and best designs for flight deck, hangar and special appliances have been assessed The experimental phase is over, and helicopters are in the whaling industry to stay

APPENDIX

DRAFT SPECIFICATION OF HELICOPTER FOR ANTARCTIC WHALING

Disposable load 2,000 lb payload plus crew of two and fuel for 10 hours at maximum range speed

Engines Two or more Capable of maintaining level flight for five hours at maximum range speed with one engine inoperative

Hovering Performance With full load outside ground cushion on 1 hour power of all engines

Max range speed 75 knots at economical cruising power

Max level flight speed 100 knots at maximum continuous engine power

Controls Dual

Alighting gear Positive stable unlimited buoyancy available without delay Preferably sealed floating hull Wide track skids for deck landings

Flight handling qualities Positive static and dynamic stability in all normal states of flight Auto-pilot permissible

Starting qualities Rotor starting and stopping in winds up to 50 knots in any direction must not involve risks of blade interference Anti-coning device permissible The time interval from engine starting to take off must not exceed three minutes

Deck handling Blade folding to be possible, not exceeding five minutes for crew of two Alighting gear provided with deck handling wheels of which front wheels are castoring

Ice protection Reliable anti-icing or de-icing for main and auxiliary rotor(s) Engine air intake de-icing Cockpit heating and windscreen de-misting Clear view panel

Flying instrumentation To include full blind flying instrumentation

Navigational instrumentation To include gyrosyn compass and drift sight, distance measuring equipment, direction finding equipment

Approach instrumentation Blind approach facilities desirable

Communications equipment Reliable voice communication over sea by day at distances of not less than 150 nautical miles Reliable morse communication over sea by day over distances of not less than 300 miles

Safety equipment Dinghy, immersion suits, marking equipment, emergency communication equipment, etc

Discussion

The Chairman The time is getting on, but I am sure that we all now know very much more about whaling than we did before One of the lessons from this afternoon's Papers is that new fields are being discovered for helicopter operation which will ultimately be for the good of industry as a whole

I have the names of certain people who have indicated their desire to take part in the discussion, but before calling on them I should like briefly to refer to Lieut - Commander Spedding's opening remarks about the interest of the Royal Navy in helicopters That interest dates back well prior to 1943 In fact to the early years of Autogiro development The very first time that a rotary wing aircraft was landed on a ship of any sort was during October, 1931, when Lieut Pride, a United States Navy pilot, carried out trials on the U S Carrier *Langley* In 1935 with a C 30 Autogiro, I myself made several landings and take-offs from the Italian cruiser *Fiume*, and I was the first rotary-wing pilot to land on a British carrier, the *Courageous*, in mid-1935 The Royal Navy's interest continued and an order was placed for five C 40 " direct take-off " Autogiros and a Naval flight formed before the war In 1941, I was sent to America on behalf of the Admiralty and with a Pitcairn PA39 Autogiro made the very first landing and take-off from a merchant ship, the *Empire Mersey* I indicate that as a background of the Royal Navy's interest, which Commander Spedding could not enlarge upon, because probably he was not aware of it Some of us who have been in this business for a long time ought to let people know more about what has happened in the past, so that the historical background may be properly built up

I should like to put a question to each of the speakers First of all, both Commander Spedding and Mr Bristow seem to feel that a pilot needs more assistance from and on the deck I should like to ask Commander Spedding whether he considers a normal type of undercarriage is really necessary on a helicopter operating from a vessel at sea, and which only once in a while has to return to shore ?

I ask Mr Bristow for more information about the interesting type of floatation gear which he had on the S 51 From his comments I gathered that there was a reduction in cruising speed of 25 to 30 knots is that so, or was that the speed at which he normally operated ? Also, it seemed to me that under the icing conditions which he mentioned there might have been a little trouble with the bags sticking to the deck

Another question which I should like to put to Mr Bristow is whether he does not think that the platform on a small ship should have an upper false deck ? On the last ship which I equipped during the war for research work we had a false deck, so that the seas rolled over the lower deck and only splashed on to the false deck on top It had about 15 inches clearance

I will ask Mr SHAPIRO to open the discussion

Mr J S Shapiro (*Founder Member—Consultant*) I am very glad that the Association has taken up the subject which we are discussing this afternoon, and I am pleased to find that the treatment has been what might be described as " down to earth," except that the metaphor is not very happy in flying, and especially in marine flying I am glad to find that both Papers contain plenty of meat, into which we can get our teeth if we wish Personally, however, I do not feel inclined to do that , in fact, the overwhelming impression which I have obtained from both papers—and here I speak mainly as a helicopter designer—is that our young mariners have made the best of a job with tools which are only just adequate It is owing to their endeavours and the risks they have taken that the helicopter as we know it to-day, which is only just good enough for the purpose, could be used to do the job and to promise even more I shall enlarge on that in a moment

