Helicopter Contracting

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E MENSFORTH, C B E , M A , M I MECH E
F R Ae S , M I P E
in the Chair

Introduction by the Chairman

Ladies and Gentlemen I am sorry there are not seats for everybody but the size of the audience is an obvious compliment to our lecturer I really don't think Mr KNUTE FLINT needs any introduction At the age of 33 he has probably as much, or more, helicopter experience as any living man He was in command of probably the first fully operational helicopter squadron in the world in China in 1945, and personally has some 2,500 hours flying experience mainly on helicopters For the last $7\frac{1}{2}$ years he has been operating his own helicopters in partnership with Mr H B Armstrong , their joint organisation is now operating 10 helicopters with a total annual utilization of about 10,000 hours which in this stage of development is a fairly formidable total

He has operated both as a company and an individual from the Arctic Circle to the jungles of New Guinea We look forward to hearing this talk, which is primarily on his operating experience, and then to see the film which he is going to show

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MR KNUTE FLINT

(I) Introduction

It is always a pleasure to be here in England for Farnborough, and doubly so to be able to address The Helicopter Association of Great Britain on a subject which is rather important to me I consider myself fortunate indeed to be able to make my living doing something which is never work but rather, almost always play Perhaps what I am going to say will amplify that statement but I believe we should first have a common understanding of a few rather arbitrarily defined terms

(II) Definition of Terms

A helicopter, to me, is any aircraft which derives both lift and thrust from horizontally rotating blades A fixed-wing aircraft is any aircraft which derives all its lift from fixed surfaces Helicopter operating means the utilization of helicopters for specific tasks Helicopter contracting means the undertaking of specific tasks with a helicopter by its owner, for a fee Private helicopter operation means utilizing helicopters for any task in which the penalty for not making a profit is the cessation of activity in that field Public helicopter operation means utilizing helicopters for any task which, once under way, will not generally be transferred to another operator through competitive bidding, and which is partially or wholly paid for out of tax-derived funds Naturally there are many shadings here, such as the private operator who operates at a loss for several years on the gamble that by doing so he will make adequate profit later The cleavage between the two lies fundamentally on the over-riding question of profit I apologize if all this seems a bit rudimentary but I know you are aware of the ever-widening gulf between the American and English languages

(III) History of Helicopter Operating

Public helicopter operation considerably antedates private, because, of course, public operations include military operations To my knowledge, the first helicopter operation started in 1943 at Floyd Bennett field on Long Island in the United States This was a U S Coast Guard training operation employing the first helicopter to be manufactured in quantity, the Sikorsky R-4 Shortly thereafter, the same equipment was used to set up a training operation for the Army Air Forces in Indiana No doubt through relative scarcity, the modern Occidental mind (with the exception of the Russian) has been more concerned with the value of human life than the Oriental The conception of the availability of helicopters for rescue, therefore, had a great impact The first attempt to use helicopters for a task other than training was in Burma in 1944 for rescue Their operation there was almost the same as taking a World War I fixed-wing aircraft and using it as a front line aircraft in World War II Nevertheless they prove that the job could be done if helicopters could be made available with more powerful engines

The result was the Sikorsky R-6, with which I was associated toward the end of the war on a helicopter rescue operation in China By that time both the R-4 and the R-6 had been employed in a number of different ways, such as the shipboard operation across the Atlantic conducted by the Coast Guard in 1944 and radar calibrating work Later the Sikorsky R-5, with a

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substantial payload, enabled the U S and British military to dabble by the end of 1946 in practically all of the fields in which helicopters are now used for non-civil purposes

By 1946, Bell Aircraft Corporation in the U S had succeeded in certificating the first civil commercial helicopter This permitted a rash of private helicopter operations in the Autumn and Spring of 1946 and 1947, the first of which was the ill-fated Helicopter Air Transport of Philadelphia Mr Armstrong and I also started our Company at that time By the end of 1948 practically all the fields developed later for profitable use of helicopters had been explored

The first scheduled public civil operation of helicopters was by Los Angeles Airways in 1947 when they started a service flying mail for the U S Post Office in and around Los Angeles I believe the first scheduled public operation of helicopters for passengers was New York Airways in 1953 I am excluding the experiments run by Los Angeles Airways, B E A and Sabena before this time

I know it is a rash statement, but to sum up in a few words the history of helicopter operating, I believe it is fair to say that no other major tool developed by modern man has been so instantly and widely accepted To reach the present stage of utilization of the helicopter , the fixed-wing aircraft, the automobile, the railroad train, the steamboat, the typewriter, the telephone all took more than twice the time As a matter of fact, one of the first problems of the helicopter operator was over-acceptance

