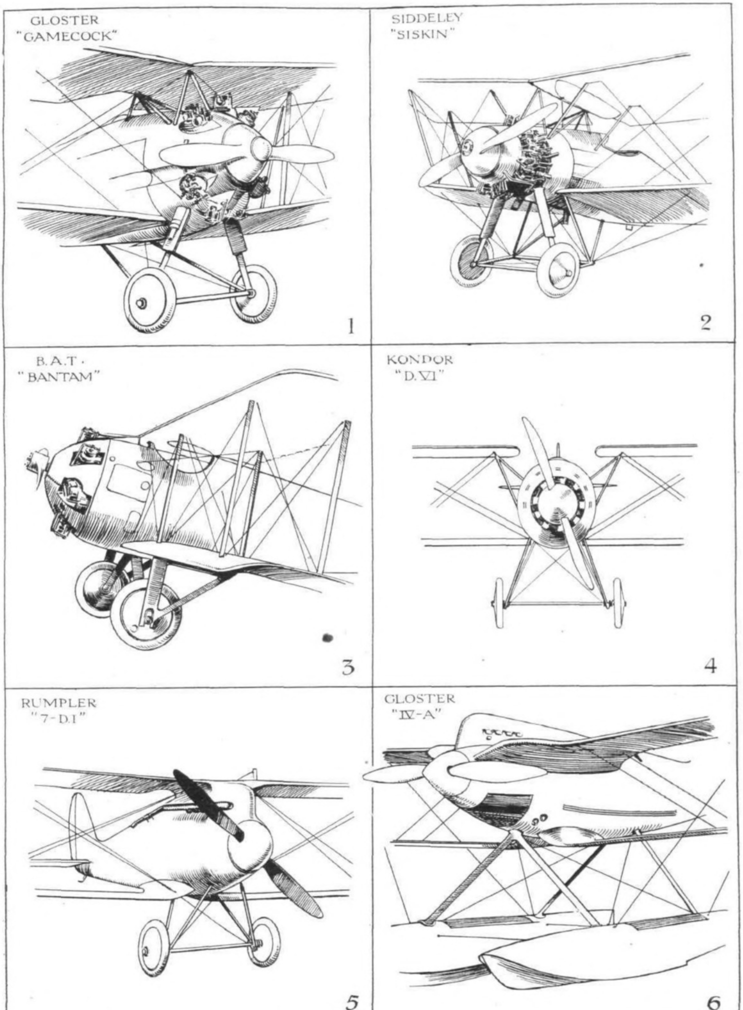
Wing-Body Interference.—An inspection of Figs. 1 and 2, showing typical single-seater fighters mounting a modern radial engine, suggest sseveral fruitful sources of mutual interference between adjacent parts of the structure—of which the two chief offenders are probably the connections of the undercarriage and wing units to the body. The usual arrangement, as shown, is a top wing suspended parasol to the body through the medium of centre-section cabane or pylon bracing, the pilot's eyes usually being slightly below the wing section at this point, with the gun sights between the body and the wing. It might be expected that such an arrangement would produce considerable turbulence between the body and its supporting system, for it is likely that the air flow along the top contour of the body is being continually trapped beneath the centre section of the wing—with resulting loss of lift and increase of drag—and then released in an eddying down-wash over the tail. In this latter connection it is well to bear in mind that the centre or inner portions of the ordinary rectangular wing reach their stalling angle and break down in lift, before the outer portions, a feature well known from pressure distribution experiments across the span, and referred to again in a later paragraph. Apart from considerations of aerodynamic efficiency, further reference to Figs. 1 and 2 will show that the pilot's forward view for sighting on a target is considerably obstructed by the top wing and its bracing to the body, whatever form of support this may take ; the upward view is also somewhat restricted. As already emphasised, the writer is firmly of the opinion that the provision of a good fighting view in this class of machine—improving as it does the fighting efficiency of the pilot—is of equal importance to the performance of the machine itself, since the visibility factor will seriously influence manœuvrability in air tactics.

We thus aim at two desiderata regarding the choice of position for the top wing in a biplane arrangement, namely, a suitable structural and aerodynamical connection between wing and body, together with an improved forward and upward view for the pilot. It is here taken for granted that the position of the cockpit is assumed aft of the rear spar, in the neighbourhood of the top trailing edge, and not situated between the wing spars as in some earlier types, such as Fig. 3, for in spite of a fairly good view forward and upward as required, this arrangement suffers obvious disadvantages in other ways, more particularly aerodynamic losses induced by the mutilated wing sections near the body. Incidentally, the pilot's position is not a very happy one in a ground crash, and easy exit in a parachute emergency is distinctly questionable. From an aerodynamic viewpoint there is a fair amount of experimental evidence now available on such types, and readers may be left to evaluate the pros and cons for themselves.*

A similar aerodynamic objection may be cited against the " split-wing " arrangement, wherein the normal centre-section is completely eliminated to facilitate the pilot's view. In the light of the vortex theory we may suspect a serious loss through the reducton of effective aspect ratio, in addition to appreciable increase of drag caused by what is, in effect, the addition of further wing tips with end circulation (or spilling of pressure), in a region of disturbed flow near the body. If one may be permitted to postulate such a homely analogy, we have only to picture the vortex action of water through the drain-plug of the ordinary domestic bath, to get a rough idea of the unfair conditions imposed upon the lift mechanism by such a crude solution of the problem, apart from the added downwash turbulence created over the tail region. Fig. 4 is a sketch of a German experimental war machine—the Kondor " D-VI " (*circa* 1917)—illustrating this type of wing connection fairly well, though it is hardly worth mentioning other than as an indication of how aerodynamic efficiency ought not to be sacrificed so completely to considerations of clear view alone. The writer has actually seen a similar scheme resuscitated only last year (some ten years after the original German effort has been abandoned), and so ventures to draw the designers' attention to the foregoing remarks. We have, in fact, arrived at one desideratum entirely at the expense of the other—a good view but poor aerodynamic efficiency, with consequent all-round loss of performance—especially climb—and control.

The English as a race are often accused of being adroit in the art of political and other compromise, and the history of engineering design in this country is no exception to the national trait, being enriched by innumerable examples of successful and harmonious compromise between conflicting

* Brit. N.A.C.A., R. & M. No. 419.—Effect of cutting a hole in the top plane of a biplane. (R.A.F.-6).—Powell.
Amer. N.A.C.A., T.R. No. 266.—Air force and moment for N-20 wing with certain cut-outs,—Smith.



INTERFERENCE: Illustrative examples of machines showing, in some cases, causes of excessive interference and, in others, methods of reducing it.

requirements in the "design conditions" or underlying "theme." Thus in the field of locomotive design, we have an outstanding case where the English loading gauge, along with other restrictions, has limited the size and weight of express engines; nevertheless, the final product is not only a most efficient performer, but a delight to the eye. But perhaps of all branches of the engineer's art the naval architect's is more closely akin to the aircraft designer's than any other, since here also external form and arrangement must play an important function in the relationship of resistance, power and speed. Hence, as a successful attempt to compromise will usually mean an arbitration between conflicting extremes, it is logical before setting out to effect the desired compromise (or balance of requirements), to examine the other extreme where aerodynamic considerations have been pushed to the limit at the expense of visibility. In other words we must look to several examples where aerodynamic efficiency has been achieved, though at some sacrifice of forward view. Thus, for example, in racing aircraft, where the reduction of parasitic and interference drag is a primary condition, the view is very often sacrificed to a certain extent—sometimes even to the danger-point—but as we are constantly told that a racing programme is embryo fighter development, we ought to attempt, as far as we can, the introduction of those aerodynamic features which are practicable propositions.

Considering then such a class where aerodynamic cleanness has been achieved, we may recall several very interesting machines, among which the Rumpler "7·D-1"* and Roland "D-IIa"† were German war machines produced early in 1917. The Rumpler only is illustrated in Fig. 5, but both machines were early and elegant examples of clean wing-body junctions. Fig. 5 is well worth a critical study, for it shows quite a striking resemblance in this feature to recent Schneider racers of Curtiss—the "R3C1" of 1925, and the Gloster "IVa" of 1927, the latter being shown in Fig. 6, for comparison. It is well known that the correct development of these wing roots has resulted in appreciable steepening in the slope and maximum of the lift curve, together with a useful diminution of interference drag: in fact, the writer believes that the present available evidence shows it about correct to assume the original monoplane lift curve, both in slope and maximum lift, as characteristic for the complete biplane machine, an increase of the order of 10–15 per cent.

A close inspection of these wing root junctions, merging into the body immediately in front of the pilot, would indicate that they are responsible for blocking out a fair amount of useful view and increasing the blind area forward. Moreover, two further points are of importance; the dihedral angle of the wing entry to the body, and its angle of incidence where it joins the top contour of the body. Lanchester has also suggested‡ that a suitable grading in plan form of the wing at the body junction may have a most desirable effect upon the lift distribution and the air flow around the body, for it is highly probable that the existence of a body will somewhat modify the present conception of the ideal elliptical wing, as derived purely from vortex considerations alone and without reference to body interference. It is interesting to observe in this connection, that the plan form of many efficient soaring and gliding birds has the maximum wing chord at some little distance away from the body, and while it would be rash for the engineer to infer that this has any real aerodynamic significance (it may be only an anatomical device to facilitate wing folding), it can only be settled by careful study in the wind tunnel, and then—if on the credit side—left to the individual designer to decide its relative merit against other conflicting requirements, such as structural simplicity, cost, &c. Usually, however, in single-seater designs, this particular question of simplicity and cost does not arise, since it is often necessary for static balance purposes—on radial engine designs, at least—to bring the pilot close up to the rear spar and cut away a certain amount of the trailing edge; hence, it usually necessitates a departure from the standard rib section over the centre portion in any case. Bearing this in mind, the problem of a suitable reduction in wing chord near the body would appear to be worth a closer investigation. The writer is aware of recent American research on wing cut-outs (ref. T.R.266, previously cited), but—if he has read this report correctly—it is believed that these experiments were conducted as a monoplane test without body interference, and so are lacking in just the information most required.