I look on this afternoon as the second occasion on which the Association has taken the trouble to discuss a field of helicopter utilisation other than transport The first, as some will remember, was the use of the helicopter in its agricultural role It is a very stimulating way of discussing the designer's task to look at it first of all from the point of view of the job to be done

I always remember an occasion when Mr BRISTOW and I discussed a memorandum with a very eminent civil servant who has also been a lawyer He criticised our opening remark, in which we said that we were presenting a memorandum on the use of helicopters in whaling, whereas he suggested that we should say " on the improvement of whaling by means of helicopters " I think that we should keep that in mind, and therefore I criticise the Chairman's remark that we are glad about these developments because they will be good for the industry I think we should make it clear that we offer helicopters not because it is good for the helicopter industry but because they can do a job which nothing else can do In particular the two jobs which the Association has now discussed at some length, the agricultural role and flying from ships, are *par excellence* the roles of aerial work

In aerial work we do a job of work from an elevated platform, and what matters is that you can stay in the air and can do so conveniently, under perfect control and most economically In these roles the helicopter is and will always remain unsurpassed I join those who urge the use of the helicopter in its transport role, but it is in aerial work that the helicopter is something entirely on its own, without a competitor To stay up in the air and to do so with the least expenditure of *pence per ton hour* there is nothing to beat the helicopter, even on the most fundamental facts of aerodynamics, whereas in other roles the helicopter can compete only because it can do with better control and under more favourable conditions, the things that the fixed wing aircraft can do more economically from the aerodynamic point of view It is very good to know, and very often forgotten, that from this point of view of pence per ton hour the helicopter is unbeatable

In considering what helicopter designers should do it sticks out a mile that we really want a naval helicopter, one with very different characteristics from those of to-day Without wishing to enlarge on it fully, I would say that I strongly advocate a twin-engine helicopter and one which can hover without any danger if one engine fails These, I think, are the first two main items of the specification The third is that a naval helicopter should be without, or almost without, directional properties

with regard to wind I think that the pre-occupation with wind which we have witnessed this afternoon, particularly in Commander SPEDDING'S paper, is not really an inherent part of the qualities of the helicopter , it is to some extent a legacy of fixed-wing flying and, perhaps, a combination of certain initial inadequacies and a tendency on the part of pilots to preserve the habits of fixed-wing thinking To my mind, the rotating wing has no leading edge and therefore no wind direction, and the sooner we realise that and adapt helicopters and instrumentation to that basic fact the more we shall get out of the helicopter In particular, the kind of manoeuvring and adaptation that we are forced to adopt in naval practice are not ultimately necessary if we have helicopters to do the job

Commander G B Hodgkinson (*Bristol Aeroplane Co Ltd*) I have a few small questions to put to the lecturers, and most of them are directed to Commander SPEDDING On the question of plane guard work, I think that everybody is convinced that the helicopter as a daylight plane guard can take the place of the destroyer, but it is still limited to daylight at the moment, which means that we have to have a destroyer round about, which is a great pity I should like to ask Commander SPEDDING whether he thinks that a helicopter with ordinary blind flying instruments and a downward landing lamp, so as to illuminate the surface of the sea, and also with a system of the kind used on the Moehne Dam raid, with two lights pointing down which eventually met on the sea or the land and when coincident gave the height, could carry out plane guard duties by night as well as by day

A second and smaller question is that at the moment I think it is agreed that the pilot should be on the starboard side of the helicopter Commander SPEDDING has told us that the helicopter flies on the starboard quarter of the carrier when acting as plane guard, and the aircraft which approach come from the port quarter Is it suitable for the pilot to fly from the starboard side of the helicopter with the other aircraft coming in on his port quarter ?

Thirdly, there is the question of starting up, which is undoubtedly a great worry in a carrier Commander SPEDDING suggested that it was best to start up when the carrier had the wind on the beam, before she turned into the wind , but the real problem of the effect of wind on the blades seems to me to be as much a matter of vertical currents as anything else There is no doubt that when the wind strikes the side of a Carrier serious Cliff effects will result These will vary with the class of Carriers but must always be bad Would it not be better for the Carrier to be into wind with a smooth airflow even if the relative wind is then 35 knots from ahead instead of 20 knots from the Beam ?

Another point which has been causing some thought is the question of the pitching of the ship, and here I think that both lecturers may be able to help There is a feeling, I think, that the helicopter blades have a sort of gyroscopic action and tend to keep in the horizontal as the blades are starting up or in the dangerous period of stopping If the ship is pitching or rolling the helicopter itself may be pitching or rolling, and rather than the blades flexing and hitting the fuselage the fuselage may actually be coming up and hitting the blades Has either of the authors any remarks to make on that ?

