Helicopter Operations in the Persian Gulf

By A E BRISTOW, A R Ae S

A Paper presented to The Helicopter Association of Great Britain in the Library of The Royal Aeronautical Society, 4 Hamilton Place, London, W 1, on Friday, 9th March, 1956, at 6 p m

W/CMDR R A C BRIE (*Vice-President*), in the Chair

INTRODUCTION BY THE CHAIRMAN

Wing Commander BRIE said that Mr BRISTOW had been connected with many aspects of helicopter development for a number of years He first learned to fly helicopters in 1944 at Floyd Bennett Field, U S A , and in 1946 was a helicopter test pilot with Westland Aircraft Ltd In 1948 he received the Royal Aero Club Silver Medal for the relief of the Wolf Rock Lighthouse, and in 1949 the Croix de Guerre for jungle rescue in Indo China whilst he was Technical Manager and Chief Pilot with Helicop-Air, Paris In 1950 he formed his own company, Air Whaling Ltd and pioneered the use of the helicopter for whaling in the Antarctic In 1955 he formed Bristow Helicopters Ltd , and tonight we are to hear an account of the work being done by this Company in the Persian Gulf and the large part the helicopter plays in transporting men and materials from the mainland to the drilling rig fifty miles out in the Gulf

MR A E BRISTOW

INTRODUCTION

It gives me great pleasure to describe the helicopter operations which my Company are undertaking for the Shell Company at Doha in the Persian Gulf

When talking about one's own operations—especially operations that have been going only five months—it is a great temptation to tell people about the things that are going well and forget to mention one's mistakes One can so easily become dogmatic and present a picture which implies that " this is the way to do it—no other way is any good " I shall try to avoid these pitfalls and be as objective in my remarks as I can, hoping that where I stray from the unbiased opinion, you will be strong in your criticism

* Acknowledgments to Shell, Westland Aircraft Limited, The Air Registration Board, and Transair Limited

First of all, I should like to give you a brief description of the delivery flight from Henstridge to Doha, and then tell you how we have set about the task of operating two Westland S 55 helicopters on a scheduled passenger-freight service, and conclude by illustrating my talk with a film

Delivery Flight

The delivery flight received much publicity, but in reality was just routine flying and nothing like so exacting as the recco flights over the Antarctic's icy wildernesses

It was required to move two aircraft, four pilots, and five engineers, complete with spares, from the U K to Doha, as quickly as possible

The economics of sea freight versus flying resolved itself readily to the latter method, when one considers the time factor, the costly processes of disassembly of the machines, crating, road transport to the docks, loading, shipping and handling charges, with the reverse sequence to be performed at the port of destination Flying was cheaper and saved four weeks

The helicopters were received from Westland Aircraft Ltd on Saturday, 17th September, and departed from Eastleigh on the following Tuesday The crew consisted of two pilots in each helicopter—engineering personnel and a limited amount of spare parts necessary to support the first two months of operations in Doha, together with all personal luggage and servicing tools, were carried in a Transair Dakota

The Dakota provided an extremely useful V H F link between the helicopter and the terminal landing point on each section of the route, and its departure programme was timed in such a way that it would overtake the helicopters after they had departed from their intermediate refuelling stops The success with which the procedure was co-ordinated was due to the excellent co-operation given by the Transair crew, particularly over the long stretches of sea and desert with regard to radio communication

The itinerary of approximately 3,700 miles was flown in easy stages ranging from 158 to 389 miles between refuelling points and was completed exactly according to the planned schedule in 42 hours flying time

The route started from

From	*To*	*Distances*
Henstridge	Southampton (Eastleigh)	44 miles
Eastleigh	Paris (Toussus)	219 ,,
Paris	Lyon (Bron)	247 ,,
Lyon	Nice (Le Var)	245 ,,
Nice	Rome (Ciampino)	305 ,,
Rome	Brindisi	292 ,,
Brindisi	Athens	378 ,,
Athens	Rhodes	267 ,,
Rhodes	Nicosia	304 ,,
Nicosia	Tripoli (Klieat)	158 ,,
Tripoli	T 1	310 ,,
T 1	Baghdad	207 ,,
Baghdad	Kuwait	347 ,,
Kuwait	Bahrein	271 ,,
Bahrein	Doha	87 ,,

The only special equipment fitted was a long range fuel tank which gave a total fuel capacity of 235 imp gallons Emphasis was placed from the outset on maintaining schedule regularity, and no attempts were entertained of making point to point time or distance records for helicopters

The flight was completed when the helicopters arrived at Doha on the 28th September, ready to commence operation

Weather generally throughout the flight was good, but in the section between Brindisi and Athens, poor visibility and heavy rain was encountered The anticipated problems of high ambient air temperatures and light wind conditions on take-off performance at or near maximum All Up Weight in the Gulf Areas of the route were virtually non-existent At Kuwait the air temperature reached 45°C, with light and variable wind conditions, no difficulty whatsoever was encountered in taking off vertically at an All Up Weight of 7,400 lbs

Finally, it is worth mentioning that only routine daily maintenance and scheduled inspections were carried out during the course of the entire flight from the U K to Doha

Operations in Doha

A lot of people have the impression that the Persian Gulf is the world's worst place to live and operate aircraft, and I must confess that I shared this view until I visited Doha in June, 1955 Let me hasten to give you a more accurate picture of the climate, for 7—8 months of the year it is very pleasant—not too warm, and not too cold For three to four months, it is extremely hot, at times very humid, and working out of doors is sheer hell ! But air-conditioning of all houses and offices has done much to make life tolerable during these periods of intense heat

From September to May, there are plenty of social and sporting activities to suit everybody's taste There are regular social activities The sporting activities include tennis, cricket, excellent sailing and fishing, hockey, football and swimming

With the scene set, and the helicopters safely in Doha, let me go back and tell you the story from the beginning

In June, 1955, my Company had contracted with the Shell Company of Qatar Limited to operate two Westland S 55 helicopters based at Doha in Qatar in the Persian Gulf The helicopters and equipment and base installations were to be provided by the Shell Company, and Bristow Helicopters Limited were to provide experienced helicopter crews and management know-how to set up the operation and keep it going without interruption for at least two years Our task was to carry drilling crews, Shell Company executives and technicians, minor drilling equipment, special tools, medical stores, mail and provisions from the exploration headquarters at Doha to a drilling rig situated some 50 miles out to sea

This was, therefore, a day in day out operation, 7 days per week, which had to be carried out without interruption and in absolute safety at all times