Recalling now a previous reference to the pressure grading across the span, it will be seen that this has a very important bearing on the foregoing paragraph, where we are concerned with the setting of the wing incidence at its connection to the body. The modern vortex theory of aerofoils (modern only in the sense of now becoming a useful tool in the hands of the designer, but hardly modern in itself, since the basic concepts were enunciated over twenty years ago, by what Lanchester describes as a process of cold-blooded deduction) gives ample evidence that wing form and arrangement will affect the maximum list coefficient. Thus, in the case of rectangular wings, the inner sections reach the stalling point first and the actual maximum lift occurs at some point of balance between the inner sections, which are on the descending slope of the lift curve, and the outer sections where the lift is still increasing with incidence. As stated earlier, this initial collapse of lift over the inner sections is a typical feature amply supported by the evidence of many pressure experiments,* the breakdown being particularly objectionable when we examine the position of the tail unit in the disturbed downwash. Accordingly, it would seem desirable to dispose a certain portion of the wings in the region of the body, at a progressively decreasing incidence towards the body juncture, with the object of developing a higher maximum lift, aiming to make (or rather—gently persuade) the inner sections reach their critical angle in "harmony" with the outer portions of the span. Such an arrangement would also tend to maintain a steady flow over the tail, due to retardation of the stalling angle in company with the later collapse of these outer sections, since the peak of the lift curve is now coincident over any section of the span. As this feature may actually amount to a negative angle of incidence at the body connections for some machines (*see* section (D), Fig. 7, to be reproduced in the next article), it might be argued from a superficial examination that the result would be a *negative lift* and probable rise of drag, but on closer investigation it will be realised that the angle at the body is only negative in a geometric sense, and not when considered in relation to the air flow upwards along the top contour of the body at this region.

* Brit. N.A.C.A., R. & M. No. 73.—Investigation of the distribution of pressure over the entire surface of an aerofoil.—Jones and Patterson.
Brit. N.A.C.A., R. & M. No. 353.—Pressure distribution on the wings of a biplane of R.A.F. 15 section with raked wing tips.—R.A.F.

(*To be continued.*)

SOME RECENT EXPERIMENTS ON FLUID MOTION

The paper under above title, read by Mr. A. Fage, A.R.C.Sc., F.R.Ae.S., before the R.Ae.S. and I.Ae.E., on January 5, 1928, presented the results of some experimental researches on fluid motion recently conducted in the Aerodynamics Department of the National Physical Laboratory. The paper was divided into two parts, of which Part I dealt with the flow at the nose of low-resistance forms (aerofoil and elliptic cylinder) moving through both inviscid and viscous fluids (air); Part II was concerned with the flows behind high resistance obstacles immersed in an airstream. Both series of experiments were made for two-dimensional motion, a condition which obtains at the median section of a body of uniform (but relatively small) cross-section when it extends between the walls of a wind tunnel.

To those able to follow it, the paper presents a fascinating study. It is, however, obviously of such a nature that it cannot usefully be summarised, and we must refer readers who desire to study the paper in detail to obtain copies of the journal of the R.Ae.E. and I.Ae.E., in which the paper will be printed in full, with the illustrations which form an important part of the paper.

* "Flugsport," No. 24, Nov. 1919.—Rumpler War Aircraft.—Scouts.
† "Flugsport," No. 25, Dec. 1919.—Roland (L.F.G.) War Aircraft.—Scouts.
‡ "The Flying Machine (The Aerofoil)," p. 27.—Lanchester.

WHEEL BRAKES AND THEIR APPLICATION TO AIRCRAFT

Brake Design and Control.

By G. H. DOWTY, A.F.R.Ae.S., M.I.Ae.E.

(*Continued from p. 80.*)

Although much can be learnt from automobile practice in wheel brake design and construction, yet the requirements of aircraft brakes are, in many ways, dissimilar. The following are some of the chief differences that should be noted :—

Automobile Brake Requirements.

1. Equal application of braking on all braked wheels.
2. Ability to absorb power for long periods.
3. Adequate provision for cooling brake drums.
4. Braking demanded at frequent intervals.
5. Provision for renewal of liners.
6. Brake drums generally mounted external or partly external to wheel.
7. Operation of brakes from one control.

Forms of Brake.

Braking members generally used may be divided into two classes, each of these depending upon the property of frictional adhesion between surfaces held in contact by considerable pressure.

The usual construction is the attachment of a pressed steel drum to the wheels and the retarding effect can be produced by an internal expanding shoe or by an external contracting band.

The internal expanding shoe brake is more popular on automobiles, possibly due to its neater arrangement and better facilities for cooling. It would appear that this type of brake is the better one for aircraft purposes. The whole unit can be totally enclosed within the wheel, thereby gaining protection against oil, dust, etc., and the operating means can also be enclosed. The band brake has little to recommend it except cheapness, and perhaps a slight saving in weight. Against this there is the great disadvantage of the cumulative action of the brake, the band tending to wrap itself round the drum with ever-increasing tightness. While this may be tolerated on an automobile, it must not be permitted on an aeroplane wheel. With some forms of internal expanding shoes this cumulative action can be obtained, but discussion of this point will be deferred.

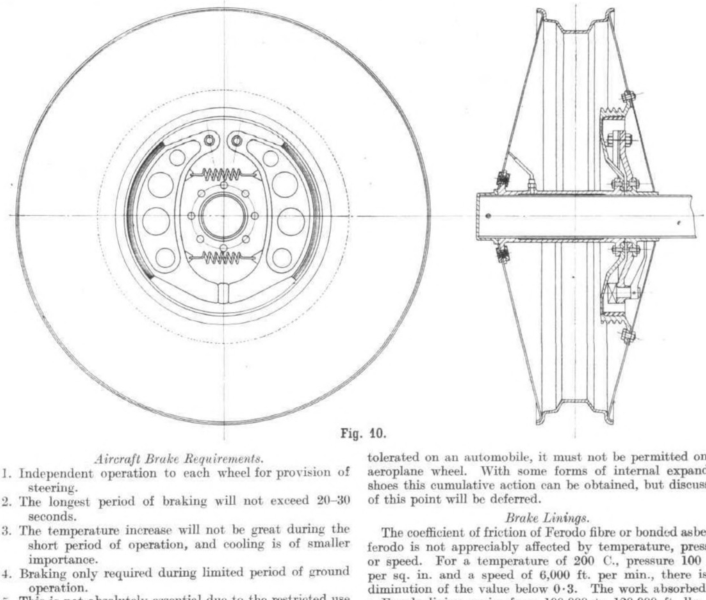


Fig. 10.

Aircraft Brake Requirements.

1. Independent operation to each wheel for provision of steering.
2. The longest period of braking will not exceed 20–30 seconds.
3. The temperature increase will not be great during the short period of operation, and cooling is of smaller importance.
4. Braking only required during limited period of ground operation.
5. This is not absolutely essential due to the restricted use of brakes.
6. Brake drums must be within the wheel or enclosed by rim to hub fairing .
7. Each wheel must be braked from a separate control.
8. Weight must be reduced to a minimum consistent with adequate rigidity. This can best be obtained by the use of light aluminium alloys.

Essential features common to both classes of brakes are :—

1. Self-balancing, *i.e.*, elimination of unbalanced forces when brake application takes place.
2. The brake should preferably be self-energising.
3. The complete brake system should be exceptionally rigid to withstand vibration and distortion, both being primary causes of brake inefficiency.

Brake Linings.

The coefficient of friction of Ferodo fibre or bonded asbestos ferodo is not appreciably affected by temperature, pressure or speed. For a temperature of 200 C., pressure 100 lbs. per sq. in. and a speed of 6,000 ft. per min., there is no diminution of the value below 0·3. The work absorbed by a Ferodo lining varies from 100,000 to 120,000 ft. lbs. per sq. in. per min., when $\mu = 0 \cdot 3$, and the pressure varies from 50–80 lbs. per sq. in.

Standard automobile practice is to design on 80 lbs. per sq. in. pressure for brake linings under normal load.

The following table gives the coefficient of friction for brake linings. This information has been taken from the Practical Engineer Handbook.

It will be noticed that the effect of lubrication is to reduce the efficiency of the brake, and care should therefore be taken to see that the brake is not exposed to oil from the engine. Preferably the complete brake unit should be enclosed. Dissipation of heat is not so important as in automobile work, and advantage can be taken of this point and the brake placed within the wheel.

Surfaces in Contact	Condition	μ
Ferodo fibre on metal ...	Dry	0·4 — 0·8
Ditto	Oiled	0·05 — 0·1
Bonded asbestos Ferodo on metal	Dry	0·3
Ditto	Oiled	0·035

The brake lining should be rivetted to the shoes with copper rivets. The use of aluminium rivets is to be deprecated because the rivets are liable to harden, become embrittled and break off.

Shoes

It is customary to make the width of brake shoes from 0·1 to 0·15 times the drum diameter, but the width should not exceed a maximum of 3 ins. If the shoes are made of greater width, there is difficulty in securing uniform contact over the entire surface, and this will lead to the concentration of pressure on a small part of the liner.

Brake shoes are usually made from aluminium on the score of weight and the good conductivity of that metal.

Brake Drums

The drum diameter should be made as large as possible in order that the brake pressures will be reasonably low. This will give the brake a longer life before adjustment is required.

Low working pressure tends to smoothness in action and elimination of squeaks. Squeaking is invariably produced by high-working pressures which cause the brass or bronze wire embedded in the asbestos or Ferodo, to break off into small particles. This results in choking of the brake, necessitating removal of the shoes for cleaning and the possible renewal of brake lining. Increased diameter, besides giving low working pressures, also makes possible a smaller width of drum and this facilitates better streamlining. This point is of considerable importance on aero wheels.

Perhaps the lightest and most rigid form of drum consists of a steel liner on which is shrunk a cast aluminium brake drum. This drum should have circumferential ribs to prevent stretching or distortion. See Fig. 10. In the case of automobile wheels, the ribs serve the dual purpose of preventing distortion and aiding heat dissipation. It has been definitely established, from automobile tests, that flanged or ribbed brake drums are necessary if spreading of the drum is to be avoided.

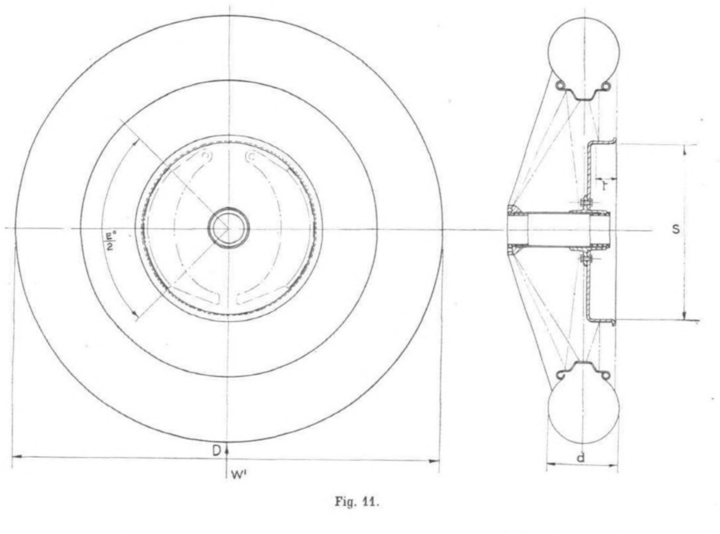


Fig. 11.