Mr K Reed (*Member—Saunders-Roe Ltd*) I am pleased I was asked to take part in the discussion today, because I know both Speakers, and we have in one way or another long standing connections

In the case of Bob SPEDDING, I had the privilege of forming and commanding 705 Helicopter Squadron which he now commands and which has in recent months, while under his command, as our Chairman has already mentioned, obtained world-wide publicity for duties highly satisfactorily carried out

In the case of Alan BRISTOW, we met in America in 1944 while both were undergoing helicopter indoctrination—I think it was from that moment we agreed to differ and, rightly or wrongly, the principle to differ remained between us

These two papers I find particularly interesting to discuss, because in both cases a similar type aircraft is used, both are shipborne, and yet there is considerable contradiction on certain extremely important points

It is my belief that the Lecture Sub-Committee's purpose for organising these meetings for papers to be read is not only from the obvious interest point of view, but also so that facts can be taken away, discussed and passed on in good faith, so broadening generally the sadly lacking publicised operational knowledge of helicopter aircraft

Consequently, the contradictions I have referred to, I intend to concentrate on now, and hope that the Speakers will clarify so avoiding misleading thoughts

Bob SPEDDING states that starting and stopping rotors proves to be the most hazardous of all operations on deck, experience having shown that a wind velocity of 30 knots is maximum, and given accompanying deck movements would reduce this maximum It is also advocated that this operation should be carried out with the aircraft " head into wind " and to avoid " tail into wind " Now Alan BRISTOW is confident to start and stop rotors, with perfect safety, in winds of 50—55 knots *IF* the aircraft is positioned " tail into wind " He qualifies this confidence by stating that flying took place in relative winds of 52 knots with no difficulties

I have always advocated with the W S 51 aircraft, when starting and stopping rotors in strong winds of 30 knots and above, if no lee is available, to firstly turn the aircraft " starboard to wind " This is not said just to provoke a personal banter with Alan, but is a practice I have always adopted or, if in doubt, hold the azimuth control forward and to the right after having landed into wind To avoid remarks concerning the " port side into wind," that being the only remaining direction, well, I would put that side into wind on an aircraft such as the Saunders-Roe " Skeeter, whose rotor rotates in the opposite direction to the W S 51

The theory I applied when adopting my method is similar to Alan BRISTOW's However, I disagree with 180° out of wind, with such high wind strength, from full load take-off point of view, unless the turntable comes into action before take-off It would be interesting to know if the helicopter anti-torque system is capable of turning the platform for take-off, or whether it is turned manually

Another important contradiction to discuss is the flexing of the blades immediately before starting and during run-down prior to stopping This problem is overcome according to Alan BRISTOW by the introduction of an anti-coning device in the rotor head mechanism on his aircraft Bob SPEDDING spoke considerably on this point and, although I believe his aircraft are fitted with the same device, he is far from happy Why have these two extremes, both coupled with experience ? Perhaps both Speakers would enlarge on their experience with particular reference to this fitting

The action of this anti-coning device is simple, it effectively holds the flapping links on the lower stops until rotor r p m builds up, when centrifugal action on bob weights in turn causes flapping links to be released (at approx 100 r p m)

Again differences arise when experimental operations were carried out by the Royal Navy on a Royal Fleet Auxiliary Vessel, I don't fully understand why it was not possible to land on a given spot for every landing when, after all, no normal landing should be made on a rolling and pitching deck until it is approaching the horizontal, which naturally is always available—that is when the stern is rising and deck approaching horizontal However, that is my experience, and Alan BRISTOW states throughout all weathers, and " it is common in the antarctic to experience a heavy swell for many days on end," precision landings were made within plus or minus six inches There is no mention by him concerning high vertical C G effect of the aircraft, or sliding on the platform after landing As this is a problem as far as Bob SPEDDING is concerned, I would ask Alan BRISTOW to explain this more fully as well as his mooring system which is stout enough to ride out a hurricane

Again blade folding limitations are contradictory, Bob SPEDDING states that the operation is difficult and hazardous to an experienced crew if the wind is in excess of 25 knots, while Alan BRISTOW states blades can and were folded on completely exposed flight decks in winds up to 55 knots Now this difference is so considerable, that I am sure we wish to know the method used by one and the method used by the other Something can obviously be learned from it, bearing in mind they are similar aircraft

If there is time, I should like Alan BRISTOW to give us his thoughts concerning " up " draught effects, using a platform deck

In conclusion, I should like to state that I have found it very interesting reading these two papers We have two extremes, one hunting to save life and the other hunting to kill, both jobs, both important, both with their problems, and ironically enough, allied in many ways to one another

As the killer always gets the headlines, I cannot finish without a few words concerning Alan BRISTOW'S paper He has again lived up to his name in producing entertainment brim full of somewhat baffling statistics Nevertheless, I am not sure that helicopters are the answer to the whaling problem I should like to hear the whaling companies' points of view, the economics of it, decks to be built, hangars,

helicopters and equipment, trained crews, operating difficulties, eventual unemployment due to redundant catchers and crews, not forgetting the high insurance premiums for such flying incurred

