

the airline point of view, to incorporate desirable maintenance features is the only way to keep the aircraft flying

I was surprised that Mr FITZWILLIAMS shies away from the "BEAlne Bus" on account of size after his brilliant paper before the Helicopter Association on the Giant Helicopter many times larger than the "BEAlne Bus" Perhaps Mr FITZWILLIAMS has had second thoughts and maybe after this discussion I shall too

But I do emphasise that from the transport operator's point of view, the one thing we want to achieve is safety, reliability and regularity from a vehicle which can be operated at a profit at fares which the public can afford And as I have tried to point out in this lecture, on the information we have on which to plan, that would seem to be within the bounds of possibility only if we can achieve a large and fast helicopter And so I come back to my plea for the "BEAlne Bus"

The Chairman I am sure you will want to join with me in expressing to Mr MASEFIELD our gratitude for this most excellent and outstanding paper—I think the most outstanding that has ever been delivered to the Helicopter Association and one which we shall be very proud to see recorded in our Journal for many years to come

Since this meeting several written contributions to the Discussion have been received and Mr MASEFIELD has very kindly agreed to reply to these The next issue of the Journal (Vol 6, No 4, April, 1953) will therefore contain the further contributions and reply

Brains Trust

A record of a Brains Trust held in the Library of the Royal Aeronautical Society on Friday, the 3rd October, 1952 The Question Master was Mr N E ROWE, and the members of the team were

O Fitzwilliams	R N Liptrot	P G Masefield
C T D Hosegood	A McClements	F O'Hara

Thirteen questions, selected from those submitted by members of the Association and not previously seen by the team, were discussed in detail, and the Editors are deeply indebted to Mr D M DAVIES and Mr J S SHAPIRO for summarising the main points of the discussions as they saw them

1ST QUESTION

What do you think of the term "Airstop" ?

Mr MASEFIELD was emphatic in condemning this expression He thought the suggestion contained in the word "Airstop" was that the air might stop, which he hoped would never happen He thought the proper name for a helicopter operating site was "Rotor Station" because it conveyed the ideas of a rotorcraft and the idea of a central place where rotorcraft come and depart Mr FITZWILLIAMS agreed, but thought helicopter landing grounds may not all be "Stations" in the centre of cities He visualised the possibility of a revival of an idea first put forward by Alan Cobham for fixed-wing aircraft It was then thought that landing grounds close to cities could be used for personal aircraft flying in Although this proposal had not proved practical for fixed-wing aircraft it may become practical for personal helicopters Indeed, in view of present day control of air space over large cities, all private aviation would be banned there in bad visibility and some facilities would have to be provided for owners of personal helicopters which would guarantee a measure of utility even in bad weather

Mr MASEFIELD referred to the example of his arrival at Hamilton Place from Northolt to take part in the Brains Trust. He hoped that it would be possible in future to enjoy the great virtue of the helicopter as a means of transport, namely their ability to get right into city centres and he was sceptical about the utility of a helicopter which did not permit making use of its most valuable feature. He thought, therefore, that rotor stations should be in the centre of the city and that buildings like a re-built headquarters of the Royal Aeronautical Society might have a roof on which private helicopters can land. He knew of course, that the question of noise would have to be solved.

Coming back to terminology, Mr McCLEMENTS thought that no matter how you interpret the term "Airstop" it gave a wrong idea and Mr O'HARA suggested that the choice of words could be considered from the point of view of public taste and asked whether the Assembly would register a vote on the subject. Mr MASEFIELD reminded the team that Rotor Station was originally created by Mr ROWE and the author should be congratulated on a happy combination. Mr ROWE summed up in saying that the team were unanimous in their dislike of the term "Airstop".

2ND QUESTION

Considering the influence of the horse-carriage on motor car design and construction, is helicopter design tending to reflect unduly the shape of conventional fixed-wing aircraft?

Mr MASEFIELD was somewhat puzzled by the question and he thought that after looking at the Comet it was difficult to mistake a helicopter as we knew it today or detect an influence of the fixed-wing aircraft. He thought therefore that the question was based on mistaken premises and indeed there was good cause for the distinctive though hardly distinguished appearance of the helicopter. At least the early designers should be commended on producing a machine which could do a job without worrying too much about lines. In future, however, Mr MASEFIELD thought there was some justification for greater heed being taken by helicopter designers of the aerodynamic achievements of the aeroplane.