Arc of Contact

There is evidently a great diversity of opinion regarding the included arc of contact of brake shoes with the drum. In various designs the writer has observed variations between 80° and 140° degrees. There is possibly no advantage to be gained in extending the arc beyond 90°, especially if the centres of the shoes are diametrically opposite each other (see Fig. 10), because any increase beyond that has little effect on the retarding power and, consequently, this is adding useless weight. Furthermore, too great an extent of brake lining, particularly in the direction of the operating cams, is undoubtedly the cause of brake chatter. In such cases operation of the brake tends to spring the shoe outward and to give rise to undue pressure at the extremities of the lining.

The metal liner should be locked to the aluminium drum to prevent its working loose, and this can be provided for by turning a thread on the outer diameter of the liner. This method is shown in Fig. 10. The threading should preferably be half left-hand and half right-hand, so that the lock is positive for either port or starboard wheels. Attention to this point will save handing of wheels.

Brake Drum Diameter

Using the following notation: (See Fig. 11)

W = Wheel load (lbs.)

μ = Coefficient of friction between tyre and ground.

L_1 = Brake load applied at periphery of wheel (lbs.)

L_2 = Brake load applied at periphery of brake drum (lbs.)

D = Diameter of tyre (in.)

d = Width of tyre (in.)
S = Diameter of brake drum (in.)
t = Width of shoe (in.) = 0·1 to 0·15S
A = Area of shoe in contact with drum (sq. in.)
E° = Included arc of contact of both shoes (degrees).

It has been shown that the average wheel load during run to pull up is approximately 1·1 times the static load, and W can therefore be replaced by the term 1·1 (12 Dd) = 13·2 Dd. This is based on the assumption that 12 Dd gives the static load per wheel. Replacing μ by the average value 0·3 we get:

$$L_1 = \mu W = 3 \cdot 96\ Dd \quad \dots\dots(1)$$

$$\text{and } L_2 = \frac{3 \cdot 96\ D^2 d}{S} \quad \dots\dots(2)$$

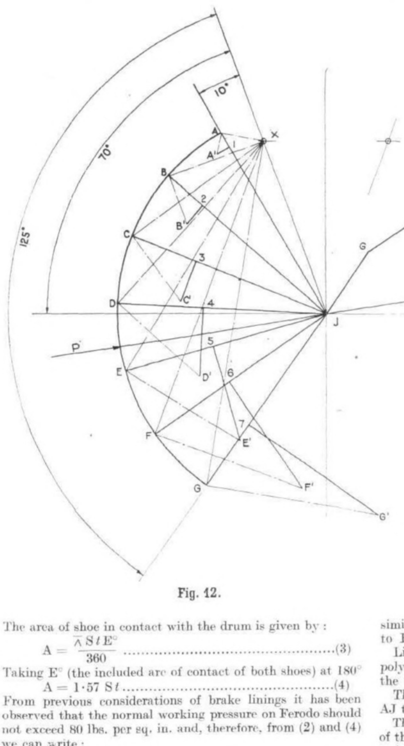


Fig. 12.

The area of shoe in contact with the drum is given by:

$$A = \frac{\pi S t E^\circ}{360} \quad \dots\dots(3)$$

Taking E° (the included arc of contact of both shoes) at 180°

$$A = 1 \cdot 57\ S t \quad \dots\dots(4)$$

From previous considerations of brake linings it has been observed that the normal working pressure on Ferodo should not exceed 80 lbs. per sq. in. and, therefore, from (2) and (4) we can write:

$$80 = \frac{3 \cdot 96\ D^2 d}{1 \cdot 57\ S^2 t}$$

$$i.e.,\ S^2 = \frac{0 \cdot 0315\ D^2 d}{t} \quad \dots\dots(5)$$

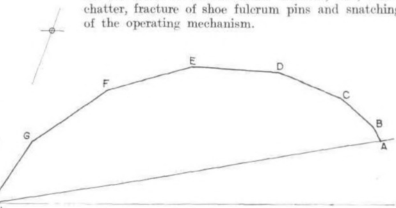
Where $t = 0 \cdot 1S$ $\quad S^3 = 0 \cdot 31\ D^2 d$ .... 6)
$t = 0 \cdot 15\ S$ $\quad S^3 = 0 \cdot 21\ D^2 d$ ....(7)

From these formulæ the diameters of brake drums for several sizes of wheels have been determined and the results are tabulated below.

Wheel Size. (m/m.)	Equivalent. W.O. Type.	Brake Drum Dia. = "S" in.	
		$t = 0 \cdot 15$ S.	$t = 0 \cdot 1$ S.
700 × 75	28 × 3	8	9
700 × 100	28 × 4	9	10
750 × 125	30 × 5	10	11
900 × 200	36 × 8	13	15
1,250 × 250	50 × 10	17·5	20
1,750 × 300	70 × 12	—	26

Self-Balancing

It is a necessary condition that the resultant loads of the brake shoes balance one another. If this point is not given due consideration, then unbalanced forces may develop which are greater than the safe load on the wheel. In any case unbalanced forces are the cause of serious brake troubles, viz., brake chatter, fracture of shoe fulcrum pins and snatching of the operating mechanism.



The balance of any brake can be analysed by finding the centre of pressure of each shoe. The centre of pressure is that point at which the resultant brake load can be regarded as concentrated. This can be determined in the following manner.

Fig. 12 represents a line diagram of a brake unit with J the brake drum centre, JA the radius of drum, X the shoe fulcrum and GA the arc of contact between shoe and drum.

The arc of contact GA *is divided into several equal* parts AB, BC, CD, &c., and each of the points A, B, C, D, ···· are joined to X and J.

Line AA′ is drawn at right angles to AX and its length is made some definite proportion of AX. Similarly BB′ is drawn at right angles to BX and its length must bear the same relation to BX that AA′ bears to AX. This construction is continued for the remaining points.

Line A′1 is now drawn at right angles to AJ and similar lines B′2, C′3, D′4 ···· are drawn at right angles to BJ, CJ, DJ ···· respectively.

Lines A1, B2, C3, ···· are now resolved into a force polygon and AJ represents the magnitude and direction of the resultant force.

The position of the centre of pressure is found by extending AJ to cut the arc GA.

This system is definitely out of balance and the disposition of the components can therefore be regarded as poor.

A layout of a further brake system is shown on Fig. 13. The construction of this diagram has been carried out in a similar manner to that described for Fig. 12. It will be seen that this system is in balance and the resultants of both shoes are normal to the wheel perpendicular.

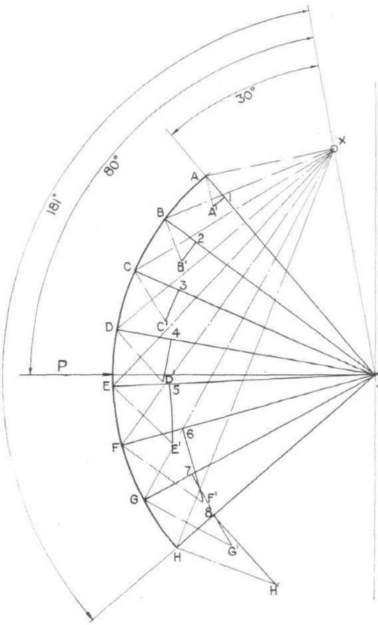
The above methods have been fully treated by Mr. Watt.*

* Proc. Inst. Aut. Eng., Vol. XVI, part 11, p. 369.

The design of correctly balanced brakes resolves into the location of the fulcrum pins, with reference to the disposition of the arc of shoe contact.

In order that the relation between these points can be readily determined, Fig. 14 has been prepared. If the positions given on this figure are adhered to, then complete balance can be assured. It should be understood that the fulcrum pin may be placed at any distance from the drum centre, providing the fulcrum is located on the angle stated.

Taking an example from Fig. 14. When $X = 120°$ and $Y = 80°$ then $\cos Z = \cos 0 \cdot 85 = 31°$ approx. The included arc of contact for one shoe is equal to X-Z and in this case it is approximately 89°.



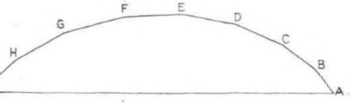


Fig. 13.

Operating Cams.

Cams are generally designed to give progressive brake action, and their form is determined by the travel and the rate of action required. Due to excessive wear on the faces, cams should be mounted with a view to ease of renewal.

Disc v. *Wire Wheels.*

It would appear that the disc type wheel possesses considerable advantages over wheels of wire spoke construction. Disc wheels provide a large internal space in which the brake drums can be accommodated, and there is no doubt that advantage will ultimately be taken of this space, for housing the undercarriage springing.

It is usual practice to enclose spoke wheels with canvas or aluminium fairings, but these cannot provide such good protection for the brake apparatus as is possible with the disc type of wheel, where the disc sides form their own fairings.

The practice of attaching brake drums to the spokes of wire wheels does not appear to be entirely satisfactory, because it is difficult to imagine that adequate rigidity can be secured in this manner.

The only aircraft wheels, complete with brakes, that have so far been manufactured in quantities, are the Bendix and Sauzedde wheels. From the published weights, it appears that the disc wheel has still a further recommendation, for it is appreciably lighter than the wire type wheel. A table of these wheel weights is appended.

Tyre Size.	Weight Wheels (less tyres) with Brakes.		Weight of Brake only.	
	Disc Wheel. Bendix Type.	Spoke Wheel. Sauzedde Type.	Bendix.	Sauzedde.
	lbs.	lbs.	lbs.	lbs.
30 × 5	22	23·4	9·0	9·5
32 × 6	30	34·7	12·0	12·0
36 × 8	31	41·6	11·0	12·5
44 × 10	60	97·5	24·0	21·5

If the frontal area and aerodynamic resistance are not increased by the addition of brakes, then the total loss in performance will be due to the added weights of the brakes and operating gear.

Control.

Brake control is usually carried out by connecting cables from the wheels to tilting type rudder pedals. This system makes it possible to apply the brakes either simultaneously or separately, while rudder control can be maintained at the same time.

In the case of undercarriages fitted with a shock absorbing leg of varying length, it is necessary to carry the operating cable down the fixed strut or radius rod, in order that brake action can be controlled without interference from the shcok absorbing member.

Various operating systems have been proposed using hand, foot and tail skid control. This latter method suffers from the inability to provide independent braking on each wheel.

In the case of hand or foot operated control, the effort of braking comes through the pilot's muscles, and the maximum effort is therefore limited. It is not considered possible to obtain a greater effort than 70 lb. through the hand or 45 lb. through the foot, and it is not usually possible to obtain a greater velocity ratio (between foot movement and travel of brake shoes) than about 50-1.