NO—I think there is a strong case here for *airships*—small ones, powerful ones, no decks and accompanying problems, no blade flexing or folding Views concerning helicopters versus airships would make good subject matter for a future paper perhaps

Commander (E) R H Webber (*Royal Navy*) When one does not speak first there is always a danger that others will steal one's thunder, and several points on which I wished to speak have already been mentioned

Mr BRISTOW, in formulating a specification for an Antarctic whaling helicopter, spoke of the requirement for a more powerful engine, and preferably two engines, and Mr SHAPIRO backed him up I have no argument to bring forward against the request for a more powerful engine , we have recently had experience at Gosport of the S 55 with more powerful engines than before, and we are delighted with the result I am not so sure, however, about the need for two engines I do not speak for the Naval Staff on this matter, but it seems to me that two engines are called for in case one fails, and that is most likely to happen when maximum power is demanded —that is, when hovering Hovering is called for at low level, where there is little likelihood of time and distance being available to build up forward speed before striking the sea if engine trouble is encountered A second engine is thus not of much use if it, by itself, will only enable height to be maintained at a reasonable forward speed

The value of a two-engine installation to enable one to get home after failure with one engine is also nebulous if the one engine is not powerful enough to permit safe landing on a particularly small landing area What value there is in a two-engine helicopter for a flight across the sea should be weighed against the disadvantages of extra complication, increased fuel consumption and loss of payload or carrying capacity However, a power plant such as the Double Mamba might have some advantages for this work if normal cruising flight could be maintained on half of the double engine, operating at better efficiency than a throttled-down reciprocating engine or pair of reciprocating engines I do not know whether any design study has been made of such an installation in a helicopter, but it might repay study

There are two other points in Mr BRISTOW'S paper that I would question, both concerned with the air-borne weapon and the ability of the helicopter to take on the catcher's job Is an air-borne electrical weapon available ? It would probably have to have a large static charge in it, and charging equipment which would have to be carried in the aircraft and would undoubtedly be quite bulky Secondly, what about the compressed air equipment to blow up the whale ? One air bottle would probably not do the job A normal sized air bottle with air in it at 3,500 lbs per sq in , would only supply as much air at 100 lbs per sq in as might be contained in a box big enough to contain say, two main rotor blades

(Read by Mr COLIN COOPER)

Mr A Green (*Member—Silver City Airways*) This afternoon we have listened to a most interesting lecture May I compliment Mr BRISTOW on the very comprehensive way he has shown us how the helicopter can be used in conjunction with the modern whaling factory ship This paper has been of particular interest to me for I also flew a helicopter for a whaling company in the Antarctic last winter and before doing so Mr BRISTOW was good enough to give me the benefit of his experience from a previous expedition, which was of great assistance to me As it was also Mr BRISTOW who first led me into the paths of helicoptering in the days when we were both employed by a then not very helicopter minded Admiralty, I hope he will not think I am being ungrateful if I do not agree with everything he has said in his lecture to us

As I was with a Hiller 360 last season, I was particularly interested in the very detailed descriptions of icing on this machine Icing is probably the greatest danger when operating in the Antarctic, as the temperatures are around the freezing mark most of the time, the worst region for ice accretion I was fortunate in experiencing no severe icing problems, and apart from a thin coat of ice being found along the leading edge of the main blades after a flight in freezing drizzle and several occasions when the windscreen was coated over with ice after flying through freezing rain nothing worse was encountered I would like to ask Mr BRISTOW with reference to the two ice formations he mentions what different conditions are necessary for the two different categories—clear and rough ice

The expedition which I accompanied, I was the only pilot and we were never able to keep a D R plot on the ship of the helicopter's position when flying However, with the helicopter being able to take a Radio bearing on the factory and the factory on the helicopter, and also as the catchers could take a D/F bearing on the helicopter, there was never any doubt as to the position of the helicopter in relation to the factory and catchers

I appreciate Mr BRISTOW's maxim of flying and more flying in all weather to convince the whalers, but from my experience it is of little use going out and finding whales if the catchers are unable to catch them due to heavy seas or bad visibility In the weather minima given for the S 51 I assume that the minima is not to be taken collect vely, for quite frankly, under such conditions with 40 knot winds, ¼ mile visibility, and the flight deck and upper parts of the factory in the cloud—*Thorshavet* —for such was the name of the ship I was with—would have been hove-to, with all the catchers around her waiting for weather to clear—as indeed happend on several occasions But on the other hand, one must be prepared for this sort of weather to occur when flying on a three or four hour trip, the weather can quickly deteriorate back at the factory, although the dispersal of the catchers may be such as to give warning of any approaching bad weather