The flight deck, which was built on a cantilever structure attached to one side of the drilling rig, measured 50 × 70 ft over all, and was raised some 60 ft above the sea This meant that the pilots could expect little or no ground cushion effect for rig landings or take-offs, as the greater and most effective part of the rotor slipstream would not impinge on the flight

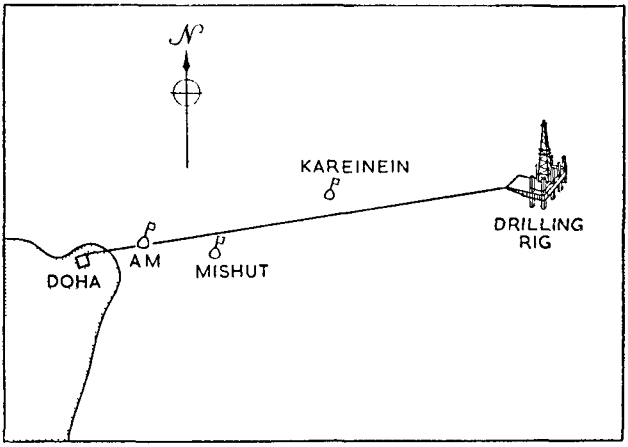


Fig 1
Sketch map of the operating area

deck and the rest would be dissipated before it reached the sea The initial utilisation target was set at 100 hours per month At first sight, this may not strike one as a very exacting task, but let us examine the requirement a little more closely

In terms of sea crossings, the flight from Doha to the rig may be likened to flying between Weymouth and the Channel Islands The W S 55 we had operated before on intensive utilisation under difficult conditions aboard whaling factories in the Antarctic for two consecutive seasons, and we had proved their reliability and performance, and learned something of the techniques and organization which was required to keep them in the air Of their performance in conditions of intense heat and high humidity, we could only guess Of the maintenance problems associated with flying in a sand laden atmosphere, we had some experience in North Africa and the Sudan

In Doha, we were to have our first experience of carrying passengers and of running a scheduled service, and also our first experience of working with an oil company Moreover, the helicopters were to be operated and maintained to the same standards and in accordance with procedures provided for in law for the operation of aircraft engaged in the public transport of passengers and goods—and in certain respects, this was new to us And whilst we were very proud of the confidence which the Shell Company had placed in us, we were more than ever conscious of the responsibility that was being entrusted to us The degree of this responsibility was more clearly appreciated when the Shell Company informed us that they were relying almost entirely on the helicopter to keep the rig working Weather records showed that 50% of the year the swell and sea was such in the drilling area that marine craft could not come alongside the rig to transfer personnel and equipment In January this year, it was impossible for marine craft to come alongside the rig on 75% of the days, and in February, the figure was 80%

Drilling for oil is a continuous process ; it must go on 24 hours per day, day after day, for periods of up to 6 or 8 months at a time Consequently, the helicopter schedules had to be geared to meet drilling requirements, and the machines had to be ready to fly on schedule in all but the most adverse wind and weather conditions (See Fig 2) Every day that a rig is idle represents a loss of the order of £1,000 to an oil company

FIG 2 HELICOPTER TIME TABLE

Weekday	Friday	Saturday	Sunday		Monday	Tuesday		Wednesday	Thursday
Drilling Day Number in 28 day Cycle	1 8 15 22	2 9 16 23	3 10 17 24		4 11 18 25	5 12 19 26		6 13 20 27	7 14 21 28
Flights	A M	P M	A M	P M	P M	A M	P M	A M	P M
Dept Doha	8 30	13 00	10 00		15 00	10 00		8 30	13 00
Arr H S	9 15	13 45	10 45		15 45	10 45		9 15	13 45
Dept H S	9 30	14 00		14 00	16 00		14 00	9 30	14 00
Arr Doha	10 15	14 45		14 45	16 45		14 45	10 15	14 45
Dept Doha	10 30	15 00						10 30	15 00
Arr H S	11 15	15 45						11 15	15 45
Dept H S	11 30	16 00						11 30	16 00
Arr Doha	12 15	16 45						12 15	16 45
Total seats available									
To Platform	10	10	5		5	5		10	10
From Platform	10	10	5		5	5		10	10
Seats reserved for D R Personnel									
1st Week									
To Platform	9(1)	4(6)	4(1)		0(5)	0(1)		7(3)	10
From Platform	7(3)	10(0)		4(1)	1(4)		0(1)	4(6)	10
2nd Week									
To Platform	5(5)	6(4)	0(5)		2(3)	1		8(2)	10
From Platform	5(5)	10		0(5)	2(3)	0	1	3(7)	9(1)
3rd Week									
To Platform	8(2)	5(5)	4(1)		0(5)	0(1)		7(3)	10
From Platform	7(3)	9(1)		4(1)	3(2)		0(1)	4(6)	10
4th Week									
To Platform	5(5)	5(5)	1(4)		2(3)	0(1)		8(2)	10
From Platform	5(5)	10		0(5)	2(3)		0(1)	3(7)	9(1)

TUESDAY plane reserved for Commissary supply

Figures in brackets — seats available or material

Our passengers were to be made up of one-third Europeans and two-thirds Arabs, and they were to use the helicopter like a bus service to get them to work and bring them safely home, and for this very reason, we figured that they would be a lot more critical than the average airline passenger Therefore, every one of our passengers was to be a V I P—a very important partner in the success of the enterprise

Initial detailed planning is of paramount importance in any long range, remote undertaking of this nature, and we recognised it as the factor most likely to determine the success of the operation , so we set about planning each phase very carefully in the closest co-operation with Shell's Group Aircraft Operations Department

The first, and rather obvious step was to visit Doha and survey the operating area and get first hand experience of local conditions, as well as to discuss the project with the Shell Management on the spot The details of this visit are too numerous to record in this paper, but the salient issues may be summarised under the following headings

Organization and Management of the Helicopter Unit
Flight Schedules and Load Requirements
Employment of Indian Fitters

Local Labour Resources
Hangar and Tarmac Siting and Dimensions
Flight Deck Siting and Flight Deck Equipment
Workshop, Stores, and Office Layout, Siting and Dimensions
Accommodation and Transportation for Crews
Workshop Stores, Hangar, and Tarmac Services such as

- Electricity supply ,
- Compressed Air supply points ,
- Distilled Water supply ,
- Refuelling equipment ,
- Fire Fighting appliances ,
- Telephone and Radio communications ,
- Night Lighting of landing square and flight deck on the rig