In view of the strictly limited effort available, it appears that it must be augmented on machines above 3,000—4,000 lbs. gross weight. This external help will come from some form of servo mechanism, but it is not necessary to elaborate on any of these various systems at the present time. There are many possible combinations of control, and these present a wide scope for the exercise of ingenuity.

(*For Fig.* **14** *of Mr. Dowty's article, see next page.*)

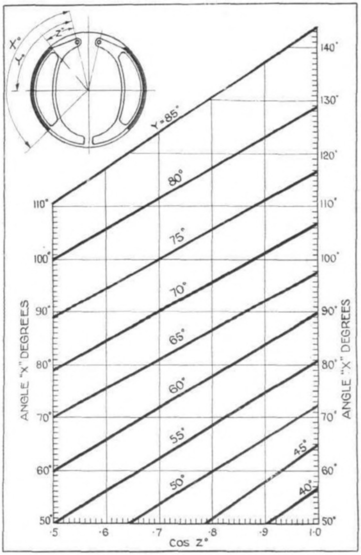


Fig. 14. **Internal expanding Shoe Brake. Angular proportions.**

(See previous pages.)

A Correction.

In Mr. Dowty's article in the December issue, two misprints occurred in the column headings of the table on page 79. Thus the heading of col. 7 of the table should have read $R_A + \mu$, and that of col. 8 should have read $\frac{\cdot 0334V^2}{R_A + \mu} = T_2$. Will readers please make the necessary corrections in their copies.

TECHNICAL LITERATURE.

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS.

FULL-SCALE MEASUREMENTS OF LIFT AND DRAG OF THE FOKKER F.VII—3M MONOPLANE.

By J. J. K. HARDY, B.A. Presented by the Director of Scientific Research.

R. & M. No. 1096. (Ae. 275) (4 pages and 5 diagrams.) April, 1927. Price 6*d*. net.

Considerable interest has been taken in the performance of the Fokker aeroplane, especially as affecting control, and it has been claimed that this aeroplane has exceptional control properties.

The lift curve of the Fokker type F.VII aeroplane has been measured in order to determine the incidence at the stall, as a preliminary to control experiments of the aeroplane at, and near, this incidence.

The lift and drag have been measured from $3\frac{1}{2}°$ to 15° incidence, corresponding to speeds from 55 to 70 m.p.h.

Two sets of curves have been obtained, one with the engines throttled right back, and the other with the engines switched off. The corresponding maximum lift coefficients are 0·78 and 0·73.

Quantitative observations of the efficiency of the controls when stalled will be made in accordance with a scheme drawn up by the Stability and Control Panel. A preliminary report on the lateral control of the Fokker F.VII has already been issued (T. 2403).*

* T. 2403 (unpublished). Preliminary report on lateral control of Fokker F.VII—3M with three Lynx engines.—H. L. Stevens. R.A.E. Report B.A. 644.

THE DISTRIBUTION OF PRESSURE OVER A MONOPLANE AND A BIPLANE WITH WINGS OF UNEQUAL CHORD AND EQUAL SPAN.

By A. S. BATSON, M.A., A. S. HALLIDAY, B.Sc., D.I.C., and A. L. MAIDENS.

R. & M. No. 1098 (Ae. 277). (28 pages and 14 diagrams.) February, 1927. Price 1*s*. 3*d*. net.

A number of aeroplanes have been built with unequal upper and lower wings, and a first set of experiments was undertaken to find the distribution of pressure over a biplane with wings of unequal chord and span so as to determine the loads carried by the separate wings for stress calculation purposes (see R. & M. 997).* The present experiments extend knowledge to the case when the wings have an unequal chord by an equal span.

Measurement of pressure distribution over a R.A.F. 15 biplane with chord of lower plane two-thirds that of upper and with equal spans; gap three-quarters of chord of upper plane; stagger 20°. Measurements also made on a R.A.F. 15 monoplane. Range of incidence from − 4° to + 40° by 4° steps.

The usual preponderance of loading towards the wing-tips is not quite so marked for either the present biplane or monoplane as for the biplane with unequal chord and span (see Figs. 4-6, 8 and 9 of report).

As there are no data for a normal R.A.F. 15 biplane with square wing-tips, measurements might be extended to this type by using the larger plane of the present biplane with a wooden one as a dummy.

* R. and M. 997. "The distribution of pressure over a biplane with wings of unequal chord and span."—Irving and Batson, December, 1925.

WIND TUNNEL EXPERIMENTS ON THE EFFECT ON THE MAXIMUM LIFT OF WITHDRAWING AND DISCHARGING AIR FROM THE UPPER SURFACE OF AN AEROFOIL.

By W. G. A. PERRING, R.N.C., A.M.I.N.A., and G. P. DOUGLAS, M.C., D.S.C. Presented by the Director of Scientific Research.

R. & M. No. 1100 (Ae. 278). (5 pages and 8 diagrams.) April, 1927. Price 6*d*. net.

Several attempts have been made to increase the maximum lift coefficient of an aerofoil, and the Handley-Page slot is an application of a principle whereby the stalling of the aerofoil is delayed to a much larger angle of incidence than in the ordinary wing section, and hence gives increased lift.

The stall occurs when the streamlines past the aerofoil cease to follow the upper surface, and this happens when the energy in the air flowing near this surface is so reduced by the viscous forces that it can no longer force its way against the increasing positive pressure. Experiments have been made in Germany on the effect of the flow due to discharging or sucking away air at the point where the flow leaves the boundary, and some experiments are here described which were carried out at the R.A.E. on an aerofoil, the air being discharged or removed from its upper surface.

An aerofoil was made up having slots running along its span and provided with means by which lift could be measured while air was discharged or withdrawn through these slots. Preliminary tests were made to find the relative merits of discharging the air tangentially and of sucking it in and also the effect of varying the quantity of air through the slots.

By discharging air tangentially along the upper surface of the aerofoil at a point 0·13c from the leading edge the maximum lift coefficient was increased by 0·35, and this value was increasing steadily as the quantity of air discharged was increased.

Similar results were obtained when the same quantity of air was withdrawn into the aerofoil.

The maximum lift depended chiefly on the quantity of air discharged or withdrawn, and to a less extent on the velocity of air through the slots.

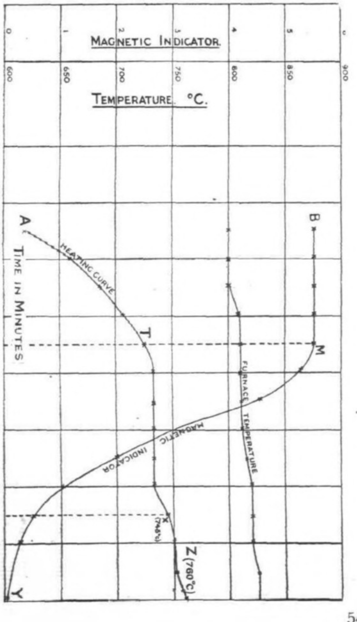
The position and shape of the slots are important and better results would probably be obtained by drawing in the air at a point nearer the leading edge than in the present experiments.

These experiments have been carried out merely to explore the possibilities of the method, and are published to enable the desirability of further work to be discussed, and to indicate the more promising lines of investigation.

THE CORRECT HARDENING OF TOOL STEEL.

We have received from Automatic and Electric Furnaces, Ltd., of 173-175, Farringdon Road, London, E.C.1, Bulletin No. 38, entitled "The Correct Hardening of Tool Steel," by A. R. Page. As it is thought that the information may be of interest to aeronautical engineers, we reproduce the bulletin herewith :

"The usual process of hardening steel tools consists of heating the tools in a furnace which may be either heated by gas or electrically to some predetermined temperature and cooling the steel rapidly, either in water or oil. By this means the great increase in hardness is obtained which is necessary so that the tool will be able to cut or machine softer materials. Hardness, however, is not the only property of the tool which is necessary to assure good cutting performances. The microstructural state of the material is just as important, and it is only by quenching at the exact moment that the best combination of hardness and microstructure can be attained.



"When a piece of tool steel is heated at a normal rate, certain profound molecular changes take place at definite points. The two obvious phenomena which occur are (1) the steel becomes non-magnetic, and (2) the steel absorbs heat, these phenomena commencing at the same temperature, depending mainly on the composition of the material.

"These phenomena, of course, take time, and while both the changes commence simultaneously, the end of the absorption of heat change, usually called the decalescent point, and the end of the magnetic change do not coincide, unless the heating is very, very slow, which, of course, does not obtain in commercial hardening.

"*Some Practical Experiments.*—Some experiments were carried out on some pieces of carbon tool steel containing about 1·10 per cent. carbon and 0·25 per cent. manganese in a Wild Barfield Electric Hardening Furnace, which was fitted with a magnetic indicator. Three pieces of steel A, B and C were used, 5 in. long by ¾ diameter, each having a hole drilled down the centre, half of the length. In A and C were inserted thermo-couples, by which means the heating curve of the steel could be determined.

"Readings were now taken at half-minute intervals of the temperatures of the specimens A and C and of the furnace itself by means of another pyrometer, and also the readings on the magnetic indicator.

"The curves were then plotted against time, and these are shown in the accompanying diagram.

"First of all it will be seen that the specimen A begins to absorb heat, *i.e.*, the beginning of the Ac. point at T, after 4½ min., while specimen B began to lose its magnetism at M also after 4½ min.

"The magnetic curve dropped until at Y the specimen had lost all its magnetism after 9 min., but the heating curve of specimen A showed that the thermal absorption was complete at X, *i.e.*, after only 7½ min., corresponding to a temperature of 745° C. The period of the thermal arrest is shown by TX, during which the specimen had not increased in temperature owing to the absorption of heat. The question now arises which is the correct point at which to quench the steel ? At a point corresponding to X, the end of the thermal arrest, *i.e.*, after 7½ min., or at a point corresponding to Y, the end of the magnetic change, *i.e.*, after 9 min.

"In order that the effect of quenching at the different points could be determined, specimen A was quenched as soon as the thermal arrest was complete, *i.e.*, at X, while specimens B and C were quenched at points corresponding to Y and Z, *i.e.*, when the magnetic change was complete. The specimens were then broken and the fractures examined, sections were cut and examined microscopically, and hardness determinations made.

Results.

"The hardness figures obtained were as follows :—

Specimen.	Ball Hardness.	Rockwell Hardness.
A	661	66
B	694	66½
C.	694	67½

"From the examinations of the fractures and microstructure it was apparent that specimens B and C had been hardened more satisfactorily than A, as is also shown by the hardness figures.