Also I am of the the opinion that little is obtained by flying on whale observation trips in conditions of poor visibility Generally the visibility is very good in the Antarctic, but let me quote a hypothetical case in a visibility of say, 5 miles, a comparatively bad visibility Let us, therefore, assume that the helicopter is proceeding at g s of 60 m p h —it will therefore cover the distance of the existing visibility in 5 minutes Whales can, under varying circumstances remain below the surface for anything up to 15 minutes, perhaps more Unless one flies a most complicated form of square search allowing for this visibility/time factor, many whales might well be missed by overflying them, and even by flying the search, how does one, in the subsequent overlapping of tracks, know that the same whales have not been seen and reported twice I am also of the opinion, to eliminate this possibility of overflying submerged whales, that it is better to fly a search at a comparatively slow cruising speed and rely on a very long endurance to get the distance required, out from the factory

I must now endorse Mr BRISTOW S comments on the flight deck equipment, particularly the use of a turntable It is imperative in whaling operations that the helicopter must be able to operate as independently as possible from the factory and it is most impracticable to have the factory manoeuvre every time for a take-off or landing to get the wind in the right position In the case of an aircraft on floats the turntable is the best answer and also as the lecturer has said the danger of blades striking the tail cone when heading into a strong wind can be eliminated by turning the aircraft down-wind before stopping the rotors However, I cannot agree with his plan of putting a landing platform on the tow boats The motion of a catcher boat in anything but the calmest sea is so violent and uncertain that each landing would be not only difficult but extremely hazardous Landing on a pitching and rolling factory ship can be timed to coincide with a pitch or roll but the motion of the catchers is so quick and irregular, that I personally would not like to attempt a landing except perhaps when lying alongside the ice pack or in very calm waters

Coming to the chasing of whales I do not think that the ability to approach a whale unannounced is altogether a good thing, a whale leisurely surfacing, blowing and submerging will stay below considerably longer than one which in the panic of a chase, and pursued by a catcher, rises every few minutes for more air to assist its increased exertions Neither am I entirely convinced that the helicopter can direct the movements of the whale by flying close to it At least not in the Hiller, which of course makes less noise and has less rotor downwash effect than the larger S 51 On several occasions I flew very low over surfacing whales even through the "blows," at times when the whale seemed to notice the helicopter and other times when it couldn't care less, this was borne out by statements from the gunners who in some cases were chasing the whales concerned

Mr BRISTOW has gone into the aspect of killing whales from the air in great detail, and he has presented a very commendable case for what I am sure must be the whaling method, if not replacing, then complementary to the present catcher But I am sure he will forgive me if I say that his time of 15 minutes for killing, flagging and inflating a whale from first sighting to be very, very optimistic This would mean getting to the whale the first time he surfaced and killing him with the first shot every time

But killing from the air must come and the attendant difficulties of flagging and inflating will be overcome as will surely the harpooning Helicopters as the lecturer has said are in the whaling industry to stay and let us look forward to the day when the flight deck and its helicopters are as much a part of the modern whaler as its radar and radio equipment

Mr C T D Hosegood (*Bristol Aeroplane Company*) Mr BRISTOW said that they were worried about exterminating the whales, and for this reason an organisation had been formed which limited the Season As numerous helicopters are employed in the manner which he described, will it not be necessary to shorten the whaling season still further, thus putting you back virtually in the same position If the object is not to catch too many whales in one season, the question will shortly be "is the cost of operating a helicopter greater or less than that involved by remaining at sea for a longer period?"

Mr Colin Cooper (*Member—Helicopter Sales (C C) Ltd*) If I may add a few personal comments, I too have read these papers with very great interest Undoubtedly Mr BRISTOW has made a very close study of the subject with which he has dealt, and we owe him a great deal for helping to establish not only the good name of the helicopter in the whaling industry but also a new commercial market, which in the present times of high prices is able to make the helicopter an economic proposition

I should like to comment on the early part of his paper, where he expresses great disappointment with the operation of the Hiller 360 in the Antarctic and draws particular attention to the ice accretion on the rotor blades I think that his experience with the Hiller in the Antarctic may have been rather short, that very little flying was done, and that which was done must have been done under the most adverse conditions, as we hear that Alan GREEN flew an entire season from start to finish without encountering any serious icing I think that theoretically the three-bladed flapping rotor is meant to be freer from ice, but the Canadian ice-breaker companies have standardised on two-bladed helicopters for all their Arctic ice-breaking work, so that I do not think that the two-bladed rotor can be very much worse under practical conditions

Mr BRISTOW refers to the poor utilisation of the first expedition's helicopter as due to poor advance planning I think that there were many other contributing factors to the low utilisation, and I would now say something that Alan GREEN was perhaps too modest to mention, and that is that he and one engineer operated the small Hiller helicopter from an open platform on the deck of a whaling factory ship for an entire season without any hangar protection at all, and without even opening their spare part allocation They changed the cooling fan and four sets of sparking plugs, but for 110 hours flying under such extreme conditions that hardly counts Several flights of over four hours were made, although reserves were small These two men under those adverse conditions kept the helicopter available for flying in all daylight hours for the entire season, and available to fly right to the end They were not on any occasion grounded, and it was the only Pilot and helicopter to complete an entire season of whaling from start to finish It is also of interest to hear that the owners of that machine believe that its utilisation in the first season paid for the machine and all associated costs, presumably by the number of whales spotted and the assistance which it gave to the catchers The company look forward to taking the machine out again this coming year

