(8) To be effective the commercial helicopter must operate into city centres If it is banned from city centres because of noise most of the case for the transport helicopter falls to the ground Tackling the noise problem is thus a major task

In brief, the large and relatively fast transport helicopter has a clear commercial potential—a potential which can begin to be significant to the pattern of national and international transport about ten years from now—in the early 1960's It will not, however, be in the mass travel field by then The 1960 " BEAline Bus " will almost certainly be more expensive to operate per seat mile than either the fixed-wing aeroplane or the train, but its savings in time and in other directions mean that it is a " natural " for development

If it has done nothing else, perhaps this lecture has served to highlight the importance of reducing the cost per seat-mile which at present appears likely to evolve for the transport helicopter If by the concentration of designers on this point better figures can be achieved than I have set out in this rather conservative forecast, then the range of application for the large helicopter in the early 1960's will be vastly extended That must be our aim

In my view, the commercial helicopter is bound to come Already it has captured the imagination of the public—and, no less important—the Press

What it needs is the continued support and enthusiasm—and faith—of its protagonists

Well may we say, with Tennyson —

" Not in vain the distance beacons Forward, forward let us range,

" Let the great World spin for ever, down the ringing grooves of change "

The Chairman My earlier words are more than confirmed We have had an excellent paper delivered in the true and delightful Masefield style

I have a list of names of those who have notified their wish to participate in the discussion and I propose to call upon them in the order in which I have them here

I have been advised that unfortunately Captain Forsyth, of Fairey Aviation Ltd , is unable, through illness, to be present, and Colonel Hodgess is taking his place

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Discussion

Mr R Hafner (*Member—Bristol Aeroplane Co Ltd*) It gives me very great pleasure to begin the discussion on Mr Masefield's paper There is, indeed, tremendous scope for discussion, a good deal of controversial material, something to get one's teeth into, in short—a typical Masefield effort

I think my best policy will be to commence with the punches and then to lead on to the more complimentary part of my comments, which will make for a happy ending

I am afraid I cannot escape the impression that one of the themes in this paper is to show how primitive all helicopters have been, especially Bristol Helicopters, in those dark ages before that important event that brought enlightenment to the people, namely, the birth of the B E A Specification This arbiter elegantiarum then produces the great " BEAline Bus," which is the cat's whiskers Thus goes the story

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Fig 8 shows how inefficient some of the contemporary aircraft are, compared with this superb bus, measured, of course, by the yard-stick of the B E A Specification Now I believe the comparison is not quite fair, because we have here two things that differ from one another like chalk from cheese In the first instance this " BEAline Bus " is, as yet, only a brochure, which like all brochures shows excellent performances Moreover the B E A Specification has been made for it, so no wonder it shows up well Secondly, in contrast with this paper bus, the other examples have actually flown, or are in the process of being built, but unfortunately they have not been made to suit the B E A Specification Take for instance the Bristol Type 171 It can be said to be perhaps a taxi, a staff car, an ambulance or many other things, but hardly a " BEAline Bus " The next example, the Bristol 173 Mark 1 is an experimental aircraft, conceived in 1947, with no background whatever of helicopter requirements It comprises simply two 171 rotors and two Alvis Leonides engines in tandem form, a configuration which I believed to be very promising As the aircraft contained so many already well tried out parts of the Type 171, I considered it to be ideal for demonstrating the novel configuration and especially for comparing the latter with the established configuration But it does not pretend to be a " BEAline Bus " One might, in fact, go a stage further and add to this strange collection of vehicles a fire-tender and a steam roller Measured by the B E A formula, these contrivances, I can assure you, Ladies and Gentlemen, show a shocking performance

The Bristol 173 Mark 3 is the first helicopter to come within the compass of Mr Masefield's paper, and here we find that the operating cost per seat-mile, within the band of economic stage distances, comes very close to the " BEAline Bus," and indeed the Pionair D C 3 Considering the operating costs shown for the latter do not include the very heavy subsidy of aerodromes, Fig 8 expresses a straight acknowledgment of the present vintage of helicopters Besides, the operating cost per seat-mile, important as it is, is not the alpha and omega in helicopter engineering and in the wider use of the helicopter broader arguments apply However, we must forgive Mr Masefield for being concerned mainly with collecting sweet honey for the BEA-Hive and for having a BEA in his bonnet

The next point I wish to make is, having reached the 173 Mark 3 stage, far from regarding ourselves at the end of the technical journey, we went further in the search for bigger and better helicopters, and, indeed, for the helicopter bus I would mention in the following some of the findings from these investigations, which are relevant to Mr Masefield's paper