"*Conclusions.*—It seems obvious from these few simple experiments that the correct point at which to quench the steel is at the point where the material becomes non-magnetic, and not at the point where the thermal arrest is complete.

"The conclusion to be drawn is that the Wild Barfield outfit definitely informs the operator as to the *exact* point at which to quench his work, whereas if he depends upon a pyrometer, quenching must take place at some predetermined point above the thermal change point.

"This may be quite satisfactory for steel which is absolutely uniform in composition but slight variations in carbon or manganese will alter this point. With the Wild Barfield Electro-Magnetic method of hardening, no matter what the percentage of carbon or manganese, the exact point for quenching will be visibly shown to the hardening operator."

PRIVATE  FLYING

A Section of FLIGHT in the Interests of the Private Owner, Owner-Pilot, and Club Member

THE MOHAWK "PINTO"

An American Monoplane for the Private Owner

IT was early last year that the then Mohawk Aero Co. of Minneapolis—formed by Leon A. Dahlem, Wallace C. Cumming, Geo. A. MacDonald and S. E. Whitney—started construction on a two-seater low-wing monoplane, from the designs of Mr. Cumming. Subsequently the machine was finished, and after a number of test flights its performance was so promising that the company was enlarged and reorganised under the name of Mohawk Aircraft Corporation, and the "Pinto" was put into production.

There are many noteworthy features about the Mohawk "Pinto" that make it particularly suitable for the private owner. It has exceptionally clean lines, being entirely free from external bracing, as the wings are of the full cantilever type, of thick section. Thus, except for a periodic inspection of the control system, the "Pinto" owner is not worried by any rigging of the wings, while the welded steel tube fuselage not only provides strength but also eliminates rigging and truing-up operations.

It also scores, it is claimed, as regards speed range and stability. Fitted with the 60-80 h.p. Detroit "Aircat" air-cooled radial engine, and carrying full load, it has a maximum speed of 110 m.p.h. and a landing speed of 35 m.p.h. The take-off and pull-up qualities are also good—it is stated that the "Pinto" will unstick after a run of 150 ft. and climb at 800 ft. per minute with full load. The cushioning effect of the low wings, together with the low-landing speed, provide the quick pull-up, so that the "Pinto" is essentially a good "small field" proposition.

The wings of the "Pinto" taper from root to tip both as regards chord and thickness; they are also set at a dihedral angle. A modified U.S.A. 35-wing section is employed. The main spars, which are not parallel, but inclined to each other toward the tip, are of box section with spruce flanges and two-ply mahogany walls. A spruce bulkhead is employed every 14 in.

The ribs are built up with spruce cap-strips and three-ply mahogany webs, while the compression members have spruce stiffeners; torsional stresses are taken by double wire bracing. Three-ply mahogany is employed to reinforce the leading edge, top and bottom, back to the front spar, while the rest of the wing is fabric covered. The ailerons, which are long and narrow, are of the Fries type, having a slight lip on the lower leading edge, giving a balancing action. These ailerons are claimed to be very effective, even at stalling speeds. They are controlled by a torque tube passing through the wing, and the control is automatically detached when the wing is removed, and *vice versa*, when attached.

Each wing is easily and quickly removed by withdrawing four pins, one at the top and the bottom of each spar, so that the machine can easily be stored in an ordinary garage. The wings have been tested by distributing a load of 3,000 lb. over each wing.

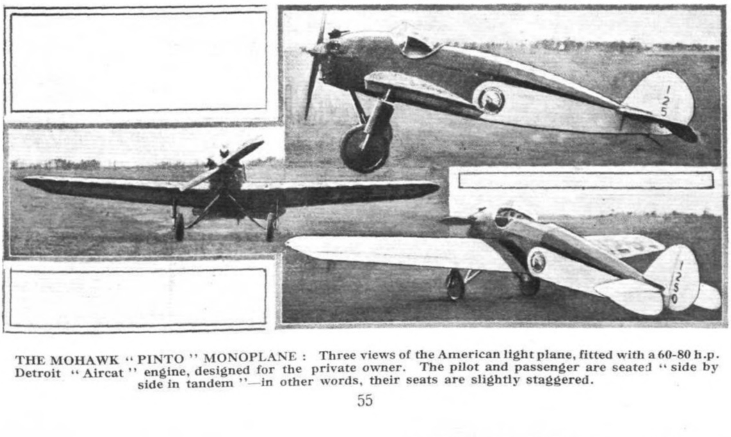
The tail plane is also a cantilever, as is the vertical fin, and we think we are correct in saying that the elevators and rudder are also of the Fries type.

The welded steel fuselage, of rectangular section with rounded top, is without wire bracing, the engine being carried on a frame in the nose. A neat cowling and spinner fairs the engine into the streamline shape of the fuselage. Behind the engine is the petrol tank which supplies the engine with fuel by gravity.

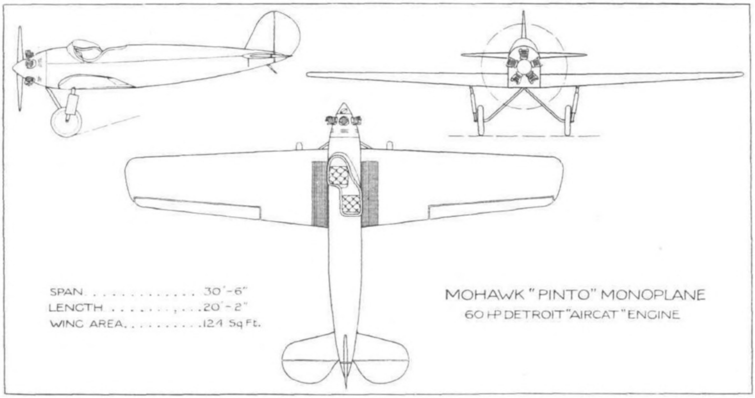
Pilot and passenger are located in the same cockpit, but with their seats staggered, the pilot's being slightly forward on the left-hand side. This arrangement, it is claimed, gives all the advantages of seats in tandem combined with the convenience of the side-by-side arrangement. A large windscreen extending round a greater part of the cockpit serves both pilot and passenger.

A conventional stick and rudder pedal control is fitted, but if desired, dual control can be fitted. All control wires run inside the fuselage and leave the cockpit free. Immediately behind the cockpit is a compartment for luggage, while behind the passenger's seat is a tool compartment.

A wide-track, split- (or non-) axle type landing gear with tripod truss is fitted, the compression member being connected vertically from the wheel up to the front wing spar. This



THE MOHAWK "PINTO" MONOPLANE: Three views of the American light plane, fitted with a 60-80 h.p. Detroit "Aircat" engine, designed for the private owner. The pilot and passenger are seated "side by side in tandem"—in other words, their seats are slightly staggered.



THE MOHAWK "PINTO" MONOPLANE: General arrangement drawings.

member carries a combined pneumatic and oleo shock-absorber, which takes up the shock with a minimum of rebound. The inner V-struts slope up from the wheels to the fuselage, to which they are hinged. The 26-in. wheels are spaced 6 ft. apart, thus giving good stability when taxying. A leaf-spring tail skid is fitted. The principal characteristics of the Mohawk "Pinto" are:—

Span	30 ft. 6 in.
O.A. length	20 ft. 2 in.
O.A. height	6 ft. 3 in.
Chord (root to tip)	5 ft. 6 in.—5 ft. 3 in.
Wing area	124 sq. ft.
Weight, empty	700 lb.
Disposable load	500 lb.
Total weight	1,200 lb.
Weight per square foot	9·6 lb.
Weight per horse-power	20 lb.
Speed range	35—110 m.p.h.
Climb	800 ft./min.
Cruising range (90 m.p.h.)	4 hours.

LIGHT 'PLANE CLUBS

London Aeroplane Club, Stag Lane, Edgware. Sec., H. E. Perrin, 3, Clifford Street, London, W.1.

Bristol and Wessex Aeroplane Club, Filton, Gloucester. Secretary, Capt. C. F. G. Crawford, Filton Aerodrome, Patchway.

Hampshire Aero Club, Hamble, Southampton. Secretary, H. J. Harrington, Hamble, Southampton.

Lancashire Aero Club, Woodford, Lancs. Secretary, C. J. Wood, Oakfield, Dukinfield, near Manchester.

Midland Aero Club, Castle Bromwich, Birmingham. Secretary, Maj. Gilbert Dennison, 22, Villa Road, Handsworth, Birmingham.

Newcastle-upon-Tyne Aero Club, Cramlington, Northumberland. Secretary, A. H. Bell, c/o The Club.

Norfolk and Norwich Aero. Club, Mousehold, Norwich. Secretary, H. O. Bennett, 5, Opie Street, Norwich.

Nottingham Aero Club, Hucknall, Nottingham. Hon. Secretary, Cecil R. Sands, A.C.A., Imperial Buildings, Victoria Street, Nottingham.

The Scottish Flying Club, 101, St. Vincent Street, Glasgow. Secretary, Harry W. Smith.

Suffolk Aeroplane Club, Ipswich. Secretary, Courtney N. Prentice, "Hazeldell," Stowmarket, Suffolk.

Yorkshire Aeroplane Club, Sherburn-in-Elmet, Yorks. Secretary, Lt.-Col. Walker, The Aerodrome, Sherburn-in-Elmet.

LONDON AEROPLANE CLUB

REPORT for week ending January 22.—The flying time for the week ending 22nd inst. was 2 hrs. 20 mins. Tuesday, the 17th, was the only day on which flying was possible, and then for a short time for solo flying only.

The following members flew solo: R. Sanders Clark, H. Solomon, W. Hay, A. F. Wallace, and C. Paul.

The London club has experienced a very bad time for the last two months. The very short periods between the rain does not allow the aerodrome to recover, and it has been quite unfit for instructional work. It has, however, given the staff the opportunity of overhauling the engines, and the four "Moths" are now ready for making up some of the lost time as soon as the weather conditions permit.

BRISTOL & WESSEX AEROPLANE CLUB

FLYING report for week ending January 21.—Total flying time, 1 hr. 25 mins. Instruction, 1 hr. 25 mins. Instruction (with Mr. E. B. W. Bartlett): Hon. H. C. H. Bathurst, Mr. D. Tanner.

The total hours flown are the lowest recorded since the club started flying. The weather has been very bad, and flying was only possible for half a day.

Owing to the increase of the clerical work of the club, Col. Fleming has found it impossible to devote sufficient time to club matters and Capt. C. F. G. Crawford has taken on the duties of secretary.

LANCASHIRE AERO CLUB

REPORT for week ending January 21.—Flying time, 5 hrs. 35 mins. Instruction, 1 hr. 55 mins. Solo flights, 1 hr. 30 mins. Passenger flights, 1 hr. 45 mins. Tests, 25 mins.