(IV) Present Important Fields

In the first year or so of commercial helicopter contracting, every operator was presented with weird propositions I hope you'll excuse the divergence, but I think some of our own experiences might be of interest to you Of course we started out aiming for steady continuous work like the patrol of powerlines, but we investigated every possibility One day in 1947 a rather excited man came to our hangar-office with a partnership proposition involving basking sharks This is the largest of all sharks with a tremendous liver that feeds in schools in the surf along the Californian coast at periodic times of the year This man rowed out in a small boat into the surf and harpooned them, leaving a float on the harpoon line with a cable attached to the float When the shark had finished threshing about and had died he would then pull the shark up on the beach with a tractor and cut out the liver As the livers frequently weighed more than 600 pounds and were fetching a very high price per pound, it was a profitable business—when he could get into the surf This was where the helicopter came in His idea was to hover over the surf and harpoon them from the helicopter and then fly ashore with the towing cable already attached It sounded fantastic, but after checking an encyclopedia and making a few telephone calls we decided to have a look We actually hovered a few feet over several sharks that were bigger than our helicopter They were very sluggish so they would have been easy to harpoon, but they fed only in heavy surf We felt this operation involved too great a risk for even if we had had pontoons they wouldn't have saved the helicopter in the event of a forced landing in that surf, and because of this certain loss in the event of trouble, plus the fact that we would have had to have an actual rendering

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factory to handle the number of sharks we could kill, we decided that that partnership venture was a bit premature However, we tried our hands at many other things in those first two years We barnstormed flying passengers, we carried movie stars on publicity stunts, we delivered newspapers and groceries, fought forest fires, sprayed and dusted crops, searched for lost people in the mountains, delivered ambulance cases, put on air shows, carried display advertising, delivered Santa Claus in disillusioning numbers at Christmas , with our rotor blast we harvested walnuts, and dried cherries and grapes after rain by ho-ering over them, installed a cross on a mountainside, helped build a television station on top of a mountain, carried in a drilling rig for a water-well, protected oranges from freezing That last one was nerve-racking flying We had a contract to protect one hundred acres of oranges from freezing, and on most nights it was a simple matter of pulling the higher warmer air down into the trees It was usually only ten or fifteen feet above the tree-tops But occasionally we had a general frost, and on those nights they had to fire burners and then we flew over the burners pushing the rising heat back down into the trees The difficulty was that the burners burned crude oil which gave off a dense black smoke The success of our operation depended on our being able to keep the heat, which meant the smoke, around the trees After about thirty minutes of flying, the visibility would get so bad that we had to adopt special tactics We would refuel facing a telephone pole which was across the road from the orange grove in an open field For take-off we would fix our landing light on the pole and climb straight up about fifty feet from the pole, which was maximum visibility At the top of the pole we would move across the arm until our light picked up the eucalyptus trees across the road and bordering the grove These were higher than the pole so we had to climb up them to the top, then make a horizontal 180° turn over them and descend on the other side until we caught sight of the orange trees, the tops of which were about forty feet below the eucalyptus trees tops Then we would turn 90 degrees and slowly fly the rows, pushing the heat down This was the only way we could maintain contact with the ground and still fly from the orchard to our refuelling station We had to have two men in the cockpit, the pilot and an observer to help watch for the trees coming up at the end of each row After three or four hours of steady flying it would become so monotonous that it became more dangerous with the pilot alone than to add the weight of another man, under conditions which demanded almost continuous full power We finished the contract but didn't try to get another

One of the most abashing small contracts we ever accepted was in the Sierra Mountains of California We were dusting cotton about 100 miles away when a man by the name of Welch called up to plead with us for a helicopter His story was that there had been a landslide cutting off his mining camp and he had to get food and a few other supplies into the camp It sounded genuine so we explained things as best we would to the farmer and took off for the Sierra It was late afternoon before we found Mr Welch and his mountainous wife They were camped in an extremely narrow gorge on the bed of an abandoned railroad As all of Mrs Welch's more than 300 pounds came waddling out to meet us, with little Mr Welch trotting behind, we caught a glimpse of a great pile of household furniture and some food It didn't take long to find out that there had been a landslide

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—last year—that they did have a mining camp—which they used for vacations each summer panning for gold—that they did have food to be flown in—for themselves, because they thought this year they'd like to modernize their transportation instead of using pack mules As she pointed out to me, they hadn't told any lies, but we were very unhappy as we were in the middle of our dusting season on cotton, and it looked like everything they owned was piled on the railroad bed and they didn't have a sou She airily brushed aside my price for flying the whole lot in and said she'd pay me when we finished We decided we might as well do the job as long as we were there, but I made up my mind that the first thing I'd do when we got back to a telephone was to call the bank on which the cheque would be drawn—everyone paid by cheque for our work—and if it wasn't any good call the sheriff and fly back in and get them It took us over two hours of flying to carry it all in—a cast-iron bedstead, a soggy mattress, an old iron water wheel that we had to dismantle, food for two months and the last load, carefully counter-balanced, was Mrs Welch I walked up to her with my pen and said with a little laugh " That'll be $275 I hope you brought your cheque book " She said " Oh, I never keep my money in banks " and pulled out from a very ample bosom a horse-choking roll of money She had nothing smaller than 100 dollar bills so she peeled off three and said " Here, son, buy the boys a drink with the rest "