We have come to the conclusion that for the " BEAline Bus ' a tandem rotor helicopter with stub-wings, powered by two free gas turbines of high compression ratio, offers the best promise for the near future We were surprised, however, to find that the economy curves measured by the yard-stick of the B E A Specification, *i e* , the operating cost per passenger-mile, show a very flat minimum between 20,000 lb and 60,000 lb A U W , which means the size of helicopter, within these limits, is not a critical factor The second important conclusion from these investigations refers to production It can be shown that the operating cost decreases steeply with increasing rate of production There is obviously a greater demand for the smaller helicopter than the larger one, because, not only more are needed of the former to satisfy the same traffic potential, but, in addition, the smaller helicopter can be employed economically on the routes of lesser traffic potential, from where the larger helicopter is precluded Another factor determining the size of helicopters is the availability of suitable engines

My last point of criticism is on the fuel reserve in the B E A Specification, which calls for one hour stand-off This is a very serious economic penalty, and efforts should be made to reduce it The requirement, of course, comes from fixed-wing practice Aerodromes and run-ways for fixed-wing aircraft are very large, expensive and thus only a few can be provided on any given route Consequently there is the likelihood of overcrowding and arriving aircraft are thus frequently obliged to spend a long time and much fuel either in circling or diverting to other aerodromes This procedure would be quite unacceptable in any other form of transportation The helicopter, as distinct from the fixed-wing aircraft, can land in very small places I do not suggest that it should make emergency landings in any odd field, but I do submit that it would be profitable to consider the provision of a number of properly equipped alighting places, instead of making the whole fleet of helicopters on all flights carry an uneconomic load of fuel I consider one half-hour stand-off time to be sufficient for short-haul operation

I am very pleased the hear that B E A favour roof sites for helicopters in built-up

areas and apply to these the " backward take-off " technique, a suggestion which I made some years ago, when beginning work on the twin-engined helicopter In those days however, the idea was not received very kindly

Mr Masefield has shown in this paper, and in previous ones, that he can free himself from the fetters of fixed ideas This is a paper of vision, and it is, notably, an account of faith in the helicopter We should acknowledge this, and above all we should salute the courage to show the faith, which is true apostle work I would like to take this opportunity of thanking B E A for having made up their minds so quickly on this important specification I trust other operators will now come forward and tell us what they want, because it is so important that we get to know as early as possible the specification of this general purpose transport helicopter, which we hope to manufacture in large numbers

I would like to end my contribution with a brief historic note I have been fortunate to follow the development and the progress of the British Helicopter over a good number of years It has been slow, sometimes despairingly slow, but it has been continuous, and I like to compare it to the sailing of a great ship For a long time before the hour of departure she lies at the quay-side, to the casual passer-by but an object of immobility and impotence Slowly, however, signs of activity emerge here and there, busy hands apply themselves to raise steam, and others to anchors, compasses and all important equipment This brings to my mind names like LIPTROT and ROWE who showed great energy and conviction in their preparatory efforts for this important sailing The tension is growing, as the moment of departure draws nearer The M O S tugs are ready for action, being the development contracts to pull the ship away from the mooring into the safer waters, from where it can continue under its own steam I can see, too, the frantic hurry of some last-minute passengers trying to get aboard Everybody is waiting for one signal Then—up goes the " Blue Peter "—and it's Masefield He has given the signal high up on the mast for everyone to see that the crucial moment has arrived We appreciate the signal and we are now in earnest about our departure I am sure that this great ship of the British Helicopter will soon be under weigh and we all wish it a *bon voyage*

Colonel F L Hodgess, speaking on behalf of CAPTAIN A G FORSYTH (*Member —Fairey Aviation Co Ltd*) Before I read CAPTAIN FORSYTH'S contribution to the discussion, I would like to add my congratulations to those of Mr HAFNER on the excellent paper from Mr MASEFIELD, but I would also point out that the tandem rotor arrangement is not the only configuration that could win the prize for this magnificent " BEAline Bus '

Now, if I may, I will read the contribution from CAPTAIN FORSYTH

Mr MASEFIELD has given us a clear picture in his excellent lecture of what he considers to be the helicopter of the future

The figures quoted by Mr MASEFIELD clearly show how the increases in size and speed reduce the operating costs These, coupled with the figures available from experimental passenger services using small aircraft, indicate that anything smaller than 30 seats will be uneconomical The aircraft covered by the B E A Specification should meet immediate requirements and would be a stepping stone towards the production of still larger aircraft