Undoubtedly the properties of the S 55 can contribute much more to the whaling industry, but when dealing with small machines there is very little to be said in favour of one more than the other Perhaps ultimately we shall see the use of very small helicopters and very large machines, thus getting maximum economy over a wide range of operation If it is true that landings can be made on tow-boats—and, having seen in the film a tow-boat in a rough sea, I doubt it—I would say that the small helicopter still has a definite part to play in air whaling, in conjunction with the use of larger machines for the actual catching of the whales

Mr Basil Arkell (*Founder Member*) I should like to refer to the point which Commander SPEDDING made about the need for a device to clamp the helicopter on to the deck immediately it had landed In the U S A in 1944—I am sure that Wing Commander BRIE remembers this—we had a dummy landing deck at Floyd

Bennett field, which was operated hydraulically to simulate ship movement and was, incidentally, very useful for training purposes

On to that deck we fitted a wire mesh The wires were crossed at right angles, the space between them being about 4 inches The mesh was raised from the deck, I think, about 4 or 5 inches Below the helicopter, nearly underneath the C G , we fitted a device which dropped through the grid when the helicopter landed on the wire mesh On striking the deck below the mesh the device shot out three arms thus preventing the helicopter from moving once it was down

We had two sources of trouble with those experiments One was that we tended to get a certain amount of resonance from landing on a springy wire mesh I think that this could have been dealt with The other was that the sprung arms sometimes released before they had gone down below the grid The experiments were never brought to a successful conclusion, because we returned to England in the middle of the developments, but I wonder whether in the archives of the Admiralty there are some reports on the work which was carried out, and which might possibly be continued by Commander SPEDDING's unit at Gosport to bring about a practical solution to the problem

The Chairman I can partially answer that, because the first crossing of the Atlantic by helicopter was made on the ' Daghestan " which I converted in the United States, and I came across with a combined British and United States team That platform which did not interfere at all with the normal duties of the merchant vessel, was located at the stern, and it embodied a turntable such as we have heard about this afternoon I believe it was the first time that such a turntable had been installed on a ship

It did more than enable the helicopter to be orientated into the wind's eye for take-off It did not employ the wire mesh which was experimented with at Floyd Bennett field, but it did embody a method of automatic anchorage of the aircraft which has never yet been fully tried out Over the years in which I have had personal experience of operation from shipboard, learning things the hard way, I came to the conclusion that the main problem in operating a helicopter or rotary-wing aircraft from a small platform on a normal ship is one of anchorage , and, unless that can be provided in such a way that the pilot is relieved of his responsibilities in ground handling the aircraft, there will be many of the problems which Commander SPEDDING has indicated are met with in the Navy, and to which Mr BRISTOW, who mentioned the number of people required for ground handling, has also alluded If a serious effort is to be made to make this operation more simple, more safe for the crew, and less expensive from the point of view of public funds, a turntable and anchorage are absolutely indispensable

Mr Colin Cooper I should like to ask Commander SPEDDING whether the Royal Navy has as yet any experience with the two-bladed Hiller helicopters which I believe they operate, and if these machines facilitate deck handling, and whether the two-bladed rotor has the same starting and stopping problems as those of the three-bladed rotor which have been discussed

Lieut -Commander H R Spedding (*in reply*) I shall deal with the various questions as they arose, and first of all with Wing Commander BRIE's remarks about the type of undercarriage required I think that, if it were possible to have it, a four-wheel undercarriage for deck operation would be rather better than the tricycle undercarriage All four wheels should be fully castoring, and they should be capable of being locked in the fore and aft position Those are my personal views

Commander HODGKINSON referred to the question of doing plane guard duty at night from an aircraft carrier I was not right in saying that the helicopter could not operate at night It can do so under contact conditions Quite a number of problems are attached to that If you are going to be of any value at all, you have to be capable of hovering low over the sea and picking someone out I think that the idea of the two lights, as used in the Mohne Dam case, is probably a very good one for giving an indication of your height relative to the sea , on the other hand, you still have to have a light to shine down on the body that you are going to try to pick out of the water With an ordinary machine like the S55, where you have the room at the back and the large access door, some kind of light controlled by the aircrew man should be sufficient to enable you to pick someone up at night You are hovering relative to the body you are picking up and trying to maintain a position over him,

and with your winch operator giving you instructions it should not be at all difficult