These are just a few examples of what the early helicopter operators had to go through to keep the wolf from the door Gradually the unimportant fields for work were eliminated until today there remain only a relative few I call a field important only if three or more operators fly annually more than 500 hours each on that particular work, which is a modest demand by fixed-wing standards but eliminates a surprising number of fields of work

(A) PUBLIC HELICOPTER OPERATIONS

In public helicopter operations no time need be spent on the military where the uses of the helicopter are legion and well known Therefore there are really only two fields of work

(1) *Mail delivery* Without question the major public helicopter use today is in the delivery of mail Three operators service New York, Chicago and Los Angeles, and Sabena covers a good portion of Europe It is a very expensive delivery, however, and until passenger-carrying on commuter or feeder services becomes widespread, thus paying the major part of the cost, I don't believe helicopter mail delivery will prove very popular In most instances a surface network of mail trucks must be maintained for ordinary mail anyway, and, therefore, it becomes purely a matter of a few hours saved The Paris pneumatic tube system almost accomplished the same

(2) *Passenger transportation* The only other important field for public helicopter operations is passenger transportation Thus far these consist almost entirely of aerodrome—mid city shuttle and similar terminal services, although Sabena has shown what the shape of the future may be for inter-city traffic At the moment most of the operations are highly uneconomic and are being done largely to gain experience and, of course, to establish service, thus holding down a route

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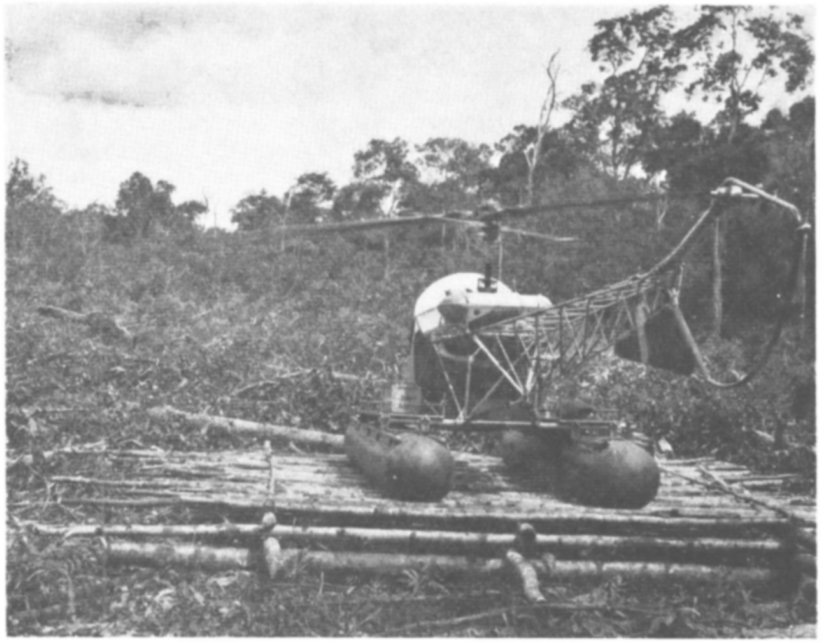

Fig 1 Showing the type of landing platform used in New Guinea in fairly open country

(B) PRIVATE HELICOPTER OPERATIONS

In private helicopter operations the important fields are much more numerous although no single one equals the annual number of flying hours of public operations on mail delivery The major private field is probably oil search

(1) *Oil search* Here the helicopter provides transportation in difficult access areas The work was started in the Mississippi-delta area where transportation problems had spawned strange vehicles like the swamp buggy, a tractor with such huge balloon tyres that it could float on water or mud Transit difficulties and slowness of the vehicles, which were their main faults, were no problem to the helicopter Today both gravimeter and seismic surveys are being conducted by helicopters over swamps, desert and jungle Each of these areas requires special techniques In swamp there are no real problems, but tail-rotor abrasion is very high because of grass Barges and houseboats have to be provided for a base to eliminate long ferry flights Attrition is very high on the rubberized canvas and nylon floats or pontoons In desert the problem is heat although sand abrasion on blades and engines is costly In jungle the problem is cutting clearings and getting out of them with loads Heavy rain causes abrasion but isn't as much of a problem as the continuously high humidity In none of these areas are there any real problems with wind, turbulence, rain or general weather conditions except heat as it effects engine operating temperatures The helicopter is now a recognized tool in the field of oil search