Referring to the B E A Specification, as it stands it will be difficult to fulfil this with one machine as at one end of the scale you can design as a 30/36 seater with a range of 100 nautical miles with a tank capacity of 200 n miles plus allowances for head-winds, hold-off, etc , or alternatively a 45-seater with a range of 200 n miles In both cases the design speed must be in excess of 130 knots

The specification says that the design capacity should not be less than 30 seats over a 100 n miles stage, and then goes on to say that 36 seats are desirable, and that it should be capable of development up to 36/45 seats with a range of 200 n miles This could mean a change of all-up weight from, say, 32,000 lb to 44,000 lb

The specification would have been much easier to fulfil if it had simply stated

(*a*) We require a machine to carry 36 passengers (200 lb each) with seats spaced at 36 with baggage accommodation, mail room, toilet, etc , with a range of 200 n miles, cruising in excess of 130 knots , tankage to be provided to cover the allowances for head-winds, stand-off time, etc , for 200 n miles , or

(*b*) 45 passengers instead of 36

Either would determine the fuselage dimensions and all-up weight of the aircraft when fully developed

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The point I am trying to make is that you cannot design an aircraft at 30,000 lb and hope to raise it to 44,000 lb You must, therefore, design for 44,000 lb

It is obvious if you design for 44,000 lb that it can be flown at a lower weight during the development period by reducing the range to 100 n miles

I consider that the 30/36 seater is the most suitable size to go for in the light of existing knowledge

The specification calls for accommodation to be provided for the payload possible with a fuel load needed for a 20 n mile stage This means that by reducing the fuel, and the passenger weight to 180 lb , room would have to be provided for a further 18 passengers The question is, have the passengers to be seated at 36′ spacing, or can high density seating be used ? There is no mention of this in the specification

Mr MASEFIELD emphasises the need for 45 mins hold-off This in my opinion could be varied with the range, *i e* , there would be no point in covering 45 mins fuel in the 20 mile case

In the interests of economy I think high density seating and varying hold-off should be allowed, as it would enable a 32,000 lb machine to carry

(*a*) 36 200 lb passengers 200 n miles
(*b*) 42 200 lb passengers 100 n miles
(*c*) 54 180 lb passengers 20/50 n miles

The characteristics of the " BEAline Bus " shown under operation ' Guesstimate ' call for

48 seats at 250 mile range
64 seats at 25 mile range
Cruising speed 160 m p h

As the existing specification calls for developments up to 45 seats on a 200 n mile range, the 44,000/45,000 lb machine would practically meet these requirements Based on the figures I have quoted for the 36-seater, using high density seating, etc , there would be no difficulty in seating 64 passengers over the 25 mile range

I still think, however, that if we are successful in producing a satisfactory 36-seater it should have a useful life of 10 years and that it would go a long way towards advancing the art and would provide a stepping-stone to the production of even larger aircraft than envisaged by Mr MASEFIELD

Safety It is agreed that multi-engines are essential and that our main concern is to provide 100 per cent rotor system and blades

The introduction of a wing to unload the rotor will assist in this direction as in forward flight it reduces the disc loading and also allows the speed of the rotor to be dropped The use of blade-tip jets provides a smooth drive and eliminates the vibrations associated with a mechanical drive

I should further recommend that the hovering power of the engines should be restricted to 80 per cent power or at a rating for continuous running This would then leave a margin of 20 per cent in the event of engine failure which could be brought to the remaining engines Mr MASEFIELD'S description of how to make a forced landing or to carry on in the event of engine failure is interesting, but I would suggest that twin-engine reliability in vertical flight would be a better solution

Comfort and Silence The time has come when we must provide maximum passenger comfort , this means that the interior of the fuselage should be completely free from engines, gear boxes, shafts, etc In fact it should be a replica of the orthodox airliner, and the power plant should be mounted as far away as possible from the fuselage

These two features coupled with a jet-driven rotor would produce a comparatively quiet interior

The external noise is a different story We have to face the turbine noise, but I think if we can produce a machine as silent as the latest fixed-wing machine with turbo-props it would be acceptable

The rotor-tip jets are noisy, but recent investigations indicate that their noise level can be reduced considerably when they are used on large blades

I am convinced that a jet rotor can be produced with a noise level as low as that of the turbine In forward flight the noise level will be as good as that for the fixed-wing aircraft

Speed It has been made quite clear that to produce an economical helicopter it must fly fast , to achieve this we must revise our ideas