With regard to flying either on the right or on the left hand side of the cockpit, we have only two types in service at the moment for air sea rescue work or plane guard duties, namely the S51, which you fly from the middle, and the S55, which you fly from the starboard side There are definite advantages in that, because both the winch and the access door are on the starboard side of the aircraft, and it is quite easy for the pilot to lower the winch while watching a body in the water and hoist the man out without any help from his winch operator If the pilot were on the port side he could not see anything and would have to rely on the instructions given to him by the winch operator at the back

On the question of the varying effects of air flow from a ship's side, particularly on board a carrier this is something which varies from ship to ship With one class of carrier you can operate well forward of the lift, almost up in the bows of the ship, without any problems at all, but with another class of ship it will probably be advantageous to operate from the stern I do not know why they vary so much If the ship is steaming across wind, provided the helicopter points into relative wind and is near the centre line of the deck, with the majority of carriers I do not think that the cliff effect or the currents caused by the cliff effect are very serious It is better to be pointing into the relative wind as opposed to having a much stronger wind coming from dead ahead

With regard to landing on a carrier which has a lot of movement on it, with a heavily pitching deck certain allowances have to be made The best position for the helicopter to land is on the spot where there is least movement, right in the centre of the deck

Dealing now with Mr REED'S remarks, the speeds which I gave in my Paper for stopping and starting rotors are, as I said, not actual maximum speeds but speeds which we have laid down as a guide to Commanders (Air) or Commanders flying in carriers, so that the helicopter is operated with maximum efficiency and least risk of damage We have operated in wind speeds up to just over 45 knots without any serious troubles, but there is a greater risk , and, since we have only two helicopters in each ship, we are anxious to preserve them for as long as we can They are expensive aeroplanes

With regard to the anti-coning device fitted to the S 51, with which all my aircraft are now fitted, this only stops the blade from actually going up over the top until the rotor r p m are high enough for centrifugal force to take charge of the blades

With regard to landing near a given spot, I should prefer not to make any comments on that because I did not do the landings and I had to go by the report as it was written

The figures which I gave for blade folding are the maximum wind speeds which we normally use, but those blade folding maximum speeds apply in the same way as our maximum speeds for stopping and starting The figure is laid down as a guide We do not say that it cannot be exceeded, because it has been , on the other hand, that is the figure which we recommend

In reply to Mr COOPER'S question about deck landings with two-bladed helicopters, we have some Hiller 360s at Gosport, but they are used purely in basic training, and, though we have done a small number of deck landings, the carrier has always been in Portsmouth harbour and not at sea I cannot, therefore, answer that question, because we have had no experience

Mr A E Bristow The best way to wind up is to say " Thank you, it is time to go," because there has been so much comment that to deal with it fairly would require very considerable thought, and it would be most unwise and unfair for me to stand up now and try to answer everything in detail I shall do my best to reply to the questions in writing, if the Association will be good enough to send me a copy of them

Written Replies by Mr Bristow to the Discussion

In reply to Mr Green

Conditions vary so tremendously from place to place and from time to time in the immense vastness of the Antarctic, and it is not surprising to learn that Mr GREEN experienced nothing worse than light icing where he was flying last season The

icing which I have described occurred while flying a Hiller 360 in the Ross Sea (latitude 74° South)—a region which is renowned for severe icing conditions

On the occasions when main rotor blade icing was encountered the free air temperature varied between 0° to —3°C Consequently, it is my belief that temperature did not play a great part in determining the type of ice formation Moreover, without equipment to measure the liquid water content and droplet size, and denied comprehensive meteorological data, I was unable to deduce a satisfactory explanation for the various ice formations

It is of interest to note, however, that no blade icing was encountered on the 1952/53 season with the Westland S 51 helicopter, although many hours were flown in similar conditions to those which so readily produced blade icing on the composite wooden and fabric rotors of the Hiller 360 It may be that the fully articulated rotor system of the S 51, coupled with the high flexibility of the metal blades, act together as an automatic de-icing medium I only regret that I can offer no conclusive evidence on this important issue at this stage Until rotor blade icing has been thoroughly investigated, I think it is imperative that all helicopters operating in the Antarctic are fitted with permanent flotation equipment

The weather minima is not to be taken collectively

It shou'd be remembered that the work with the S 51 was still to a large extent experimental and that the flights in fog, snow and heavy rain were made primarily to assess icing risks and instrumentation, and not to search for whales 1,334 whales in 36 days is a creditable performance which nobody can deny On occasions, however, we did fly out through areas of bad visibility to search in clear areas reported by the catchers some 50 miles ahead of the factory ship

With a target utilisation of 400 hours per helicopter in a 90 day season, the ability to fly safely, regularly and in all weathers, is essential—and to this I have always been working

The risk of ' overflying ' whales whilst they are submerged is not, in my opinion, directly related to the helicopter's speed over the sea as Mr GREEN's remarks would have you believe