Next, we turned our attention to the helicopter specification, spares provisioning, the selection of personnel, and the administrative and operational organization To meet operational requirements every weight economy consistent with safety was made to keep the basic weight of the helicopter as low as possible The specification, therefore, called for a bare machine fitted with permanently inflated rubber pontoon type undercarriage, plus the following extra equipment

- 8 Lightweight passenger seats ,
- Removable lightweight cabin soundproofing ,
- V H F Transmitter/Receiver ,
- A D F equipment ,
- Night flying equipment ,
- Fixed fittings for an external cargo sling

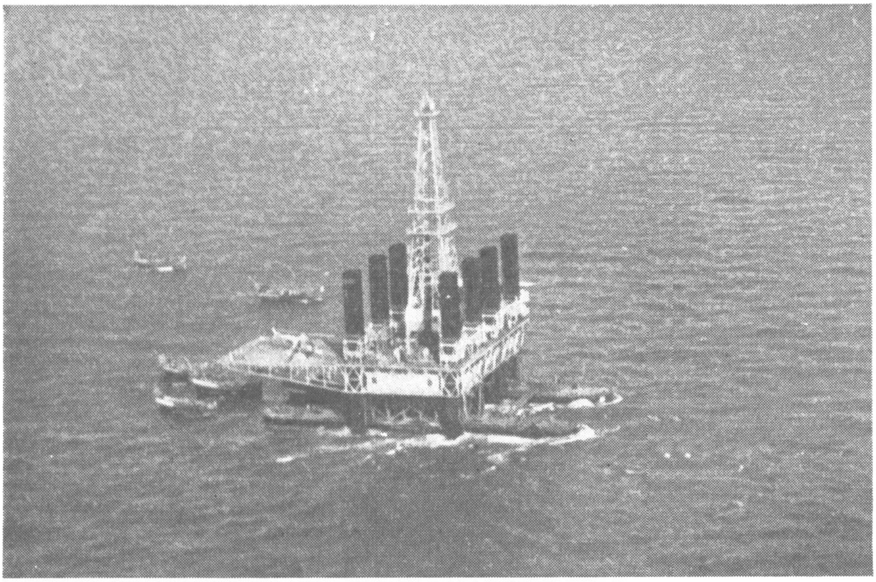
Messrs Rumbold Ltd did a remarkably fine job, and produced 8 seats, two groups of three seats, and one group of two seats, for a total weight of only 83 lbs

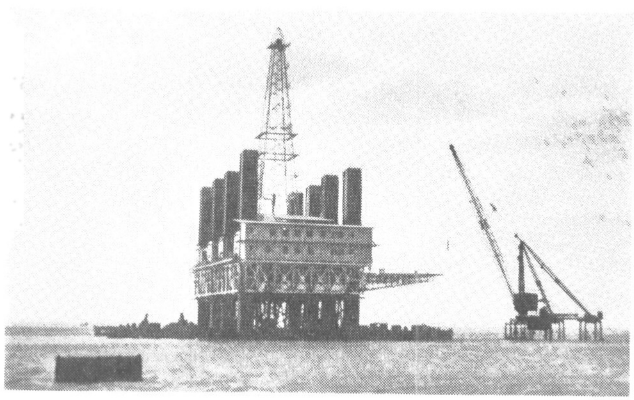
We selected the STR9X transmitter/receiver and the Marconi AD7092—both well proven pieces of equipment We would have preferred to have dispensed with the A D F and to have employed a VHF/DF system—thereby keeping the weight on the ground and not in the aircraft—for locating the rig in bad visibility, but the manufacturers of VHF/DF equipment advised us against its use, due to the inherent errors that would be created by the proximity of the massive steel structure of the drilling rig

Inclusion of night flying equipment in the original specification was made in the belief that it would be expedient to fly at night during the summer months (June—September) to maintain the same load capacity as in the other months of the year Moreover, it was thought more practicable to change the working routine for the helicopter personnel than to alter the drilling shift system which was complex enough and had to be controlled and co-ordinated by the Shell management Night flying trials are due to commence in April, and the decision to introduce a night flying schedule will have to be based on the outcome of these experiments

The flotation gear was to be the first line of safety in the event of a forced landing having to be made between Doha and the rig , each passenger would wear a lifejacket throughout the flight, and each aircraft would carry an emergency survival kit, including shark repellent

The second line of safety was to be vested in the VHF control and plotting system—which I shall describe later on





Two views of the drilling rig The helicopter landing platform is clearly visible

Provision of fixed fittings for attaching an external cargo sling was called for in the specification against the time when this equipment received A R B approval and could be used for the carriage of bulky loads

The Doha operation was to be the W S 55's first real test in very hot, very humid, and sandy conditions Our task was clearly to try to anticipate the maintenance difficulties and operation limitations that were likely to arise, and our notes were full of question marks, some of which read like this

1 How to prevent corrosion on the aircraft and spare parts stock ?

2 How to control the abrasive and damaging effects of sand ?

3 How to overcome the adverse effect of high carburettor air temperature on performance ?
4 What operating techniques should be employed to get the highest possible payload in high ambient air temperatures ?
5 Was it practical to overhaul major components on site ?
6 How to keep at least one helicopter always ready to fly ?

The greatest possible precautions to prevent corrosion occurring in the large areas of the aircraft covered with magnesium alloy material were called for in the painting specification, because once corrosion starts in magnesium components, it is almost impossible to check Just as every phase of construction and testing had been witnessed by our representatives, so was every phase of painting inspected We were not very fussy about the high gloss finish, but we were very meticulous about the protective treatment between skin joints and the number of applications of pre-treatment primer, etc —the anti-corrosive treatment was to the latest Naval aircraft protective paint specification RS116 Synthetic paint was called for as the final finish as it is less susceptible to chipping than cellulose paint and, moreover, can more easily be applied in the field

Having got the aircraft to Doha, still looking very smart and polished, fine appearances were promptly forgotten and the elegant colour scheme was somewhat marred when all magnesium alloy skinning on one aircraft was sprayed with sea-plane varnish, and the other aircraft treated with a lanolin compound with white spirit added Again, great care was taken to see that all crevices and joints were well covered The varnish sprayed on easily and formed a transparent yellowish covering which, after a few hours, hardened with no trace of stickiness