The ideal machine would be the best airliner that it is possible to built with a disappearing rotor As rotors do not lend themselves to disappearing, we must do the next best thing and build in as far as possible the good features of the fixed-wing

machine, coupled to the disadvantages of the rotor

The introduction of fixed wings and propeller drives will undoubtedly enable reasonably high speeds to be reached I consider that the speed called for can be reached by such an arrangement

The all-up weight of the proposed B E A aircraft can range from 30,000 to 44,000 lb It may be suggested that the step up in weight from 8,000 lb to 30,000 lb is too great to take at one bite The position as I see it is that we must think big and in doing so must revise our ideas regarding the design of a suitable machine

The whole design hinges upon the method of harnessing high power (approx 4,000/4,500 h p) to the rotor systems As there is no limitation in fuselage size, the main problem is to remove the mechanical complexity associated with driving rotors by gearing, clutches, shafting, etc

Sikorsky and Piasecki are of the opinion that we are rapidly approaching the limit in rotor diameters when driven mechanically, and that for large rotors it will be essential to adopt some alternative system of rotor drive

The jet-driven rotor is the obvious answer, as it immediately opens up a new field in rotor design, eliminates all mechanical complexity, simplifies the design, reduces cost and maintenance, and, most important of all, there is no difficulty in harnessing the power now envisaged to the rotor or rotors

I am convinced that this is the only way to produce large machines now with the speed, safety and reliability so essential for civil airliners The 30,000 lb (or over) aircraft is the ideal size to start off with, as it is outside the scope of the mechanical drive (unless multiple rotors are used)

The views expressed are my own and do not necessarily agree with those of the Fairey Aviation Company

Mr J L C Briscoe (*Ministry of Civil Aviation*) I should like to add my congratulations to Mr MASEFIELD on his most excellent lecture I feel the highest compliment one can pay is to say that it may well become the classic in the helicopter world that his Commonwealth and Empire lecture has in the fixed-wing world

First, I should state that the views I express are not necessarily those of my Ministry

Mr MASEFIELD'S economics are most instructive, but in one or two ways seem unfair to the helicopter He compares a brand new aircraft with a converted D C 3, which has already had its capital value largely written off The helicopter would have shown up much more favourably if he had used a Viscount in his comparison

Another point that should be taken account of is that if a passenger in a fixed-wing aircraft pays five shillings to get to the airport by a B E A bus at each end of a 120 miles stage, the fare to that passenger is increased by 1d a mile—a cost the helicopter passenger does not have

I note that in describing the interim phases of helicopter development as having consisted of the introduction of the Bristol 173, which is an 18-seater in its later marks, the lecturer for the later phase deals exclusively with the 40 or more passenger helicopter Looking into the future, I find it difficult to see a winter day with 40 to 70 passengers getting into a " BEAline Bus " at Tiree, and it would be a pity, in my opinion, if all effort in the British helicopter manufacturing world was channelled into thinking only of such large aircraft So far, more money has been brought into this country by the export of Doves than of all the 30 and 40 seaters combined I do not see why there should not be a profitable market for a twin-engined helicopter carrying 8 passengers which may theoretically, like the Dove, be uneconomic

I should like to draw attention to the area involved in the city centre site In the B E A specification 400 feet was asked for in all directions This is considerably more than asked for by the Inter-Departmental Helicopter Committte which suggests either a square site of 300 feet, or not less than two strips at right angles 300 feet long by 150 feet wide The value of sites in city centres is very great When one thinks of ordinary aircraft requiring 6,000 feet for take-off the difference between 300 and 400 ft appears quite small But to emphasize the scale of an area of 400 by 400 feet, one could draw a line from the further corner of Apsley House along Piccadilly and up to the end of Hamilton Place, thence to the steps of Achilles statue and back to Apsley House and still only achieve 400 feet square If a helicopter site is built on a roof, only the outer 25 feet can be let to the ordinary tenant who requires natural light That is to say, out of $3\frac{3}{8}$ acres, which 400 feet square represents, $2\frac{3}{4}$ acres are entirely without natural light If the site is of the size that the Inter-Departmental Helicopter Committee recommends, the area without natural light is

confined to 1½ acres, or if the site consists of two strips in an " L " shape the area is less than one acre I understand that the value of an acre of land round here is about £650,000, so a 400 feet square site represents a value of £2,500,000 I remember the first slide where we saw a nice little square dot representing the helicopter station compared to the large area of London Airport, but if one draws a chart based on site values one would find that the little square representing the rotor station was now 1½ times the size of London Airport, whose site value, of course, is relatively low Building helicopter stations on top of railway stations is often quoted as a solution of the site problem but many are inadequate The station roofs of Marylebone or Charing Cross, for instance, are quite long enough one way, but only half long enough the other I think it is extremely important that designers should not be led to think that very large areas are going to be available in many important traffic centres With an emergency landing when an engine has failed close to the site, the slower the helicopter can fly with one engine out, the safer it is going to be operating into a confined area and the more possible it will be to find a site in the first place The alternative to moderate sized sites may well be no sites