Captain LIPROT emphasized that economic transport helicopters must borrow the aerodynamic shapes of the aeroplane.

Mr O'HARA thought that by attaching stub wings in order to overcome the speed limitations, helicopters were getting even nearer to the fixed-wing aeroplane.

Captain LIPROT questioned whether stub wings could be said to constitute a step towards the aeroplane since they had a different function in a helicopter, but was reminded by Mr ROWE that the questioner was concerned with shape and not with function.

Mr McCLEMENTS thought that although there was not much evidence that the conventional aeroplane had hitherto influenced the design of helicopters, it was true that it had *tended* to do so inasmuch as some designers had spent a good deal of effort in the attempt to copy the appearance of the aeroplane. These efforts had not, however, been very successful and helicopters in operation today were those which had paid most attention to the many problems of good functioning which a helicopter has to overcome. Mr MASEFIELD joined Mr McCLEMENTS in giving further reasons for the belief that future helicopters will approach the appearance of aircraft. These reasons were the probable size of helicopters, certain consequences of high speed such as retraction of undercarriage, the use of turbine power plants and the associated attraction of high altitudes which may lead to pressurizing.

Mr ROWE summarized the opinion of the team that the tendency was to design helicopters looking progressively more like aeroplanes but reluctance was felt by some of the Team to see the helicopter moving too far in that direction.

3RD QUESTION

Is it the view of the Team that the requirements framed by B E A in its latest specification can be achieved or represent a realistic objective at the present time?

Mr MASEFIELD, invited to open the discussion, was somewhat reluctant to speak first, except to suggest that, realistic or not, the B E A Specification was already obsolescent. The specification started with a 30-40 helicopter and B E A now wanted a 40-50 helicopter. They foresaw that by the time there were likely to be public transport helicopters in service a 60-70 passenger machine would be needed. The policy of B E A was to call for the most advanced helicopter which could be

developed on the basis of the existing state of knowledge. It was thought that many years would pass before this machine was ready for service and it was therefore necessary to look ahead and avoid the development of an obsolescent type. Transport helicopters, to be a commercial success, must be large and fast. Current thinking visualised a 48-passenger helicopter and the design studies which were now being conducted by constructors should show what industry regards as the most advanced design which comes nearest to fulfilling the needs of public transport.

Captain LIPROT did not hesitate to proclaim his belief that the helicopter specified by B E A was a realistic objective, now. After a performance analysis of many kinds of helicopters, he thought that the demands on the performance of the helicopter as specified were exactly those he would consider capable of achievement. His aim had been to find the limits which could be attained with certainty without exceeding present knowledge. Moreover, with the help of stub wings and propellers, discussed earlier, a higher performance than specified by B E A could be obtained.

Mr MCCLEMENTS, expressing his personal views, agreed that there was enough *knowledge* on which to base the design of a large helicopter, but he did not think there was enough experience which justified so big a step as that between machines in operation today and the giants wanted by B E A. He believed that successful progress was made in a series of reasonable steps and thought that proceeding straight away with the construction of a helicopter to B E A requirements was too big a jump, such a jump made it difficult to decide with confidence what configuration should be chosen. Mr MCCLEMENTS thought the failure in the past to proceed gradually had been unfortunate and that more modest steps would ultimately give us the right size of helicopters sooner than if it were attempted to design and make a giant straight away.

Mr ROWE thought that they had heard a very balanced statement and invited Mr FITZWILLIAMS to express the constructor's view. Mr FITZWILLIAMS had some sympathy with what Mr MCCLEMENTS had said on the immediate jump in weight, size and performance. He had no doubt, however, that it was technically possible to attain B E A requirements, and in fact, it was already being done. He thought nevertheless, that a technical feasibility was not everything and that the physical resources needed to carry out the development under discussion should be considered. He feared that a full survey of existing resources would reveal that we were, in fact, more limited by this factor than by any other and our optimism with regard to future possibilities needed some correction. He also feared that B E A requirements with regard to limiting noise and vibration went beyond a level that could be guaranteed today. He did not deny there was a good chance of meeting these requirements, but, not he thought, without considerable development work after the first few machines were made, and he warned against underestimating the importance of these aspects, particularly that of noise, which may become a decisive criterion for the ability of an airline to use a helicopter. He thought that machines of the size needed by the airlines were too big for the needs of the general market.