Instruction (with Mr. Brown): Messrs. Meads, Gort, Hall and Moss.

Soloists (under instruction): Mr. Browning.

Pilots: Mr. Twemlow, Miss Brown.

Passengers (with Mr. Twemlow): Messrs. Allott and Sullivan. (With Mr. Cantrill): Mr. Brown. (With Mr. Lacayo): Mr. Browning.

There is nothing aeronautical to report, except that Mr. Browning successfully accomplished his height test.

O.K.'s engine is suffering from valvular disease and the doctor has ordered complete rest during the week, leaving LV to carry on gamely in spite of her varicose veins. Fortunately she has been flying like a two-year-old (or rather *not* like a two-year-old), and leaped up to 6,000 ft. like a young gazelle (or wapiti).

Empire Flights.—Mr. Cantrill, who left Woodford on December 31, 1927, with the object of flying to Blackpool, returned safely on January 22, 1928, having reached Southport. He covered a total distance of nearly 100 miles at an average speed of a little under ¼ m.p.h.

MIDLAND AERO CLUB LIMITED

FLYING report for week ending January 22.—Total flying time, 5 hrs. 35 mins.

Dual instruction (with Mr. McDonough): Messrs. E. Lane, E. Wynn, G. Robson and N. Baker.

Solo: Messrs. S. H Smith, R. Jackson, H. Willis and E. R. King.

Owing to high winds and heavy rain, flying was again restricted this week.

NEWCASTLE-UPON-TYNE AERO CLUB

REPORT for week ending January 22:—Total flying time, 14 hrs 20 mins. on club aircraft, (Q V), L X. not yet having returned from De Havillands. In addition to this, 1 hr. 30 mins. was flown on Miss Leathart's "Grasshopper," piloted by Mr. Parkinson, with Miss Leathart and some of her friends as passengers.

Instruction, 8 hrs. 10 mins.; solo, 1 hr. 30 mins.; "A" Pilots, 4 hrs. 30 mins.; tests, 10 mins.

The following flew under instruction: Miss Rambaut, Mr. L. Runciman, Mr. L. M. Middleton, Mr. N. Horn, Mr. V. Heaton, Mr. A. Sadler.

Solo: Mr. De Pledge.

"A" Pilots: Mrs. Heslop, Dr. Dixon, Mr. C. Thompson, Mr. D. Wilson, Mr. F. L. Turnbull.

Passengers.—With Mrs. Heslop: Miss Leathart, Mr. C. Thompson. With Mr. C. Thompson: Mr. Luckman, Mrs. Heslop.

On Sunday afternoon a further foot race over 100 yards was run. There were eight entries and Mr. H. Ellis was the winner. Next week's event—around the aerodrome. Approximately 1½ miles.

NORFOLK & NORWICH AERO CLUB

REPORT for week ending January 22:—Total flying time, 3 hrs. 30 mins.; instruction with Capt. Lines: Mr. Surtees. Soloists, Messrs. H. Pank, F. Gough, C. A. Rea. Passengers, Messrs. G. Brett and H. Mack.

NOTTINGHAM AERO CLUB

REPORT for week ending January 20.—Total flying time, 13 hrs. 10 mins. Dual, 5 hrs. 35 mins; solo (A), 20 mins.; solo, 5 hrs. 15 mins.; passenger, 1 hr. 30 mins.; tests, 30 mins.

Dual (with Mr. B. Martin): Messrs. Granger, Pilgrim, Hancock, Calladine, Glenn and Stevenson.

Solo ("A" Licence): Mr. Paul. Solo (under instruction): Messrs. Blake, Cox, Whitby, Hallam, Sands and Wilcox.

Passenger (with Mr. Martin): Messsr. Kay, Waller, Siddons and Langster.

High winds have made flying interesting, but possible on only four days. Wilcox has re-qualified for his "A" and is the first club member to do so.

SUFFOLK AEROPLANE CLUB

REPORT for week ending January 22:—Flying time, 1 hr. 30 mins.

Instruction: With Mr. Lowdell—Mr. H. Billington.

Passenger (with Mr. Prentice)—Master Eugene Prentice.

Soloists: Dr. J. Sleigh, Mr. S. Schofield.

We have always been very proud of our president, the Hon. Lady Bailey, and we are delighted that the well-deserved honour of champion lady aviator of the world should be conferred upon her.

Lady Bailey flew over on Saturday in spite of the extremely bad weather and attended the club's first annual meeting in the evening. At this meeting it was definitely decided to purchase a second machine immediately.

A lengthy discussion took place as to the type of machine, and several members were keen to have a monoplane. The committee were instructed to make enquiries in this connection.

Gales and fog have held up flying throughout the week.

YORKSHIRE AEROPLANE CLUB

REPORT for week ending January 21:—Flying time, 9 hrs. 15 mins. Instruction, 3 hrs. 10 mins; soloists, 4 hrs 25 mins.; passengers, 1 hr. 40 mins.

Instruction (with Capt. Beck): Messrs. Bamford, Ostler, Ellison, Birch, Shires, R. K. Lax.

Soloists: Messrs. Dawson, Ellison, Birch, Lister, Critchley, M. B. Lax.

"A" Pilots: I. Thomson, R. Atcherley, D. Atcherley, Wood.

Passengers (with Capt. Beck): Mr. Greenwood, (with Mr. Lister) Mr. Hepworth (with Mr. Wood) Mr. Critchley.

Things are looking up. We have actually had two and a-half days during the past week when the weather permitted flying. We are also in imminent danger of having a second machine serviceable for the ensuing week instead of the usual one.

On Thursday Jackie Ellison completed his height test, and all examinations for his "A" licence. The landing minus engine from 4,580 ft. displayed Mr. Ellison's very fine judgment; in fact, it was so fine that another foot would have left him in the next field on the other side of the fence. However, he was well within the required distance.

Mr. R. K. Lax has at last consented to have his photograph taken and complete his application form, his "A" tests having been passed a couple of months ago. So we have to sting the Air Ministry for £100 this week.

The subsidiary branch of our club, viz., "The Moaner's Club," although small in number (two out of 249 or so) is strong in spirit! It will be glad to hear that it has recruited a veritable champion; in fact, there is little doubt it will elect him president. This member having only joined about a fortnight ago, and been out to the aerodrome twice, has done about 10 minutes' flying and one hour's grousing on each occasion; of course, the usual moan: that he wasn't in the air for anything like the time attributed to him! It is very gratifying, however, to have a gentleman with 2,000 hours' flying to his credit who finds that "time" still "flies" too. Atta grousers!

A "Widgeon" for India

THE Westland Aircraft Co. has received an order for a "Widgeon" from the French Motor Car Co. of Calcutta.

A Liverpool Flying Club?

THE Liverpool organisation for advancing the interests of Liverpool is holding a public meeting at the Liverpool Town Hall at noon on January 26 for the purpose of discussing the formation of a flying club.

A Flying Club for Essex

MR. E. A. SISSONS, of 5, Chadwell Heath Lane, Chadwell Heath, Essex ('phone, Seven-Kings 1032) would like to hear from anyone interested in the formation of a light 'plane club for Essex. Mr. Sissons states he was the founder of the East London Aero Club in 1911, and the South Essex Gliding Club in 1913, the activities of which were abruptly suspended in 1914 by the outbreak of the war.

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MODEL AIRCRAFT EXHIBITION

AT the Royal United Services Institution in Whitehall, London, S.W., an interesting group of model aeroplanes lent by the Overseas Board of Trade has been added to the historical exhibition. They reveal the more obvious strides in aircraft design during the twenty-five years' history of flying. In an illuminated case the machines are appropriately suspended against a background with a sky effect, and as they are well and accurately constructed, mostly by the firms who made the originals, they provide, after a short study, a good and authentic knowledge of broad design even to the lay mind. Naturally enough, the first model is of a 1908 Wright biplane, complete with its chain-driven propellers on the wings, and curved skids which served as the undercarriage. Probably most visitors will not be familiar with such an early machine, and will consequently wonder how it ascended from the ground with skids. It was mostly catapulted into the air. It rested upon a trolley which ran on a single line about 75 ft. long. The motion was provided by the releasing of a heavy weight suspended in the air between supports fixed to the ground at the beginning of the line. A rope from this weight ran down to this line, and along to the end, where it turned on a pulley and came back to the trolley. When the weight was released the trolley was shot forward, and with the help of its own engine the machine gathered sufficient speed to lift off the trolley. But this starting operation was often dispensed with, and ascents made from the actual ground with the skids.

The second model is that of the 1908 Avro triplane, which had a 9 h.p. engine. It is more simple and cleaner in design than the former machine, and has a fabriced fuselage.

Cody's big, complicated, chain-driven machine, a mass of struts and wires, with a small wheel on each bottom wing tip besides the three landing wheels, is an interesting model.

There is Bleriot's 1909 monoplane showing the type on which he made the historic first Channel crossing in July, 1909.

Short Bros. Hydroaeroplane (1912) reveals a marked advancement in clean and neat design, too. It was the first successful British seaplane, and carried two passengers and a pilot.

The Avro training machine will claim recognition from the visitors to the exhibition perhaps as well as any model there.

The Sopwith Bat Boat (1913) was the first British flying-boat and the first amphibian ever designed. The hull was built by Messrs. Saunders and Co. The wing structure, with the engine in the centre, was mounted rather high over the rear half of the hull, and looks like a completely-detached unit.

The next model is also a Sopwith machine, the Tabloid (1913), which was the forerunner of all small high-speed single-seater machines. It had a 80 h.p. Gnome engine and a speed range of 37-92 m.p.h.

The Vickers "Gunbus" (pusher) shows the earliest type of fighting machine. It carried a gunner and pilot in a front nacelle.

War models are well represented. They include the 1916 R.E.8 machine designed for artillery observation and night bombing, and the Bristol Fighter. There is also an impressive model of our first big bomber, the Handley Page 0/400, looming like a dark monster beside the smaller models and immediately suggesting its sinister purpose. This type made very successful raids on Constantinople and the Rhine towns.

Next range the Fairey IIID seaplane with variable camber gear, the single-seater Sopwiths, Camel (1916) and Snipe (1916); a Supermarine "Seagull" flying boat, a D.H.9 and the single-seater S.E.5.