The lanolin compound sprayed easily, but it was of such thin consistency that it ran off the aircraft skin, leaving a thin, clear, oily deposit which refused to dry or harden Sand and dust adhered easily to this oily film, and it was very soon apparent that this anti-corrosive protection, whilst doubtless very effective, required a lot of labour and attention Consequently, the comparative tests were abandoned in favour of the sea-plane varnish—which to date has shown no evidence of cracking, peeling, or chipping in spite of exposure to heat and sunlight A little less than a gallon of varnish was used on each aircraft

Minute inspection for cracked or chipped paintwork or exposed metal surfaces is made every day, and the slightest deterioration in the protective varnish or paintwork is immediately remedied

As a further deterrent to corrosion in magnesium alloy parts, a supply of distilled water is provided to allow frequent washing of the aircraft and blades, and it is our practice to wash the aircraft every other day and remove the main rotor blades every 15 hours for detailed inspection and washing

Anti-corrosive treatment of spares received very careful attention All exposed metal parts were treated with a protective wax solution to afford maximum protection for long term storage Large assemblies were covered with grease and sealed in polythene plastic bags Engine Change Units were given special texicoon treatment, and all small and electrical components which could not be dipped in the wax solution were treated with VPI powder and wrapped in Kraft paper Rubber components were well covered with french chalk, and magnesium alloy sheets, alloy tubes, etc , were heavily greased Instruments, electrical test apparatus, electrical fittings were to be stored in a part of the air conditioned inspection shop

It is hard to imagine anything more detrimental to helicopter rotor blades than millions of particles of sharp abrasive sand that are whipped up by the rotor slipstream during run-up, take-off, and landing, and blasted against the leading edges of the blades To reduce, if not eliminate altogether, blade wear and/or damage from this source, oil was to be sprayed on the sand up to a distance of 80 ft out from the edges of the concrete operating area Arrangements were made with local contractors to spray the oil—the same oil as is used in making desert roads—when into the office one day came one of the Shell Company's senior surveyors with the news that part of the road from Doha to Umm Said, treated with the same grade of oil, had caught fire This was quite a set back Tests were made with various mixtures of sand and oil, but in the end, it was decided that it would be more effective and cheaper in the long run to cover the sand area round the operational areas with a two inch thick layer of concrete

As you will see in the film I am going to show after this paper, the construction of the hangar, workshop, stores and offices were not finished when we arrived in September, and the treatment of the ground adjacent to the landing area to control sand being blown up by the rotors had not been carried out However, flying could not be stopped altogether while we waited for the construction work to be completed

We could have sprayed the sand and landing areas with salt water, but we decided against this, believing that corrosion from a salt ladened atmosphere and sand impregnated with salt crystals were likely to be more damaging than sand by itself

In our study of the aircraft specification, we had decided against fitting the sand protection modifications offered by Westland Aircraft Limited, on the grounds that whilst they would afford some protection, they could not completely keep out the sand Moreover, it was our contention that a hidden mechanism would be less likely to get the same attention than an exposed part would receive, and, besides this, the modification added weight to the aircraft

Now we have flown more than 400 hours in very sandy conditions, and contrary to our first thoughts, have experienced no signs of excessive wear on bearings or control linkages, universal joints, control chains, or sprockets, due to the effect of sand We can only attribute such good bearing life to the fact that, from the time of delivery of the machines from the factory, we have applied grease to all such parts very generously and more frequently than the manufacturers recommend Moreover, we instructed our maintenance team never to attempt to clean surplus grease from a bearing surface with a rag or solvent spray, but to pump in more grease to purge out the old grease, and let the surplus grease be thrown off when the parts rotate—to hell with appearances Please do not interpret these remarks to mean that we let the machines get filthy, that we never clean components, or inspect for deterioration or cracks, etc —nothing could be further from our practice

To combat filter clogging, we specified more frequent inspection cycles than were recommended for operations in temperate climates—and this preventative inspection procedure seems to be giving good results As a further precaution, it was agreed to reduce the engine overhaul period from

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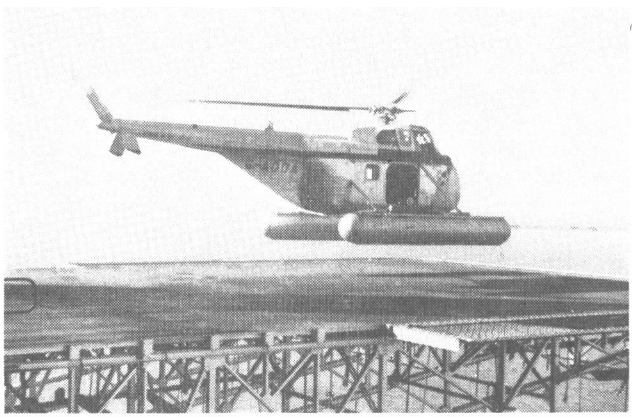
700 hours to 500 hours, until we had enough experience under the adverse summer operating conditions to warrant a return to the higher overhaul cycle

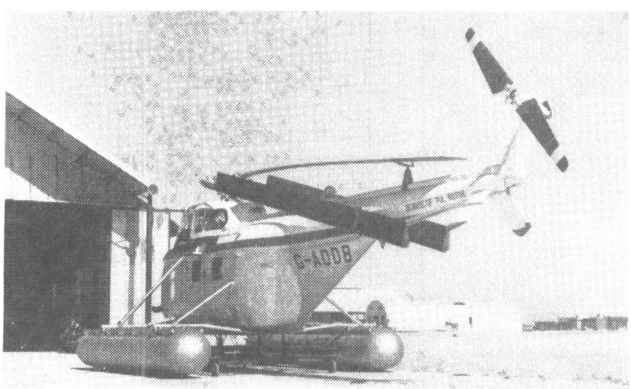
In the initial stages of operations, before the concrete surround was laid, the abrasive effect of sand on the fan blades and tail rotor blades was negligible, but it was very serious on the leading edges of the main rotor blades In fact, the rate of wear was so rapid that we calculated that a set of main blades would have to be scrapped every 500 hours

We anticipated high carb air temperature, and asked the manufacturers to design and make an improved air intake system which would substantially reduce carb air temperatures in high ambient air conditions and prevent a marked loss of power This modification is at present undergoing tests with the manufacturers and we hope it will be ready before the hot weather begins in June

As a further measure to reduce carb air temperature, test flights were made with the engine doors removed, and a big drop in carb temperature was observed The increased drag caused by removal of the engine clam doors reduced cruising speed by 4 knots, but the weight saving of 48 lbs

Coming in for a landing on the drilling rig





One of the helicopters on its ground-handling trolley outside the hangar at Doha

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coupled with enhanced hovering and climb performance, far outweighed speed considerations