Mr O'HARA thought the requirement for the helicopter to make all-weather take-offs and landings in restricted spaces, as expressed in the B E A Specification, could ultimately, from the technical point of view, be met. However, he was not sure without further experience in a field wherein our knowledge was largely based on theory, that safe take-off and landing in an area of 300 ft diameter would be possible except for a very high performance helicopter, for which economic operation would be uncertain. Mr HOSEGOOD, asked whether he could make some deductions from his recent experience with the flying of the Bristol Tandem helicopter, was not prepared to go further than to say that, in his view, when you scale up a helicopter you scale up your problems.

Mr MASEFIELD was invited to answer some criticisms put forward by previous speakers, and suggested that apart from its general requirements, the B E A Specification had the virtue of setting out, for the first time in the helicopter field, the specific and detailed needs of the transport helicopter. He found from his talks with constructors that this contribution to thought on helicopter design had proved to be quite valuable. Mr MASEFIELD thought that Mr MCCLEMENTS'S desire to see limited steps of development was met by the construction and development of the Bristol 173 and that this machine should give a great deal of flying experience which was badly needed. Mr MASEFIELD agreed that the project of a 40-50 seater helicopter was a major enterprise, requiring the investment of millions of pounds. This investment was accompanied by a risk but the success was more certain if we stuck our necks out and made a determined and persistent effort. The Comet was

a good and successful example. When first thought of in 1944, it was a large step to go straight to a big Jet Transport. It we could emulate the determination with which the development of the Comet had been pursued we stood a good chance of making a helicopter which would be as great and unique a success in its field as the Comet is among fast passenger liners. We should put this country ahead of others and Mr MASEFIELD thought from his discussions with leaders of other airlines that K L M, Sabena and Air France were anxious to order a successful helicopter of a type specified by B E A in quite large numbers right away. He thought, therefore, that there was a very good case for getting on with the job with the hope of putting large public transport helicopters into service in 1960, but every year lost now would mean that the service will start a year later. Captain LIPTRON felt that the value of the guidance given by a specification of this kind was very great and he regretted that constructors had not earlier set themselves as aim as clearly defined as that described by the specification.

Mr ROWE thought the discussion on this question was vital. He perceived a somewhat unusual spectacle of the operator pushing the designer and registered general agreement with the feeling that we were facing a major project, but a worthy one for this country.

4TH QUESTION

Is it the view of the Team that sufficient economic backing is being given to helicopter research, development, design and production by the appropriate department of H M Government?

Mr FITZWILLIAMS, invited to give his views, said that we were not justified to judge the support of the Government to the helicopter simply on the basis of our enthusiasm. Outside our circle the helicopter was appreciated, but the Service Authorities which really had the support of the Government could not be expected to drop everything else in favour of helicopters, bearing in mind the actual development of the helicopter to date and its immediate possibilities in the next few years. He did not think it was reasonable to expect the Government to force the development of helicopters without a demand coming from elsewhere. Mr FITZWILLIAMS believed that industry had to take greater risks and could not depend on outside agencies to make its decisions.

Captain LIPTRON said his answer to the question would vary according to the period considered. During the last three years there had not been much backing from the Government, mainly because the Services were not supporting the helicopter. It seemed that the experiences in Korea were changing the attitude of the Services and even that of the R A F. Mr FITZWILLIAMS agreed that Captain LIPTRON's distinction between the Services and the Government was important, and that he, too, did not think the Services were giving the helicopter the support it deserves, but nevertheless, he felt strongly that management in industry often acted as though it didn't really believe the helicopter existed.

Mr MASEFIELD preferred to discuss the future. He was particularly concerned with the financial support needed from now on, to gain operational experience of available and coming helicopters. We needed answers to many problems of operational technique and endurance strength on which only flying would teach us the lessons indispensable to make our choice for the future. He hoped, in particular, that much more money would be made available to carry out the flying with the Bristol 173 from which we could gain so much information.