Among the post-war models is a fine specimen of the Blackburn "Dart" torpedo biplane, complete with torpedo, a Fairey "Pintail" amphibian, an Armstrong-Whitworth single-seater Siskin Scout, and a huge dominating Vickers "Victoria" troop-carrier, which lifts about 23 troops and their equipment beside the crew. Others include the four-passenger seater D.H.50, D.H.53 light aeroplane, Handley-Page "Hamilton" commercial machine, and, separately, a large model of a Supermarine "Southampton" flying boat; the type which is at present carrying out the R.A.F. cruise to Australia and Singapore. In a window is a model of the D.H. Hercules.

At the back of the exhibition case is a very interesting array of old prints depicting the efforts of the earliest balloonists and other aerial endeavours, including man-power flight, and an early successful parachute descent, in which the parachutist had thoughtfully attached a sort of bucket chair to his parachute for his comfort.

AIRISMS FROM THE FOUR WINDS

African Survey Flight Starts

AFTER his enforced stay at Malta through damage to his "Singapore" flying boat, Sir Alan Cobham left Malta on January 21, and later arrived at Benghazi on the North African coast. The next day he reached Tobruk where the Italians gave him facilities for refuelling. A gale sprang up during the night and the flying boat had to be watched. On the following day, January 22, the flight was resumed to Abukir, where a safe landing was made in the bay early in the afternoon.

Great Flying-Boat Cruise

ON January 19, the four R.A.F. "Southampton" flying-boats which are flying towards Australia, flew from Trincomalee, Ceylon, to Lake Pulicat, Madras; and then to Cocanada, Madras, a distance of 280 miles, on January 20. They reached Chilka Lake (Bihar and Orissa) from the Cocanada on January 23.

New Zealand Airmen's Fate

CONCERNING the fate of the two New Zealand airmen Lieut. Moncrieff and Capt. Hood, Capt. Knight, their reserve pilot, who was not on board, suggests as a possible cause of the disaster that the two airmen attempted to change seats, which was not possible to achieve in their Ryan monoplane. He believes, too, with the officials, that the machine sank when the signals ceased. There are still hundreds of people who believe they saw the machine, however, and the captain of the ship "Kaiwarra" is particularly convinced.

Another Sydney-Wellington Attempt?

DESPITE the warning of Lieut. Moncrieff and Capt. Hood's fate, Capt. Moody, a Queensland pilot, proposes to fly from Sydney to Wellington shortly.

The French South American Tour

CAPT. COSTES and Lieut. Le Brix flew from Colon, Panama, to Maracay, Venezuela, a distance of 1,000 miles, on January 17, in 11 hours. On their arrival they were decorated with the Order of the Liberator by the President.

Foul Play on French Air Liner

A CRASH that occurred to a Latécoère mail aeroplane on January 16, in Uruguay, causing the loss of two lives, is attributed to foul play. It is stated that an examination of the wrecked machine revealed that one wing had been deliberately cut, apparently at Porto Alegre, where the machine started.

Swedish Aircraft for Russia

THE Russian Government has placed a large aircraft order with Sweden. The first consignment of eight three-engined machines of the R 42 type was shipped on board the Soviet steamer *Leonid Krassin*, on January 10.

A New Ford Light 'Plane

A NEW model of the Ford aerial "Flivver," recently produced at the Ford factory—differing in several respects from the machine described in FLIGHT some time back—left Detroit on January 24 for a final long-distance test flight. It was piloted by Harry Brooks, who hoped to fly to Miami in about 14 hours. The machine, which is a low-wing monoplane of 20-ft. span, carried 48 gallons of petrol.

Bemuda Air Safety Competition

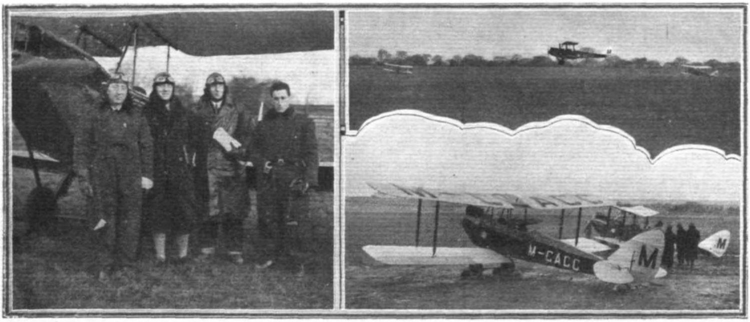
A PRIZE of £2,000 has been offered for a flight between New York and Bermuda, any time between February 1 and Aug. 1. The first pilot to accomplish the distance will not necessarily win the prize, for main considerations in making the award will concern the safety of the flight and accurate navigation, for which entrants must provide as far as is in their power. Only seaplanes and amphibians will be allowed, and each crew must consist of a navigator as well as pilot, whilst wireless must be part of the equipment. The distance between the two places is 783 miles. One of the intended competitors is Col. A. Goebel, who won the first prize in the Dole competition flight between San Francisco and Honolulu last year.

Fighting Eight Miles Up

THE U.S. Army has placed an order with the Curtiss Aeroplane Co. for five Curtiss "Superhawk" fighters, which will be capable of fighting at an altitude of eight miles. Oxygen bottles will have to form part of the equipment in the machines, and the cockpits specially insulated and heated.

Australian Aerial Services

AUSTRALIAN Aerial Services, Ltd., which operates the Melbourne-Hay, Cootamundra-Hay-Adelaide, and Mildura-Broken Hill air lines, had completed, at the end of November last, a total mileage of 506,879. During the month of November itself, the mileage flown over mail routes was 12,798, and that flown by taxiplanes, 1,208. The arrivals at terminal airports within 30 min. of schedule figured at 70 per cent. There was no injury to passengers or crew during this period.



["FLIGHT" *Photographs*

"MOTHS" FOR SPAIN: Recently three de Havilland "Moths" were flown to Spain, two for the Aero Club of Madrid, and one for Duc D'Estremera. The three machines were flown by three brothers, Juan, Jose and Enrique Ansaldo. One of the machines also carried the Commandante Ricardo Bellot.

THE ROYAL AIR FORCE

London Gazette, January 17, 1928.

General Duties Branch.

The follg. Flight Cadets having successfully passed through the Royal Air Force Cadet College, Cranwell, are granted permanent commissions as Pilot Officers, with effect from and with seniority of Dec. 17, 1927 :—E. A. Jones, K. F. T. Pickles, A. W. Hunt, E. R. White, D. J. Waghorn, N. A. Tait, W. H. Hutton, G. H. H. Procter, J. S. Dewar, R. C. Field, C. E. St. J. Beamish, J. R. H. Pott, P. J. H. Halahan, H. C. Parker, J. H. L. Dillon-Trenchard. W. K. Beisiegel, H. A. Constantine, S. L. Blunt, H. H. Leech, N. B. Norris, S. R. Groom, P. J. B. Chalmers, J. E. Allen, J. E. MacCallum, E. J. Hill.

The follg. are granted short service commissions as Pilot Officers on probation, with effect from, and with seniority of, Dec. 30, 1927 :—H. Bailey, V. S. Bowling, G. C. Butler, C. W. F. Carter, T. J. Clarke, N. W. Creasy, R. N. Dashwood-Tandy, W. H. B. De Courcy-Wheeler, B. G. D'Olier, E. D. Elliott, D. A. Forbes, W. R. Hartwright ; J. O. C. Huggett, J. B. Mackenzie, K. I. F. C. Norman-Wright, N. C. Odbert, P. B. T. Rowland, B. P. Silk, J. H. T. Simpson, J. S. Tanner, W. R. Tope, R. C. Warner, W. R. C. Wilkins, L. E. A. Wright. The follg. are granted short service commissions as Pilot Officers on probation with effect from the dates indicated, and with seniority of Dec. 30, 1927 :—J. B. Fyfe (Dec. 31, 1927) ; R. A. E. Birch (Jan. 2) ; B. W. Figgins (Jan 7).

The follg. Pilot Officers are promoted to rank of Flying Officer :—J. Constable-Roberts (Sept. 13, 1927) ; G. M. Beattie, J. E. A. Binnie, W. C. McNeil, J. E. McC. Henderson (Oct. 11, 1927) ; L. E. R. Fisher, M.C. (Lt. R.A.R.O.) (since deceased) ; L. T. Keens, K. C. Netherton, H. J. G. E. Proud, B. F. O. Smith (Nov. 8, 1927). The follg. Pilot Officers on probation are confirmed in rank :—C. C. D. Williams (Oct. 24, 1927) ; K. E. Parker (Nov. 30, 1927).

Flying Officer R. Legg (Lt. K.O.S.B.) relinquishes his temp.comm. on return to Army duty (Jan. 3) ; Flying Officer J. W. Vanderbeeck relinquishes his short service comm. on account of ill-health (Jan. 18).

Medical Branch.

Flying Officer J. D'I. Rear is promoted to rank of Flight Lieutenant (Jan. 1).

Memoranda.

The permission granted to Lt. H. B. Challen to retain rank is withdrawn on his enlistment in the Territorial Army (Dec. 12, 1927).

Sec. Lt. J. A. Payne is deprived of permission to retain rank on conviction by the Civil Power (Oct. 11, 1927). (Substituted for *Gazette*, Nov. 1, 1927).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the R.A.F. are notified :—

General Duties Branch.

Group Captain J. H. A. Landon, D.S.O., O.B.E., to H.Q., Halton, for administrative duties, 1.2.28.

Wing Commanders : E. L. Gossage, D.S.O., M.C., to Air Ministry, Directorate of Organisation and Staff Duties, for Air Staff duties, 1.1.28. J. E. A. Baldwin, D.S.O., O.B.E., to R.A.F. Depot, Uxbridge, whilst attending course at Imperial Defence College, 16.1.28.

Squadron Leaders : V. Greenwood to R.A.F. Depot, Uxbridge, 20.1.28. G. C. Pirie, M.C., D.F.C., to H.Q., Iraq, 6.1.28. G. F. Breese, D.S.C., to No. 99 Sqdn., Upper Heyford, 16.12.27. T. W. Elsdon, to H.M.S. *Furious*, 6.1.28.

Flight Lieutenants : G. T. Richardson, to No. 111 Sqdn., Duxford, 19.1.28. S. T. B. Cripps, D.F.C., to No. 19 Sqdn., Duxford, 25.1.28. E. N. T. Edwardes, to No. 8 Sqdn., Middle East, 6.1.28. G. M. Moore, M.C., to Central Flying Sch., Wittering, 21.1.28. S. E. Storrar, to No. 7 Sqdn., Worthy Down, 16.1.28.

Stores Branch.

Squadron Leader W. F. Bryant to Central Supply and Petrol Dump, Iraq, 6.1.28.

Flight Lieutenants : T. H. Jolley, to H.Q., Middle East, 6.1.28. J. H. Dale, to Aircraft Park, India, 6.12.27. J. Hobbs, to H.Q., India, 7.12.27. F. H. Sims, to Station H.Q., Hinaidi, 21.12.27.