Finally, it is very pleasing to hear someone else emphasising the noise problem M C A are very concerned about noise and it was largely to check noise that the Ministry organised the helicopter site on the South Bank and arranged the flying with the B E A Helicopter Unit Many reactions have been unfavourable and helicopters may well not be tolerated in many cities unless they are quieter than even the present generation

Mr A McClements (*Founder Member—Ministry of Supply*) Mr MASEFIELD has made the case for larger and faster helicopters He bases his arguments on theoretical considerations backed by practical investigations and some " guesstimates "

I would like to look at the probable trend in a more general way, viz If fixed-wing aircraft could be made to fly at zero airspeed with no appreciable power or other penalty, there would be rotating wing machines Fixed-wing aircraft cannot behave like this so the operator is forced to use two vehicles to cover his overall speed requirements instead of having only one Since the helicopter enjoys its existence because of a technical limitation of the aeroplane one would, I think, expect the operational trend of other quantities such as size and top speed to follow the same direction, and hence I do not think we should be surprised to hear an operator asking for bigger and faster machines Of course, trends in themselves do not get us very far and it is necessary to give quantities dimensions Mr MASEFIELD has done this and, if his paper did nothing else, it would be a contribution of the greatest value Of course, his paper does much more, so now let us look at a few of the other points it contains

Noise The lecturer's requirement for a low external noise level is agreed and we hope we can go quite a long way towards meeting it There will, of course, be economic penalties, but these need not, I feel, be as great as in the case of the fixed-wing machine (should similar techniques ever be applied), in view of the helicopter's elasticity in shape, and the fact that it is less susceptible to the penalties of drag The implications of providing the means of silencing are being investigated

Sites I am glad Mr MASEFIELD mentioned the enormous cost of airports used by fixed-wing aircraft which somehow or other are often overlooked in making economic comparisons Naturally we take comfort from the fact that the helicopter need not carry this penalty , further, that the lecturer visualises the use of elevated sites The lecturer seems more favourably disposed towards rooftop sites than was the earlier report of the Ministry of Civil Aviation Inter-Departmental Helicopter Committee, and I think he is right We do, of course, want to know more about the requirements of operation from such sites For example, what are the crash requirements to be ? It would seem to me that one requirement should be that the helicopter must break-up if it hits the roof hard before the roof breaks up Can such requirement be met in the case of old and relatively weak buildings ? Perhaps this possibility is not out of the question if, say, a method were adopted whereby concentrated loads could be spread uniformly over the whole roof There seems to be scope for ingenuity here

Engine failure during vertical climb Mr MASEFIELD does not think it practical to anticipate multi-engine reliability during vertical climb Perhaps we should not be too firm in our ideas here, especially in looking to the future when no doubt we shall have turbine engines and, in certain cases, jet propelled rotors Then it might not be out of the question with certain arrangements to anticipate large bursts of power for short periods (associated perhaps with lots of noise) which might enable

controlled vertical flight with one engine out The noise, or the need for an engine change following the incident, could perhaps be put up with since we will be concerned with emergencies which we hope will be infrequent and of short duration

Pressurization The lecturer mentions that, with the engines of the future, there might be a requirement for pressurized cabins One of the reasons he gives is that the rates of climb and descent will be high I suggest that we should do everything possible in the helicopter to avoid the complications of pressurization, and it might be better to overcome the comfort aspect associated with rapid pressure changes by just climbing and descending at lower rates

S 51 Economics I think the economics, which Mr MASEFIELD quotes for the S 51 are extremely misleading, and I suggest that when he states that his figures are " not entirely fair " he is making a serious understatement, which, if left unchallenged, might reflect unfavourably on the commercial future of the 5,000 lbs all-up-weight class of helicopter I feel that it would have been fairer if he had quoted realistic figures obtained, say, by B E A or Los Angeles Airways during regularly scheduled operations