To give complete freedom in ground handling of the helicopter on floats we designed and built a special trolley The trolley was designed to allow —

1 The aircraft to be turned through 360° within the limits of the 50 ft wide tarmac in *one* movement ,
2 The aircraft to be rigged without removal from the trolley , and,
3 the float and wheel undercarriages to be interchanged easily and quickly without special ground equipment

It was not, however, intended for use on rough ground

Our fears of high engine oil temperatures in ambient temperatures of 35°C and upwards, led us to install an oversize oil tank of 11 imp galls capacity without the usual hot well, but they have proved completely unjustified Likewise, we anticipated a marked rise in gear box oil temperature, but to our delight the main gear box temperatures have not risen above 58—60°C —the temperate climate normal operating condition

Soon after flying began in Doha, it became clear that I had underestimated on the office and control room space required, and an additional room had to be built This could only be positioned in one place—as an extension to the existing office, and this created an obstruction in the N E take-off and overshoot lane There were two other factors which I had failed to appreciate to the full when I surveyed the site in June

Firstly, the need to make very shallow approaches to land to allow ground cushion effect to build up gradually to a maximum in high air temperatures when heavily loaded

Secondly, the large and rapid change in wind direction from W to S E that occurs during the months of September/March, and these considerations, coupled with the obstruction created by the additional office, necessitated laying out a second operation square at 45° to the original tarmac

Some critics may say that I have been too generous in my landing space requirements—but I would reply that one cannot be too generous in the interest of safety for regular day after day scheduled passenger operations

While construction of the flight deck was progressing steadily, we continued to adjust our operating techniques to local conditions and lay the foundations of our operation

The hangar and inspection shop equipment was installed and the stores system put into effect, and the pilots played an important part in this work Now, I am a great believer in having a flexible team, in fact, I know it is essential when helicopter operations are pioneered in remote parts of the world—and, in particular, I expect my pilots to be able to assist with maintenance work, be capable of running a stores system, and be ready to undertake many other jobs besides their flying duties I have found that this policy stimulates in pilots a greater personal interest in the work, and binds the maintenance and flying personnel into a harmonious and efficient team which is so vital to the achievement of safe and successful helicopter operations

In my opinion, the creation of a good team rates more important than technical or operational considerations, no matter what the nature, size, or location of the helicopter operations may be Our team in Doha was carefully chosen—for it was recognised that on their efforts, skill, initiative, personal interest and determination, more than any other factor rested the success of the undertaking and, indeed, the future of the Company

The team was formed round a nucleus of people with whom my Chief Pilot, A G Green, and Chief Engineer, J Woolley, and myself had worked before under isolated and exacting conditions

All the resources and energies of the Company were devoted to one end, namely to completing preparations ahead of schedule Our slogan was "On schedule is too late" Management delegated authority at every possible opportunity, and turned its attention to seeing that all efforts were properly co-ordinated

With the basic organization clearly defined, complete responsibility and leadership for the everyday running of the show was vested in the Chief Pilot It would be more accurate to say that the Chief Pilot and Chief Engineer, together, control and administer the day to day running of the operation, assisted by 2 pilots, 6 fitters, a clerk/storekeeper and a local labourer

Sheet No 1

CHIEF PILOT S REPORT FOR THE MONTH OF JANUARY 1956

Nature of Flights	*No of Single Flights*	*No of Passengers*	*Drilling and Eng Equipment (lbs)*	*Commissary Sup and Equipment*	*Baggage Mail Misc*	*Flying Time Hrs/Mins*	*Remarks*
Doha Drilling Platform / Drilling Platform Doha	101	332	6817	10 616	2946	72 45	2 Flights via Halul Isle 1 Flight was via Das Isle with a landing in each case
Flight with Rotating Mirror	1	—	—	—	—	0 10	
Training Air Tests Radio Air Test Check Flights	10	—	—	—	—	4 35	
Totals	112	332	6817	10 616	2946	77 30	

Total Freight = 20 379 lbs

FUEL AND OIL CONSUMPTION FOR MONTH

Aviation Fuel 100/130 Grade	2855 imp galls	*Hydraulic Fluid DTD 585*	54 imp galls
Engine Lubricating Oil DED 2472 B/o	60 imp galls	*Regal Starfak Grease ANG 15*	15 lbs
		Gear Box Oil DED 2479/1	12 imp galls

The need to always keep one helicopter ready to fly, required a careful use of this manpower if long working hours were to be avoided, especially in the hot weather and during leave periods Therefore, it was agreed to work an eight hour day shift and one eight hour night shift for the maintenance crews, each shift being led by a licensed engineer

This system is working extremely satisfactorily and, to date, in spite of the set backs which I shall describe, one helicopter has been always ready to fly on schedule on every day of the week This standard of serviceability is partly attributable to the use of progressive maintenance In view of the local climatic conditions and the shortage of living accommodation for additional personnel, all major components are returned to the U K for overhaul

The administrative organization has been made as simple and streamlined as possible, but inevitably there has to be a certain number of records kept However, these are limited to the following documents

Airframe, Engine and Component Log Books

Pilots' After-Flight Report Forms

Chief Engineer's Defect Reports

Load Sheets

Material Requisition Forms

Stores Index and Costing Cards

Monthly Flying and Maintenance Reports

First on the flying programme was a series of tests to determine hovering performance at various All Up Weights while ambient air temperatures were still relatively high

Air Temp	*Humidity*	*Wind*	*A U W*	*Carb Air Temp*	*Cyl Head Temp*	*Oil Temp*	*Remarks*
80	75%	5	7130	47	190	65	5 ft hovering
83	83%	Nil	7130	40	175	60	Hovering difficult
90	66%	7	7196	46	185	65	3 ft hovering
90	85%	8	7426	43	190	65	Hovering difficult
95	76%	5	7230	48	185	72	3 ft hovering
107	75%	5	7290	47	190	65	2 ft hovering
107	75%	3	7500	47	190	65	Jump take-off technique used

Whilst the results of these tests were most encouraging, as can be seen from this extract from our records, they served to show that we should limit the All Up Weight to 7,200 lbs until we had had more experience of local conditions