Mr McCLEMENTS made some observations which had been missed by previous speakers. In this country it was necessary to take into account that the helicopter industry had a certain capacity and the question, therefore, could be formulated more precisely. Did the Government department concerned support the adequate employment of available capacity? He thought the answer to that question was "yes". Government support could also be formulated in asking whether the Government had sponsored ideas really worthy of development. Again Mr McCLEMENTS thought the answer was "yes". In his view, therefore, if industry should show signs of extending in size and improving in effectiveness, the money would be found. Mr McCLEMENTS thought that the staffs made available at Government Establishments for helicopter work were too small. However, in the manner of its backing of

research and development Mr McCLEMENTS was convinced that the Government was very forward looking and was sponsoring precisely those projects which were thought most desirable by other members of the Team

Mr O'HARA was asked whether he was able to defend the attitude of the Services and said that the Services wanted the finished goods and he advised industry to take the risk of producing helicopters in which the Services would be interested Mr O'HARA also put forward a consideration which he thought had some bearing on the attitude of the Services There was some reluctance among both technical and Service personnel to commit themselves to the helicopter field because its prospects were thought to be uncertain and they could not therefore judge their personal chances in entering this branch of flying

Mr ROWE summed up the general feeling of the Team that the Government had given reasonably good backing but more was needed and that some departments and agencies of the Government did not have sufficient conviction in the importance of rotary wings

5TH QUESTION

Assuming that Flying Saucers exist, how does the theory of lift from a rotating solid disc relate to the lower solidity of a rotor disc Assuming again that a Flying Saucer spins?

This question gave rise to a lukewarm discussion from which this writer gathered that no member of the Team had any convictions, but that some were prepared to admit the possibility that many people were going to be surprised in future

6TH QUESTION

Does the Panel foresee a speed "barrier" for helicopters beyond which it will be extremely difficult to fly economically, comparable with the sonic barrier as applied to fixed-wing aircraft?

Captain LIPROT said that the upper speed barrier for helicopters was caused by the phenomenon of blade stalling, a phenomenon very different from the sonic barrier found in fixed-wing aeroplanes The association of rotors with fixed-wings, leading ultimately to convertible aircraft, may give us much higher speeds than those possible with the pure helicopter Mr O'HARA agreed in general terms but pointed out that there were possibilities of extending the speed limit of the pure helicopter by adopting certain aerodynamic refinements and without introducing additional wings, propellers or other devices Nevertheless, even the extended limit was not very high, he thought we could hope for 200-250 m p h at best If we needed more it was vital to relieve the rotors of their lift

Mr FITZWILLIAMS thought that the questioner was concerned at least equally with the economic barrier to helicopter speed It was generally believed that the faster your vehicle goes the more you could charge passengers for travelling in it, but somewhere there was an optimum He was not sure where this optimum was but believed that at present the B E A specification, which envisaged 120-140 knots, was about right Perhaps, later on, helicopters will get closer to 200 knots Mr FITZWILLIAMS was convinced that there was no absolute limit of helicopter speed He was conscious of the fact that in holding this opinion he was challenging the orthodox, but he thought there was nothing in the stalling of blades or in the tip speeds which produced a barrier to the attainment of any speed one liked provided it was worth attaining

Mr McCLEMENTS reminded the previous speakers of the steep increase in power which accompanies an increase of helicopter speed He did not really think there was a great urge for very high speeds in helicopters because even at moderate speeds (of the type mentioned in the B E A Specification) they could beat the fastest aeroplanes when operating between city centres, and it was the business of the helicopter to save time on those journeys where the time spent between city and airport was an important factor On long journeys, where cruising speed was decisive, the helicopter in any case was uneconomical

Mr MASEFIELD was anxious to add further points to those expressed earlier on the desirability and value of speed. There was a limit below which the helicopter became all but useless, not because it was unable to compete with other means of transport between city centres but because, for loss of regularity and punctuality, it could not compete consistently enough to be relied on. Furthermore, he pointed out that increasing speed without excessive expenditure in power led to an extension of an economic range of helicopters. The helicopter could compete with the jet plane over many more services, more helicopters would be needed, and, if more are made, their price will come down and further increase the appeal and market of the helicopter. Mr MASEFIELD thought that this logic held until helicopters reached a speed of 200 knots. Mr MASEFIELD attached so much importance to increasing the speed of helicopters that he was prepared to accept the structural and mechanical consequences of higher speeds in aeroplanes, if these consequences are clearly shown by designers to be profitable. In particular, he visualised wings, propellers, turbine engines, and high altitude flight even to the point of imposing pressurised cabins. In fact there were other virtues in high altitude flight apart from the raised efficiency of turbines, namely, a more ready co-ordination with the pattern of air traffic control and the ability to climb through icing conditions which more often than not are found at low altitudes. Mr FITZWILLIAMS picked up the argument and added that we had in this country a very limited choice of engines which would in itself dictate the speed of the transport helicopter. He guessed that most of the design studies would be based on the use of four Rolls-Royce "Darts," or four Armstrong-Siddeley "Mamba" engines. Every such project would automatically give a speed rather higher than 120 knots. This seemed to please Mr MASEFIELD, though he pointed out in answer to a question that the penalty in fuel consumption should not be too severe within a range of speeds wide enough to permit the necessary operational flexibility.