Government Support As the lecturer says, it is obvious that Government support is necessary if large and fast helicopters are to be developed in this country

In the past the Government has supported helicopter research and development, and its contribution has been quite appreciable , for example, it includes

(*a*) The financing of all current designs originated in Britain
(*b*) The loan of the Bristol 171 helicopter to B E A to be followed by the loan of a Bristol 173
(*c*) The financing of the design studies for the large helicopters which the lecturer has mentioned
(*d*) The provision of the majority of the funds expended by the B E A Helicopter Unit

I think the Government will, if it possibly can, continue its policy of making money available for continued development and I hope, like Mr MASEFIELD, that its support will be generous

In closing I would like to associate myself with Mr BRISCOE's remarks about the excellence of Mr MASEFIELD s paper and add that we, the Helicopter Association of Great Britain, are indeed fortunate in having it presented to us

Dr G S Hislop (*Member—British European Airways*) I am rather like President Wilson with his Fourteen Points, as I started off with at least fourteen which I wanted to raise, but these have now been whittled down by preceding speakers, and, as time is getting on I will curtail my remarks to one or two only of the remainder

Firstly, I should like to add my congratulations to Mr MASEFIELD, who has done a very good job from the operator s point of view The points I have in mind are

(*a*) I would like to ask him if he is not having his cake and eating it in that he has envisaged high density seating in order to pull down costs He has also, shortly afterwards, described this as a luxury service I am not sure that he will be able to persuade people to pay high fares and expect all the trimmings, but actually get seats at 36 pitch or less with a cup of tea instead of a glass of champagne
(*b*) Another point is that of the question of noise As various people have brought out, it is of vital importance I, for one, think that what constitutes an acceptable noise level needs to be established Decibel readings at various frequencies are not enough and one must consider the character, duration and any directional effect of the noise If we achieve about the noise level which we have at present from the Bristol 171 on future aircraft we shall do very well , I think such a level will be acceptable This is a personal view, but I think we are in danger of setting altogether too high and too stiff a requirement I believe that we must be more realistic in this matter and not expect a major transport vehicle to be virtually noiseless Tubes, electric trains, buses and trams all emit noise—sometimes a very great deal of it Yet their value is appreciated and the noise is accepted as part of the price to be paid for the benefits which accrue This outlook must surely prevail in the helicopter field also
(*c*) A possible site for a London rotorstation is the next point A number of flights were made by B E A to and from the South Bank site, but a better site would probably be the roof of Waterloo Station itself This is a big

area, considerably bigger than the South Bank helicopter site , I believe that the possibility of ultimately using the roof of Waterloo Station should be taken up seriously with the Railway Executive to see what their reactions would be to having a helicopter operating off such a place It is big and high and has good approaches and is almost ideally placed for surface communications which, paradoxically, are an important feature of air travel

(*d*) Mr BRISCOE is worried about the cost of the site, but we must not forget that a rotorstation specially erected for the purpose, as distinct from using or adapting existing roofs, will have other uses The operating requirement for an area of 400 feet square and perhaps 80 feet high encloses a volume much greater than the airlines need for their own use Such a volume would provide much sought after space for car park or garage, and hence a steady source of revenue, quite apart from that derived from helicopter operations The design of a major rotorstation is an aspect which we have not fully discussed tonight, as other considerations have been very much in the forefront, but it is a fact that local authorities in cities are really up against the problem of parking space, and such a building would be a godsend from that point of view

(*e*) My last point is that I hope it will not take 3,000 flying hours on civil prototypes to get a British Civil Certificate of Airworthiness on a new helicopter, else we shall never capture the market for large civil helicopters with a British machine

Mr J Wotton (*Member—Percival Aircraft Ltd*) It was expected that Mr MASEFIELD'S paper would deal at some length with the specification requirements for the large B E A helicopter It is generally agreed that the specification will be extremely difficult to meet, but there are certain points which the lecturer could perhaps elucidate or think worth reconsidering for inclusion in the specification The first of these concerns stand-off allowance which in the brochure is required to be for 45 minutes If the specification is to be understood as read this stand-off duration is required even when the stage distance is only 20 nautical miles, which at the required cruising speed occupies only 10 minutes Does not the lecturer think that with the increasing application of turbines to helicopters some new pattern of traffic control will become necessary? It appears that some new conception of Airport control must be introduced before fixed-wing aircraft like the Comet can effectively take advantage of their special characteristics