In his argument he assumes that whales swim at a constant speed and sound at regular intervals for regular periods of time Nothing could be further from their actual behaviour One must totally disregard hypothetical arguments in considering helicopter whale reconnaissance tactics and concentrate on analysing each circumstance on its merits

To rely on detecting the presence of whales from the air only by their " blows " would result in missing a fair percentage One must employ a search technique which ensures maximum efficiency in coverage, and at the same time allows the pilot and his observer to examine the evidence provided in the form of Krill, " oil foot prints," birds and other types of whales

Mr GREEN asks how does one know that the same whales have not been seen and reported twice ? The answer is simple—by keeping an accurate air plot and position fixing with special radio navigational equipment

That a helicopter can approach to within a very close range of a whale unseen and unheard is not in dispute—and this is indeed of the greatest significance

Surely the value of whether a helicopter frightens whales or not depends on

(1) the particular role of the helicopter (reconnaissance, shadowing or killing) ,
(2) what the whales are doing when sighted ,
(3) the position of the catchers in relation to the whales reported by the helicopter

It must be emphasised that whales can be frightened and made to " run " by manoeuvring very close to them during the blowing cycles

In reply to Commander Webber

The value of a multi-engine installation for flying over the sea is so universally accepted that it cannot by any stretch of the imagination be described as nebulous Provided the power available when one power unit is inoperative fulfills the accepted requirements, it enables operations to take place from the smallest areas with the greatest safety, makes hovering safe at any height above the landing area and permits the helicopter to get safely back to the ship or if possible to a shore base when one engine fails The achievement of these results demands a certain drill after an engine failure, but this drill is well established and acceptable The fact that twin-engined helicopters of present design cannot continue to hover in still air after the failure of

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one power unit is not relative to the safety aspect Moreover, this is not the place to go into details of a problem which has been thoroughly discussed on many other occasions

The leading question is whether these advantages are too expensively bought at the price of additional mechanical complexity and maintenance costs, which are inherent in present twin-engine installations Neither can be considered hypothetical In some cases I am told that no weight penalty is involved and that the gain in accessibility outweighs the loss through complexity in maintenance

Whilst the use of a double Mamba as a helicopter power unit may have its advantages, it is generally believed that the value of twin power unit installations depend on these being entirely independent I believe that the double Mamba is almost independent, but not quite, and on that score its value is in some doubt

The remaining questions of Commander WEBBER'S are not really the subject of this lecture, but let it suffice to say that airborne killing weapons are under development at the present time I do not wish to discuss the arithmetic of Commander WEBBER'S argument, but it is my conviction that the method of inflating dead whales is technically not one of the most difficult of problems

In reply to Mr Cooper

The Antarctic is a most unpredictable and vast place and it would be foolhardy for anyone to generalise, particularly on weather conditions The icing which I experienced was in the region of 74° South in an area called the Ross Sea, which is famed amongst whalers for severe icing conditions

The use of small helicopters such as the Bell 47 by Canadian ice breaking companies bears no relation to whaling requirements

I can see no future whatsoever for small helicopters in Pelargic whaling, and this view is supported by the fact that at least three expeditions next year will be using the Westland S 55 helicopter and it is not unlikely that the Hiller will be withdrawn and a larger machine put in its place

In reply to Wing Commander Brie

The floats used on the S 51 last season were the American coastguard " doughnut " type which were permanently inflated from a ground supply These floats presented a very large drag surface in flight and were directly responsible for the very large reduction in speed No tendency for the bags to stick to the deck was experienced

Modern whaling factory ships are in the region of 18,000 to 20,000 tons and in consequence the flight deck is situated about 50 ft above sea level with the ship at maximum draft, and there would appear to be no need for a false deck

In reply to Mr Hosegood

Perhaps it should be made clear that from an economic point of view employment of the helicopter in whaling can be divided into two periods In the initial stages the helicopter will only be in the hands of some Whaling Companies and to them will go the additional productive benefits derived from aerial reconnaissance When all whaling expeditions are equipped with helicopters an overall reduction in expedition capital and operating costs will be achieved and the benefits enjoyed by the industry as a whole

THE CHAIRMAN

We shall have the answers in due course In winding up this meeting, I must say that I have been agreeably surprised, and I think that the lecturers must be gratified also, by the remarkable attendance on an afternoon such as this, when there are so many other ways of spending one's time Those who have come here have not, I know, been disappointed This is the first time that we have tackled a subject of this nature, and we have had some news at first hand about a very specialised activity What we have heard today is merely the fringe, because the subject has tremendous applications

In expressing our combined thanks to the lecturers, I can assure them that personally I have enjoyed listening to them I do not necessarily agree with them in all respects, and I think that that is quite logical , the object of these lectures is to provoke discussion and interest so that in the end the right answers can be found from collective thinking I ask you to join with me in thanking Commander SPEDDING and Mr BRISTOW for their contributions this afternoon

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