Flying Officers : A. J. Walker, to Aircraft Depot, Iraq, 16.12.27. F. C. Griffin, to No. 6 Sqdn., Iraq, instead of to Aircraft Depot as previously notified, 2.12.27. E. A. Slater, to No. 2 Wing H.Q., India, 7.1.28.

Accountant Branch.

Flying Officer J. L. Armstrong to Superintendent of Reserve, Hendon, 4.1.28.

Flight Lieutenant R. Byrne, M.C., to H.Q., Middle East, 6.1.28. W. E. V. Richards, to School of Photography, Farnborough, 13.2.28.

Medical Branch.

Flight Lieutenants : T. V. O'Brien, M.B., to R.A.F. Depot, Uxbridge, 24.12.27. L. C. Palmer-Jones, M.B., to No. 208 Sqdn., Middle East, 3.12.27.

Flight Lieutenant (Dental) N. J. O'Roilly, to R.A.F. General Hospital, Iraq, 11.11.27.

Flying Officers : J. Maguer, M.B., to Aircraft Depot, India, 17.11.27. G. T. O'Brien, Home Aircraft Depot, Henlow, 9.1.28.

Flying Officers J. D. I. Rear, J. Hill, M.B., M. O'Regan, to H.Q., Iraq, 6.1.28.

NAVAL APPOINTMENT

The following appointment was made by the Admiralty on January 18 :—

Lieut.-Commander (Flight-Lieut., R.A.F.) : S. Richardson, to *Vivid*, for *Courageous*, Jan. 12.

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THE HEALTH OF THE R.A.F.

Report for 1926

A REPORT on the health of the Royal Air Force for 1926 has just been issued. The incidence of sickness, deaths, and number of sick daily was slightly higher than in 1925, but that of invaliding showed an appreciable decrease. Of the officers of the general duties branch, 89 per cent. were found fit for full flying duties at the annual medical examination. The average strength of the Air Force was 32,985, and the number of cases of disease and injury was 26,422—equivalent to a case incidence of 801·1 per 1,000 of strength compared with 901·1 in 1925 and an average of 1,119·4 for 1921–24.

Number of sick daily per 1,000 of strength was 24·4 compared with 23·6 in 1925. Average duration of home cases, excluding 48-hour cases, was 19·7 days, as against 16·7 the year before. The corresponding figures for the forces abroad were 17·1 and 19·8. At home the case incidence was lower than in 1925, this being considered as due to the reduction of influenza attacks, which totalled 472 as compared with 1,080 of the year previous.

Increased incidence of sickness abroad was attributed chiefly to malaria in India and Iraq. In the latter country this was caused by the after-effects of the floods, which left pools of water lying over an enormous area even in the late summer. In India the disease was also prevalent amongst the civil population, and this, with a tendency to slackness in the care of nets and proper adjustment of punkahs, etc., may be considered the cause of the disease among the forces. Generally, however, the health of the R.A.F. in India and Iraq was judged satisfactory.

With regard to accidents, the report states that in relation to the number of hours flown these were lower than in previous years. There were 179 casualties, of which 78 were deaths. Injury through airscrews occurred in 29 instances, and caused two deaths and one case of invaliding. No one was wounded in action, and no deaths resulted from the seven parachute accidents.

Viewing the situation at home, the report gives the number of cases at 14,974 out of an average force of 23,958. This was a slight improvement on the year before. As in past years, the highest disability incidence occurred in the youngest age group. An analysis of stations which had an average strength of 500 or over showed that Digby had the highest sickness incidence, whilst Halton came next and Cranwell third. These same three stations headed the corresponding list the year before, though not in the same order. High figures were expected of Halton and Cranwell because their strength included aircraft apprentices.

Abroad, out of a force of 9,027 there were 11,448 cases, giving a slightly higher percentage than in 1925, but a considerable lower one than for the previous four-year period. Dysentery, malaria, and sand-fly fever increased at all stations except Aboukir, Abu Sueir, Hinaidi, and Malta. The highest incidence of disease abroad occurred at Basrah, as in former years. There, out of 730 cases 508 were due to the three diseases mentioned.

During the year the "Flying aptitude apparatus" was tested at No. 2 Flying Training School. The conclusions arrived at were that it offered great assistance in making a decision upon a doubtful flying pupil. In the past the unsupported opinions of instructors had to be solely depended upon and definite evidence was rarely available ; but graphs produced by this new apparatus constituted definite evidence, not only of physical, but also of temperamental attributes in the pupil. It was made clear, however, that flying aptitude cannot be induced by the apparatus, but it seems that under proper supervision practice induces facility in the co-ordinated movements employed in flying. Thus, an instructor can be provided with more apt material for training ; also, it may help to eradicate some flying faults. Consequently, the apparatus implies a saving of time and money in training flying pupils. For the period the report concerns experiments had coincided with actual flying training, so that the separate value of the apparatus had not been judged. By now this will have probably been done, but the prior view expressed a fear whether the separate use of the apparatus would give the pupil an impression that it was teaching him to fly, which it could not do. The first experiments showed its definite value to be in assisting original selection of pupils, the elimination of unsound pupils, and in actual flying training. On comparing the results obtained from the apparatus after pupils had been tested, it was found that they closely agreed with the personal opinions of their instructors. Of the pupils who practised on the device, four flew solo after five weeks' training as against two among those who did not practise, and the corresponding figures at the end of the tenth week were 10 against six ; thus the apparatus justified itself and is probably established now.

CORRESPONDENCE

[The Editor does not hold himself responsible for opinions expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for insertion in these columns.]

THE CASE FOR THE CANTILEVER WING

[2168] In your current issue (January 12) I note with interest a description of a new Koolhoven (F.K. 30) light monoplane, and, in particular, the feature of the "turntable" mounting for the cantilever wing, a novelty which your article stresses as "remarkable."

What is perhaps still more remarkable is the fact that this idea has lain dormant in design practice for so long, since its introduction would have given practical impetus to the case for the cantilever principle on commercial aircraft and small shipboard fighters, as well as light 'planes, by allowing the cantilever mono. to compete on level terms with the folding-wing biplane.

The writer is especially interested in the practical evolution of this scheme, as he proposed and illustrated this turntable device on several designs presented in a paper to the student body of the Royal Aeronautical Society (Pilcher Prize Essay, 1921-22). One of these designs was a small cantilever monoplane with 200 h.p. radial engine, carrying pilot and four passengers, the specification being similar, in fact, to many of the present American "feeder" transport machines. It is hoped to treat this subject more fully at a later date, when the attractive simplicity of the turntable arrangement will be apparent from the drawings. It is questionable whether the folding-wing biplane can offer such structural simplicity (with its bearing on first cost and upkeep) and aerodynamic cleanness.

Another feature of the suggested design which may be worth recalling now—reviewing perhaps at a later stage—was an automatic rear camber flap, adding less than 20 lbs. to the normal aileron controls. The writer actually filed provisional patents for these ideas, but after polite rejection on the part of several English firms, later abandoned them and proceeded to Holland.

It would be unfair to conclude without reference to an earlier series of articles in FLIGHT (March 11, 18 and 25, 1920) on "The Case for the Cantilever Wing," under the pen-name of "Marco Polo," a pseudonym which older readers of the paper will probably penetrate. The designs there submitted (1920), while not incorporating the actual "turntable" principle, introduced a swivelling parasol wing, which may rightly be accepted as the forerunner or "germ" of the later idea, and the present writer, at any rate, wishes unreservedly to acknowledge his indebtedness to "Marco Polo" for his early thoughts along these lines.

The practice of "poaching" other men's ideas without acknowledging their original source is apparently as popular in the aircraft industry as in every other sphere of human endeavour, but while in the universal field of science the only thing that finally matters is the work and not the man, at the same time in the interest of common justice, it is proper to award priority where such is rightly due.

"WING TIPS"

A BRITISH GLIDING TEAM FOR GERMANY

[2169] It is proposed to enter a British team at the German gliding meeting to be held next August in the Rhon Mountains, near Frankfurt. As this meeting is open to machines and members of all nationalities, it is felt that Great Britain should be represented.

The organization of such a team must, of course, depend on the support which is forthcoming, and I shall be glad if any reader who is interested will write to me and say in what way help will be given. Supporters may take part in gliding practices, and will, if chosen, go to Germany as a representative of Great Britain. Supporters may make financial contributions to the venture even if they do not wish to take part in the actual gliding. The proposals are these:

(1) That everyone wishing to take part in glider practices shall subscribe, say, £5 by way of entrance fee to cover preliminary and general expenes.

(2) When sufficient names have been obtained, a general meeting will be held to select a machine, and a site for gliding. When sufficient funds have been collected a machine will be purchased, and gliding will commence.

(3) That gliding practice be held near Harrogate, where I can personally supervise the training and ground arrangements. In this connection, of course, the members may rule otherwise at the general meeting. From the training practices four or six pilots will be selected to represent this country in the competition.

(4) Except for the initial entrance fee, members should not be put to any expense other than their own transport and hotel fees either in England or in Germany.

At the gliding meeting held in Germany last year a great desire was expressed that a British team should come to the next competition—a French team was there last year. I sincerely hope that support will be forthcoming, and that we shall be able to send a team which will add fresh credit to British prestige in the field of gliding.

E. DE BUSBY, *Lieut.*

Ashville College, Harrogate.

THE BERMUDA AIR SAFETY COMPETITION

[2170] We have been asked by Maj. Hemming, of the Aircraft Operating Co., Ltd., to draw our readers' attention to the following extract from a letter he has received from Mr. J. P. Hand (Chairman of the Bermuda Trade Development Board) regarding the Bermuda Air Safety Competition between the colony and New York, which opens from February 1 to August 1:—

"A number of us here are most keen to secure a British entry, and, having regard to the expense of getting a 'plane to America, I feel sure that I could raise a sufficient amount locally to assist in this connection.

"I have in mind at the moment raising £1,000 to add to the £2,000 offered by the Bermuda Government, in the event of the contest being won by a British entrant.

"I would appreciate tremendously your interesting yourself in this matter, as I feel that British prestige in this part of the world is at stake, and anything that I can do locally to induce one of your good airmen to enter in this contest will be done."

Maj. Hemming adds that he can assure any prospective entrant that he will receive a very hearty welcome in Bermuda.

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Calendar, 1928. The Palmer Tyre, Ltd., 100–106, Cannon Street, London, E.C. 4.

A Manual of Flight-Test Procedure. By W. F. Gerhardt. Engineering Research Bulletin, No. 9. December, 1927. Department of Engineering Research, University of Michigan Ann Arbor, Michigan, U.S.A.

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