The B E A specification requirement for 600 feet a minute rate of climb in still air is severe as is the low percentage power specified for maximum cruising speed In the case of helicopters powered with more than two engines is it not conceivable that some modification of the still air climb figure would be to the overall advantage of the operator ? The suggestion that helicopters should take off from rotorstations backwards may make the situation even worse

The call for power plants to be operated during cruising at 70 per cent of maximum power is in the case of turbine engines unlikely to greatly improve the overhaul period and is uneconomic operationally This figure would be much more realistic at 80 per cent Indiscriminate loading is readily met in the tandem twin rotor configuration which is the logical development of the shaft-driven passenger machine but is unfavourable to the single-rotor helicopter The advent of various forms of tip jet drive and torqueless rotors can be expected to bring with them the simplified engineering and structural features associated with a single lifting rotor Unless absolutely essential the requirement for indiscriminate loading can scarcely be justified at the expense of overall simplicity Incidentally this requirement is negatived to some extent by the statement that luggage can be so disposed as to aid in trimming the machine Other mandatory requirements which are uneconomic are the air conditioning which is considerably in excess of that specified for the Bristol Britannia, for blade folding of rotors of the size and weight necessary with such large machines, and the stringent demands in connection with the fuel system The multitude of desirable features of doubtful economic or operational value which appear in the specification will, if met, result in aircraft of poor payload and very large size for a given duty, all delaying the cheap travel between city centres which Mr MASEFIELD desires The specification also insists that no pneumatic or vacuum systems shall be used, and that all services are to be either electric or hydraulic Would not such decisions best be left to the designer in his quest for the essential qualities of low first and maintenance costs and maximum disposable load ?

Mr MASEFIELD seems undeterred at the thought of extremely expensive helicopters for his purpose, doubtless many of those present will appreciate the lead as to the sort of price tag which may reasonably be tied to their projects They may, however, be somewhat disconcerted to learn that even the much publicised B E A Specification is already out of date and that the day of economic helicopter operation is as far off as ever

Mr D L Hollis Williams (*Member—Westland Aircraft Ltd*) I shall not keep you many minutes, as most of my points have been covered already There are, however, one or two I should like to make

When in July of this year five aircraft firms received an invitation from the Ministry of Supply to submit design studies to the B E A Specification, we must all have thought " how remarkable to receive a Specification made up of some 20 sheets of typewritten matter, with every requirement logically argued Here is a concern that really knows what it wants "

The firms concerned started work, but the task was found so big that by common consent an extension of time was given Tonight we have been told that this work is just a mental exercise and the requirements on which we were working are now out of date, as Mr MASEFIELD has said What is now required is a very much larger helicopter

I would like to add a word of caution, as we start from a state of affairs where the only aircraft that have obtained British Civil Certificates of Airworthiness are in the 5-6,000 lb class and to one configuration only When talking of designing helicopters of 30, 40, or even 50,000 lb all-up weight we should consider the advisability and practicability of taking such a large step forward, in view of the very serious problems that will arise

Mr MASEFIELD showed us a chart of the probable time scale for the development of the " BEAline Bus " I think there should be a period of time allocated in front of his " dead-line ' for the start of design, representing the time that will be lost before the final specification is stabilised, and the financial backing arranged

A project of the size contemplated is probably outside the scope of private finance, and Government backing will be required The best way to obtain this backing is to find a common inter-service requirement To obtain a stable inter-service requirement there must be compromise in size and lay-out, and the best way of introducing a large helicopter on to the airlines, is to build up operating experience as a military helicopter

Mr O L L Fitzwilliams (*Founder Member—Westland Aircraft Ltd*) I did not expect to be called upon to speak, but am very pleased to have an opportunity to congratulate Mr MASEFIELD, particularly for the excellent way in which he delivered the lecture

While on my feet, I might mention that we have been invited to study the possibility of making a helicopter to the B E A Specification, and have been somewhat disconcerted to note the differences between that Specification and Mr MASEFIELD'S " BEAline Bus," which seems to be an altogether larger project

I must say that I have great sympathy with the views expressed by Mr HAFNER and others concerning the possible value of smaller aircraft and I suspect we are going to have great difficulty in finding a suitable compromise between paper accounting for purely airline purposes and the other complex considerations which govern practical engineering and general commercial possibilities

Mr Masefield (*in reply*) As time is late I will cut my remarks short I thought I would be sticking my neck out, and sure enough, I was I tried to be fairly controversial in my lecture as this often produces the best ripostes

Mr HAFNER did not seem to be altogether happy that I had so much to say about the Bristol Company's products On the other hand most other manufacturers seem to have been sorry that I did not mention theirs Obviously it is a hard life