Mr HOSEGOOD was asked to give a pilot's comment on the subject and had an amusing story to relate which brought home the moral of an airline's demand for high speed.

"I have just come down from Scotland, and last night I dined with a gentleman who, I had noticed, had a B E A label on his suitcase. He did not know I had anything to do with helicopters but, when asked, assured me that he had enjoyed his flight. When I asked him if he did not find it rather annoying that the helicopter could not take him nearer the centre of the City, he said "Yes, that would have been nice, but it so happened that my brother was driving from Birmingham to London on the same day and it was quite convenient for him to drop me at the Birmingham Airport, and on his way up to London to pick me up again at the London Airport and drive me into the City."

"Nevertheless, he seemed to have thought the trip worth while."

Mr ROWE summarised the opinion of the Team in saying that everyone agreed that helicopters must move a little faster and most people will have to revise their ideas on the economic speed of helicopters.

7TH QUESTION

In present day helicopters, it is not advisable to hover or fly at low forward speed, in a range of heights (say between 25 feet and 400 feet off the ground) because of the risk of a heavy landing following engine failure. Does the Panel consider this to be a serious operational limitation and is it likely that the risk can be overcome by improved design?

Captain LIPROT pointed out that a limitation of this sort did in fact apply to existing single engine helicopters, but that it would no longer apply, or at least would apply to a much smaller height range, when twin-engine helicopters became available. Steps could be taken on single-engine helicopters to reduce the limits—for example, high rotor speed or very absorbent undercarriages, but the real answer was to use multi-engine aircraft.

Mr O'HARA and Mr FITZWILLIAMS agreed with this and the latter pointed out that there were other methods—e.g., a flywheel capable of supplying energy for a short period—to alleviate the difficulty. This characteristic of present day helicopters did undoubtedly constitute an operational limitation, but a skilled pilot could minimise its adverse effects.

8TH QUESTION

What is the attitude of the Brains Trust towards the tendency of applying fixed-wing standards of safety of operation to helicopters in their present state of development, particularly in respect of single engine safety?

The Brains Trust took the general view that the Ministry of Civil Aviation was correct in principle to apply fixed-wing safety standards to helicopters where the operational requirements were the same. Certainly it was correct to ask for "single-engine safety." Mr FITZWILLIAMS pointed out that conflict of opinion would tend to arise rather in those features of helicopter operations which have no fixed-wing parallel. Mr MASEFIELD cited the case of operation into a rotorstation, stating that in his view it was essential that, should an engine fail at any stage of take-off or landing the aircraft should be able either to land safely or divert elsewhere. No unsafe height and speed range could be tolerated in a passenger helicopter. He believed, too, that adequate fuel reserves were necessary, though Mr HOSEGOOD thought that these reserves could be made smaller than their fixed-wing counterparts.

9TH QUESTION

A report by an officer of the United States Marine Corps on the use of the transport helicopter in Korea states that "Contrary to popular belief helicopters cannot land and take-off in a vertical direction with a full load unless moving into at least a 20 knot wind (which will provide sufficient lift for vertical movement). Otherwise a helicopter must take off much as a normal aircraft." Do the Team agree with this view and are they satisfied that in the design of large capacity civil helicopters sufficient attention is being paid to the need to develop a machine which can operate regularly into the limited areas of unobstructed space likely to be available in city centres?

Captain LIPROT stated that the questioner was confusing design principles with operational licence. Helicopters could take off vertically, but were sometimes overloaded to the extent where vertical climb was destroyed. This illustrated an advantage of rotating-wing aircraft, even when overloaded to a very marked extent, they could still take off after a short run on the ground or in the ground cushion and then proceed to fly perfectly satisfactorily. On the other hand, the safety margins were reduced and such over-loading would not be contemplated except in cases of military necessity, or for other very pressing reasons. Mr HOSEGOOD agreed, he was accustomed to fly helicopters which could climb vertically. Whether vertical climb was possible in a given instance depended, however, on a number of factors—*e.g.*, weight, temperature, height, and so on.