The flotation gear which permits water landings to be made, weighs 21 lbs more than the wheel undercarriage, and has the effect of reducing cruising speed by 3—4 knots Having reduced the All Up Weight from 7,500 lbs to 7,200 lbs the next step was to retrieve as much of the 300 lbs " lost " payload by making drastic weight economies in the aircraft equipment These measures resulted in the removal of 244 lbs of non-essential equipment The tare weight of the helicopter equipped with passenger seats, safety equipment, dinghy, etc , is now 5,087 lbs After adding fuel, oil and the pilot, a payload of 1,322 lbs can be carried for day operations For night operations, the nett saving is 186 lbs owing to the need to retain gyro instruments, inverters, landing lamps and cockpit lighting, etc

Refuelling on the rig was prohibited on account of the fire risk, and the difficulty of keeping adequate stocks available because all fuel would have to be carried by dhow, and the regular deliveries of fuel could not be guaranteed owing to the frequent bad sea conditions This has meant that the helicopter carries petrol enough for the return flight, plus allowances for warm-up, idling during loading on the rig, and adverse wind and weather conditions The average total flight time for the return service is 1 hour 25 minutes (See 'B' load sheet)

(Specimen)

WS 55 HELICOPTER LOAD SHEET FOR DOHA/RIG SCHEDULE

Date 24 1 56 *Helicopter* G AODB *Pilot* E Milburn

Aircraft basic weight	5087 lbs
Pilot	172 lbs
Fuel (incl 25% reserve factor)	576 lbs
Oil	45 lbs
Items additional to basic weight	NIL
Operating Weight Empty	5880 lbs

Air Temperature 25°C *Humidity* 72% *Wind Speed* 7 knots

Maximum Authorised Take off Weight 7200 lbs

LOAD

Passengers		*Freight*	
No 1	183 lbs	Food Supplies	190 lbs
No 2	231 lbs		
No 3	220 lbs	Drilling Equipment	179 lbs
No 4	135 lbs		
No 5	145 lbs	Mail and Miscellaneous	19 lbs
No 6	—		
Total	914 lbs	Total	388 lbs

Total Load Pax and Freight	1302 lbs
Operating Weight Empty	5880 lbs
Actual Take off Weight	7182 lbs

This actual load sheet is typical of the Friday, Saturday, Wednesday, and Thursday flights where the majority of the load is made up of passengers The Sunday, Monday and Tuesday flights are reserved for Shell Executives and/or concentrated freight loads The freight loads have been divided into three broad categories

(1) *Food Supplies*, which are self-explanatory

(2) *Drilling and Engineering Equipment* This covers all operational equipment, such as special tools, drilling gear, laboratory equipment and instruments, radio sets and anything which is classified as a technical requirement for the drilling rig

(3) *Mail and Miscellaneous Freight* This includes personal baggage of the passengers, mail, laundry, bedding, personal tool kits, and other equipment of a non-operational or non-technical nature

The latest statistics for the months of January and February for the carriage of freight and passengers are as follows

January 332 passengers, 20,379 lbs freight — 1 cat

February 361 passengers, 18,554 lbs freight — 3 cats

The delivery flight had been completed safely and without any hitches, and the initial shakedown period in Doha had been accomplished without any troubles , in fact, everything was going so well that Alan Green and I often used to say to each other , " This luck can't last " Trouble finally arrived, two weeks before full scale schedule operations were due to commence Firstly, fuel tank leaks , secondly, float failure , and thirdly, excessive engine oil consumption

A fuel leak in one aircraft caused us a lot of extra work and anxiety, and nearly brought operations to a standstill before they had had a chance to get established, for we had failed to anticipate this sort of trouble by provisioning with spare fuel cells

Fuel was observed dripping from an aircraft whilst it was hovering just prior to landing after a routine flight Inspection on the ground and a further check with the aircraft hovering revealed no signs of any further leakage, but a few days later, more petrol was seen dripping just before landing In both cases, the amount of leakage was small, and the pilots reported no rise in fuel consumption during flight

Further investigation with the aircraft jacked up inclined forward in the flying attitude, revealed fuel leaking from the starboard forward cell from the joint between the cell and the filler scupper The rubber material around the bolt holes in the cell attachment to the aircraft structure was found stretched and split At this discovery, the investigation was extended to all inter-cell joints in the eight cell system , a further four joints were found similarly defective In some instances, the material round the bolt holes was so damaged that it would have only been a very short time before vibration and the movement of the cells would have caused more leaks Although these failures in one aircraft seem to be an isolated case, the manufacturers decided to improve the design of the inter-cell couplings by moulding the attachment flange and bolts in rubber

Next followed two float failures The first occurred whilst the aircraft was parked on the tarmac, as you will see in the film The outboard horizontal seams of the front three compartments of the port float had come apart This failure occurred after the float had been in service only $13\frac{1}{4}$ hours Inspection showed that there were no signs of the fabric having been split and that the failure was restricted to the seams

As far as one could see, it looked like a case of insufficient adhesive having been used in the manufacture of that particular part of the float A new float was fitted, and within $2\frac{1}{4}$ hours, the circular rubber patch which attaches the inflation valves on top of the float, started to lift round the edges of No 2 valve It was then that we began to suspect that the heat from the exhaust was having a detrimental effect on the adhesive material

To the best of our knowledge, the same sort of bags had been in service for many hundreds of hours in America and given no trouble Nevertheless, we decided to carry out test flights for ourselves to determine the areas most likely to be effected by exhaust heat Night flights were made, and it was observed that the exhaust flame passed within 6″ of the top of the front three compartments in the port float, and curled round the outside of the float in the same place that the failure had occurred Temperatures were measured to be 80°C on the top, and at the side of the float in hovering flight

Simultaneously, a test was made on a specimen piece of fabric and, again, the adhesive showed signs of weakening at 80°C After these tests, work was put in hand to make a protective guard (a photograph appears on page 18) but, unfortunately, a second failure occurred before the guard was ready to be fitted

The second failure occurred in flight To attempt to land with the front three compartments of the port float deflated would have certainly resulted in damage to the aircraft—there was only one thing to do—hover while the engineers fitted the nose wheel assemblies The operation was not as simple as it sounds , the engineers had to crouch under the hovering helicopter to locate bolts in inaccessible positions in an airframe that could not be kept absolutely still and, on the port side, they had to endure the heat

The protective guard fitted over the forward end of the pontoon to prevent deterioration of the adhesive in the hot exhaust gases

and fumes of the exhaust Whirling, biting clouds of sand only made the task more uncomfortable, but both nose wheel assemblies were fitted in 10 minutes, and the aircraft landed safely

The absence of any reports of similar failures from other operators using the same equipment still puzzles us, but at least we have overcome our difficulties with the guard To reduce temperatures near the floats further, a small deflector lip has been welded to the exhaust to push the exhaust gasses upwards away from the float, and this is proving very effective