On Mr HAFNER'S remarks, I was not sure from his first point as to whether he was in favour of using the helicopter as a steamroller, fire-engine or as a transport vehicle I was talking about the transport vehicle If Mr HAFNER is talking about the steamroller I am afraid the " BEAline Bus " is certainly not going to be a great deal of use

The problem from the point of view of the transport vehicle is to produce a helicopter which will have operating costs which will result in low enough fares If we cannot get big enough and fast enough machines to do that we, as operators,

shall not be able to afford to buy them I would rather have a helicopter costing £250,000 in the first place which we could operate for 3d per seat-mile than a helicopter costing only £100,000 in the first place and costing 5d per seat-mile to operate

Fuel Reserves On the subject of fuel reserves, of course everyone is concerned to reduce them to the minimum acceptable amount Fuel reserves are indeed a thing one would like to do away with completely The real trouble is that if we are going to operate with regularity and punctuality we cannot afford not to have fuel reserves We have got to be able to plan to operate in any weather and if necessary to wait our turn to go into the rotorstation at the destination Unfortunately, we shall not be able to land helicopters anywhere and we shall require a really properly equipped place in bad weather so that eventually we shall be able, I hope, to bring helicopters in in a minimum visibility of 100 yards with the right aids and possibly with a ceiling down to 200 feet

We cannot possibly do that without radio aids, and high intensity lights in built-up areas, which will be extremely expensive From an airline point of view one must have constantly on one's mind that there will be 50, or perhaps 90, passengers on one's hands, so that adequate fuel must be kept in reserve to meet eventualities

I endorse very much Mr HAFNER'S statement about Mr ROWE Mr ROWE is the " grand-daddy " of the helicopter, from the operating point of view, in this country and it is good to see him here this evening He has made a magnificent contribution

I am grateful to Colonel HODGESS for reading Captain FORSYTH'S comments I am in gereral agreement with what he has to say

Mr BRISCOE made a lot of very interesting remarks If we are going to replace DC 3s—and the replacement may well be the helicopter—we must make it able to complete with the DC 3 either on fares or in offering other saleable advantages and the helicopter will not come in unless we can

On Mr BRISCOE'S point about secondary services, Bristol 173's or Westland S 55 s with two engines would do very well, with a cost of about 1/-d per passenger-mile to operate But in the Highlands of Scotland that would be a " Social " service on which the high fares necessary to break even would have to be subsidised by the Scottish Office if they were to be brought within the reach of what the local inhabitants could afford to pay

Site Values Dr HISLOP made some very interesting points and you will not be surprised to know that we find ourselves in general agreement If we are permitted to put up a building with large offices and a hotel on the South Bank site with an Airways Terminal at the bottom and a rotorstation at the top, we can hope to make a profit out of it It would be made up of a tremendously valuable office space, going up to about 80 feet Allowing 20 feet per storey, if we were allowed to put up a skyscraper, we could run B E A on the profits made out of it

Four hundred feet length is right, because in addition to take-off and landing we must be able to park helicopters and also have room to manoeuvre in parking, and we need plenty of elbow room for that

In connection with natural lights, Consolidated's Headquarters at San Diego have an area of about 100 yards by 100 yards, with not a single window Although it is a very hot climate they just do without because it is more economic with complete air conditioning

I agree with Mr MCCLEMENTS about speed and size, and am encouraged by his optimism about noise

I agree that £100 an hour for the S 51 is a bit unfair and I must apologise to Mr HOLLIS-WILLIAMS on that The S 51 is not, in fact, terribly expensive to operate but the high figure included all experimental work at a low utilisation It is interesting that Sabena have found the same results Mr Vernieuwe spoke before this Association a little while ago He said that the Bell 47 costs the same amount per hour as the DC 4

Government Support Of course we do very cordially acknowledge that the Government has supported the B E A Helicopter Unit and is paying for the design studies

I am in agreement with Dr HISLOP on the high density of seats, but luxury seats can be used in the same vehicle The seats can be set on rails so they can be shifted up tight when operating for as short as 50 miles For longer operations the seats can be spread out with more leg-room

Mr WOTTON, of Percivals, was, I imagine, not very pleased with the B E A Specification and was not going to build anything to it I do assure him that, from

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 "BEAline Bus" on account of size after his brilliant paper before the Helicopter Association on the Giant Helicopter many times larger than the "BEAline 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 "BEAline 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

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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

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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 though 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

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