10TH QUESTION

What development in the foreseeable future is likely to give the greatest advantage in the improvement of the helicopter and most promote its use?

Mr McCLEMENTS thought the most promising field was in rotor propulsion. Some form of jet propulsion offered great advantages, but the jet engines now available appeared to be far too noisy. He hoped for the development of a completely new type of power plant which would be really efficient thermally.

Mr MASEFIELD stressed the noise problem. It was essential to reduce noise levels if large helicopters were to operate into city centres.

Captain LIPROT thought that great advances could be achieved with jet-driven rotors, particularly if the effluent jet could be used for boundary layer control. Noise, however, was a difficult problem.

Mr FITZWILLIAMS considered that development would be achieved from careful consideration of many factors rather than from one only. For small helicopters he thought the flapping wing principle would repay further examination.

Mr O'HARA cited instability as a severe limitation on helicopter operations. He thought that the achievement of good flying characteristics was a major need, particularly for blind flying, and that, if necessary, the problems should be solved by developing an automatic pilot.

Mr HOSEGOOD wanted to get existing types right before indulging in too many flights of fancy. He did not regard automatic pilots with enthusiasm. While, as a pilot, he would welcome stability, he did not want, in the process, to lose other desirable characteristics.

11TH QUESTION

An aircraft flying through the "sound barrier" makes a noise like a couple of guns going off. When the helicopter rotor blades reach some speed will they make a noise like a machine-gun?

The Brains Trust viewed this with caution—no accepted explanation of the sonic bang has yet been given. Mr FITZWILLIAMS, however, was undeterred. He thought that there would, in fact, be a noise like a machine-gun and evoked a fascinating picture of a supersonic rotor, enveloped completely in a self-generated cloud, emitting staccato reports.¹

12TH QUESTION

What is the relative approach success in low weather minima compared with fixed-wing aircraft? Can any figures be given on similar basis to the Sperry evaluation of fixed-wing aircraft with zero reader?

This question produced a vigorous discussion, largely concerned with the airline problem. The general opinion was that helicopters should be able to operate to lower limits, but certain problems would have to be solved first. In the military field, helicopters could, and did, operate to low limits; Mr FITZWILLIAMS cited a landing in virtually zero-zero conditions during Exercise "Surprise Packet," but this did involve taking systematic risks—the risk of engine failure for example—which would not be acceptable in civil operations. Mr ROWE expressed the view that a target should be set for weather minima—that helicopters should be able to operate to limits at least as low as those to which surface travel operates. This was accepted as very desirable, but a number of speakers touched on the two major difficulties—relatively poor stability and control characteristics at low forward speed and the difficulty of building a helicopter which can hover with one engine out and still remain an economic vehicle.

The particular radio (or other) let-down aids to be used were not discussed in detail, the general assumption appeared to be that some form of "talk-down" method would be used. Mr MASEFIELD mentioned "FIDO" as a possibility, perhaps in conjunction with a completely automatic pilot for blind landings.

The essential airline problem was stressed by Mr MASEFIELD. He was unimpressed by the fact that blind landings had been made when such landings were really no more than a demonstration of pilot virtuosity. In civil operations, landings in bad weather must be a safe routine and, unless 100 per cent success is achieved, reserve fuel is necessary to divert, probably to a major fixed-wing airport.

13TH QUESTION

What does the team see as the work of helicopters 25 years from now?

Mr MASEFIELD gave a concise description of the work he hoped transport helicopters would do in the future. They would take over all air transport at ranges of 50 to 400 miles and, if large enough, they would replace much of the surface traffic. Mr FITZWILLIAMS, too, hoped to see the helicopter become the "universal" vehicle.

Mr McCLEMENTS elaborated somewhat on his conception of a new power plant. Effort should be directed to produce an engine giving the order of 80-90 per cent thermal efficiency as against the 15 per cent or so now possible. If this were done, the rotor could be dispensed with—a great advantage.¹

The idea of a helicopter without a rotor intrigued the Brains Trust, in this connection the term "helicopter" was felt to be rather restrictive. It was not altogether a new idea, however. Mr HOSEGOOD referred his audience to "The Eagle," that well-known source of forward-looking design concepts for this and, indeed, other imaginative layouts.

The Chairman, Mr ROWE, thanked the members of the Brains Trust for their most admirable performance, a sentiment supported by the audience, who also applauded Mr MASEFIELD's vote of thanks to Mr ROWE.