To cap our troubles, the oil consumption of the engine fitted in G-AODA, which had reached the top approved limits of 10/12 pints per hour during the latter part of the delivery flight to Doha, suddenly increased to 18/20 pints per hour The engine had been in service only 50 hours All cylinders were removed for detailed inspection, but all components were found to be within the engine manufacturers specification for new components However, an accumulation of oil in the induction pipes indicated possible supercharger trouble But we had little choice but to re-assemble the engine and try to hasten delivery of the spare engines which were then some three months overdue for delivery

The oil consumption still remained at 18/20 pints per hour for the next hour, but within four hours, it suddenly reached 40 pints per hour Again, the aircraft was grounded

Fortunately, a new engine arrived just in time It may be of interest to note that it took only twelve man hours to remove the defective engine and install a new one in its place We are still awaiting a report from Messrs Alvis Limited, who build and overhaul the Pratt and Whitney R1340 engines in this country, on the outcome of their investigations on this freak oil consumption

Apart from the three major technical set backs which were encountered almost at the beginning of flying in Doha, only very minor unserviceability of components has been experienced—and these failures cannot be attributed in any way to the local conditions In fact, in a total of 400 hours flying, the only components which have had to be replaced are — a fuel booster pump, an engine tachometer generator, a battery relay engine starter, and a fuel contents warning indicator There may be some significance in the fact that these are all electrical components, but the operation is too young to draw any definite conclusions, although it is anticipated that the prevailing high relative humidity will shorten the service life of electrical accessories

It would, perhaps, give you a better picture of what we are doing if I described an actual routine flight operation

One hour before departure time, the helicopter on service is towed out of the hangar by the Land Rover, the ground handling trolley is removed, and the helicopter given a thorough ground running test and radio functional check This procedure enables minor snags, which can so easily cause schedule delays and needless irritation, to be detected and put right in plenty of time

Passengers and freight arrive at the hangar 15 minutes before take-off, and are weighed by the traffic clerk The weights are passed to the duty pilot who, by this time, has verified the wind and weather at the rig

The Load Sheet is prepared and checked, and then the performance curves are used to determine the maximum permissible All Up Weight for the prevailing wind, temperature, and humidity When the load sheet has been approved, the traffic clerk supervises the loading of passengers and freight , this takes about 3/5 minutes

The duty radio controller and plotter—who is a pilot on standby for flying duty—advises Doha Airport A T C of the helicopter's departure, and then keeps a continuous watch on the helicopter's frequency, and plots the helicopter's position along the route on a perspex panel, superimposed on the route chart, which is laid out on the control table The route chart is covered by a vector scale grid, which extends 30 miles on either side of the Doha-Rig-Doha track Each square on the grid measures 1 mile by 1 mile, and is identified by a letter and number reference The D C A in Bahrein, who controls and co-ordinates the air/sea rescue organization in the Persian Gulf Area, holds a duplicate of our route chart and grid reference system

The helicopter pilot takes off and climbs straight ahead into wind to 500 ft before turning to climb on course to 1,000 or 2,000 ft Cruising speeds are between 65—72 knots

The route from the heliport to the Drilling Rig is over water for the entire distance of 50 miles 6½ miles from the heliport, the track passes over a channel buoy This buoy has been given the name Able Marker and is used as the first radio reporting point on the outbound route Overhead Able Marker the helicopter reports wind velocity, I A S magnetic course being flown, height, and air temperature and visibility With this information, the radio/plot controller computes the course to steer for the rig and E T A at the rig and passes this information to the helicopter 13½ miles from the base, the track passes within 2 miles of another channel buoy called " Mishut " This is the second reporting point outbound The helicopter passes time and distance-off when abeam, together with any other relevant navigational information The heliport controller checks ground speed, and when necessary, passes the helicopter a new course to steer and a revised

E T A at the Rig 22 miles from the heliport the track passes within 3 miles of another buoy—Kareinein, and again the helicopter makes its position report The heliport controller plots the helicopter's position, computes the latest information and, if necessary, instructs the helicopter to alter course

After leaving Kareinein there are no more navigation pin points, and the helicopter makes a check call every 10 minutes and reports when the rig is in sight On clear days, the sighting report is omitted, for at 1,000 ft over Able Marker outbound it is possible to see the rig quite clearly Before leaving 1,000 ft to land on the rig, the helicopter reports " overhead rig " and control responsibility automatically passes from the heliport to the rig Below 800 ft after leaving Kareinein outbound two way VHF communications cannot be maintained direct between the aircraft and the heliport, and when it is necessary to fly below this height in conditions of low cloud or bad visibility, control responsibility passes from the heliport to the rig after the Kareinein position report on outbound flights, and vice versa inbound

As soon as the helicopter has landed on the rig, or taken off from the rig inbound, the heliport is advised through the Shell main radio telephone communications centre The schedule allows 15 minutes for unloading and loading on the rig, except on two days a week, when the helicopter waits 3¼ hours to enable Shell Management and executives to hold meetings with the drilling crews Generally speaking, 15 minutes is longer than is required to disembark one crew and embark another, and frequently the rotors are kept running during such turn rounds Whether this practice will be continued in the hot weather, rather depends on carburettor air temperatures

When it is hot and there is little, if any, wind blowing, the need to land directly into the wind on a raised platform where there is no ground cushion effect is greater than when it is hot and wind is 7 knots or more Wind velocity more than anything, influences payload in high ambient air conditions

From this illustration it will be appreciated that straight-in approaches in light S E—E—N W wind conditions require considerable skill and fine judgement, owing to the proximity of the spud legs on the downwind corner of the flight deck All types of approach were investigated, including even the sideward descent technique, but best results were achieved with a flat approach 45° out of wind, followed by a last second turn with low forward speed into wind once over the flight deck The approach is commenced at 40 knots I A S , 200—300 yards from the deck and 20—30 ft above the height of the deck, and speed and height are reduced progressively to clear the downward edge of the deck by 2—3 ft still moving forward at 7—10 knots Once the floats are over the deck, the helicopter manoeuvres into wind and skids very slowly to a standstill This technique of maintaining slow forward speed on touch down, whilst contrary to normal helicopter practice, enables 100 lbs more payload to be carried than would otherwise be the case in the same circumstances Furthermore, the flat approach associated with slow forward speed on touchdown makes an overshoot easier and, consequently, safer, and moreover, obviates the application of maximum power to arrest vertical descent at the last moment

Approximately half the load carried by helicopter to the rig consists of freight, most of which does not require delicate handling In still air conditions and with summer air temperatures about 30°C it will become necessary to reduce the aircraft All Up Weight for rig landings to between 6,700 lbs and 6,800 lbs This would represent a considerable reduction in payload compared to the cooler months of the year To keep this reduction of payload to an absolute minimum, two experimental programmes are to be explored The first trials will be to evaluate performance and other problems associated with night flying, and, in parallel with night flying experiments, tests will be made in freight snatching and dropping techniques The air temperatures at night in the summer months range between 30-35°C, some 5-10°C lower than the day temperatures However, one cannot base one's decision to fly night schedules solely on the grounds of lower air temperatures Humidity and wind are equally important factors to be considered Statistics show that calm air prevails at night during the summer months—and this is the most likely factor to make night operations onto the rig impracticable During the day breezes, or even fresh winds, prevail

Should it not prove prudent or practical to fly at night with the required payload, then it is our intention to use a cargo snatching and dropping technique

Cargo, secured in a net, would be snatched from the ground as the helicopter flew at 25—30 knots I A S over a pick up cable, stretched between two steel posts, some 20 ft high, and would be dropped into a net 50 × 50 ft erected on the flight deck

The net would be supported on steel stanchions which could be easily raised and lowered to give freedom for normal landing on the rig to discharge and embark passengers To prevent damage to the cargo, the net would be attached to the stanchions through a system of recoil springs which would absorb the initial impact and dampen subsequent movement of the net

Perhaps next year, I shall be able to tell you which system we adopt Trials will also be made embarking and discharging passengers and cargo while the helicopter rests on the sea—this method would only be used in calm sea conditions Running take-off and low forward speed landings may prove to be the best way to achieve the highest possible payload in summer However, we are reluctant at this stage to make regular water landings on account of the corrosion problems that are bound to arise

In addition to the routine flying, experiments are being made to explore the value of using helicopters for long range triangulation work To enable the helicopter's position to be observed at distances beyond which it could be normally visible through a theodolite, we have employed the heliograph principle Beneath the helicopter, a cylinder is suspended, and to this cylinder is attached a number of mirrors set at pre-determined angles The mirrors rotate in flight to give a continuous series of reflections from the sun Initial trials have proved that the helicopter can be observed up to 30 miles, but it is hoped to extend this range to 50 miles by improving the stabilisation of the rotating cylinder

The radio communication system plays an important part in the efficient and safe running of the schedules, and it is worthy of mention

The Shell radio communications centre has direct HF/radio telephone links with the Rig and all Shell marine craft in the Persian Gulf area, and it also has direct VHF communication between the heliport and the helicopters At certain times of the day the radio communications centre can work two-way VHF traffic with the Rig, but this link is seldom used

The heliport control has its own VHF transmitter/receiver, and this enables direct communication with the radio communications centre and the helicopter in flight at all times up to a distance of 50 miles when the helicopters fly at, or above, 800 ft

The Doha telephone exchange is wired into the Shell radio communications centre, and this link enables one in an emergency to pick up a telephone at one's bedside or in the office, and speak direct to the helicopter in flight, the rig, or any of the Shell marine craft Similarly, the helicopter can call the radio communications centre and be linked to any number on the Doha exchange Action to be followed in the event of failure of radio communications between the helicopter, the plotting room, the rig, and the radio communications centre has been carefully prepared, together with procedures to be put into action in the event of an emergency or precautionary landing

The radio beacon is located on the drilling rig to assist in navigation of the helicopter in conditions of bad visibility which occur more frequently than one would imagine Bad visibility is associated with sand storms and low stratus cloud which prevails in the early mornings of the summer months and which can reduce visibility to a matter of about ¼ mile or less We have had a considerable amount of trouble with the ADF equipment in the helicopter, and this is thought to be due to the fact that the loop is sited on the tail cone, which is subject to a fair degree of high frequency vibration Investigations are going on at the moment to determine whether in point of fact vibration is the cause of the trouble, and it may be necessary to re-site the loop on top of the cabin structure, which is the position adopted by the American Forces for the ADF loop

I should like to end up my talk this evening on a more controversial note, and one which I feel concerns all helicopter operators in this country

There are plenty of people associated directly or indirectly with the flying business, who are repeatedly getting up on their hind legs in public, and stating with great self-assumed authority, and with equal ignorance and little or no practical experience, that this or that sort of helicopter operation must not be undertaken until twin or multi-engined helicopters are available Their statements have gone too long unchallenged and they have done much to retard the development of civil helicopter operations in this country If people are told a thing over and over again, they will come to believe it, whether it is true or not Well, it is time to put an end to this helicopter single-engine bogey, and this is as good an opportunity as any

If one listened too long, or worse still, accepted the weak-kneed, unimaginative, misguided opinions of the single engine critics, then all pioneering of civil helicopter operations would cease Fortunately, a few far sighted and determined people have not heeded the critics One has only to look at the achievements and safety records over the last 5/8 years of Sabena, Los Angeles Airways, New York Airways, Chicago Helicopter Services and the frequent use of the helicopter made by our Royal Family, to realise that single engine helicopters can be operated with great safety and schedule regularity and into the heart of cities

Helicopter operators the world over know and appreciate the advantages to be gained with the advent of twin, or multi-engined helicopters which can fly safely with one or two engines inoperative The single engine helicopter has certain definite and well known limitations Operators recognise these limitations and evolve techniques to overcome them

Operating helicopters regularly on schedule at high utilisation month after month differs very little from operating fixed wing aircraft—both require hard work, intelligent and alert management, imagination, carefully planned maintenance The will and determination to succeed must be the inspiration of all concerned

In spite of what many critics of the helicopter say, and often with the most appalling display of ignorance of their subject—the helicopter, complex though it still is, is a robust and reliable flying machine, capable of high utilisation and a multitude of special applications Their development is gaining impetus—perhaps a little too slowly for some of us, but the fact remains that helicopters are being operated under some of the most exacting climatic conditions in the world from the Antarctic to the Tropics, and slowly, but very surely, earning themselves a well deserved place in the civil aviation business To those who consult crystal gazers, I would say " Beware, those predictions which tell you that the helicopter is on the way out and that STOL and VTO aircraft are the answer The helicopter is here to stay with us for a very long time to come "

After the showing of a very interesting film, the Chairman expressed his thanks to Mr Bristow and congratulated him on the job he was doing with British equipment

The vote of thanks to Mr Bristow was carried by acclamation