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Fig 2 Showing a landing at a density altitude of 8,000 feet on a fire operation in the Sierra Mountains of California

(2) *Mapping* For the last few years there have been more than 25 private helicopters operating on mapping contracts in Alaska alone Similar work has been done in Greenland and South America, and no doubt will continue all over the world The work has been awarded by various departments of the U S Government on competitive bidding by private operators It generally is done over the three or four summer months and consists largely of landing surveyors and equipment at innumerable points on mountain peaks and flanks, and sometimes in stream-beds The mapping is done as before, through triangulation for instance, but the increase in speed borders on the fantastic Records of three men doing in two weeks the work that previously took twenty men three years are commonplace

(3) *Agricultural Aids* Crop dusting and spraying was one of the immediately recognized uses of the helicopter It was the field which attracted more private operators than any other In 1947 almost everything including the dusting and spraying equipment was experimental Theoretically the advantages of a helicopter for crop dusting and spraying as compared to fixed-wing aircraft were very impressive The large volume of air passing down through the rotors could push the dust down into the plants, treatment could be accomplished at slow speeds insuring complete coverage, flying could be done from an edge of the field so that the farmer could see that the proper amount of chemical was being spread and very restricted fields could be treated due to greater manoeuvrability These advantages permitted the helicopter to do excellent work on special problems in agriculture It was

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largely helicopters that almost completely eradicated a pernicious thistle which was spreading rapidly over the grazing lands of southern California ranches It reseeded itself on the valley floors from the heavy infestations on the steep hillsides which could not be treated successfully by either fixed-wing aircraft or ground machinery The slow speed of the helicopter permitted it to spray plant-killer down the hillsides following the contours The same advantage resulted in the winning of large seeding contracts in hilly country by helicopters and I have already described their work on frost prevention

In general practice, however, these advantages were minimized, and in many cases overshadowed, by the much lower operating cost of the fixed-wing aircraft This fact derived largely from the purchase price of the fixed-wing aircraft, a price which was never more than a quarter that of the helicopter and very often was as little as one tenth In their efforts to become competitive, helicopter contractors were forced to adopt special techniques and operating procedures No flying was done between jobs, for example, all movement was accomplished by special trailers from which a helicopter could be unloaded, or loaded, in less than five minutes ready to fly A great deal of crop treatment was done at night when there was more chance of still air The helicopter would land and take-off by truck headlights and fly between the torches of two markermen The field would have been previously surveyed for wires and other obstacles in the daytime and, of course, a large floodlight was employed on the helicopter These specialized techniques and procedures, plus the inherent advantages already mentioned, have placed the helicopter firmly in the list of agricultural tools employed by farmers It is a very small niche, however, when compared to fixed-wing Even in California where I suppose there are more private helicopters employed in agriculture than the total so employed for the rest of the world, they treat less than 20% of the acreage treated by aircraft I do not believe helicopters will seriously compete with fixed-wing aircraft in agriculture until they are available on the market for less than £2,500 with a payload of at least 500 pounds

(4) *Power-line patrol* Again this was a field which attracted the first helicopter contractors Our company made its initial demonstration patrol in the spring of 1947 and obtained a continuous contract shortly after that patrolling over 1,500 miles of high-tension power lines in southwestern United States The tremendous Federally-owned power complexes of the Tennessee valley authority and the Bonneville authority in Oregon are now regularly patrolled by helicopter, as are many of the lines of private companies throughout the United States The work requires a high degree of precision flying For best results on our own work it was necessary to keep the observers' eyes on a level about two to four feet above the top insulator arms and not more than fifty feet away That left a clearance of about 30 feet from the rotor tips and in mountainous terrain that required a great deal of skill Most of our line mileage was in desert or open country but a considerable portion was in mountains where turbulence always produced a struggle I have patrolled a line myself in which I was in autorotation at zero airspeed and still unable to sink fast enough to follow a plunging line down into a canyon because of tremendous updraughts Except when wind velocities got above 40—50 miles per hour we were always able to get through, however Incidentally, we found that a helicopter could handle any degree of turbulence

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far better than aircraft of its weight or even much heavier

(5) *Forest-fire fighting* A big fire outbreak just above Los Angeles in the summer of 1947 occasioned the first use of helicopters in this major field, I believe We were requested by the United States Forest Services to place our two Bell 47-B helicopters at their disposal to see if we could help stop the fire Another pilot and I flew over 80 hours in the first four days on the two machines and in the process attempted most of the procedures that have now become routine Fires in California, as no doubt elsewhere, are controlled like little wars with a general-in-command called a fire-boss, lieutenants under him called line-bosses, sergeants under them called section-bosses and even corporals called squad leaders On this particular fire I believe there were over 1,000 men employed Naturally the first job was to fly the fire boss along the fire line on reconnaissance That proved so valuable that we were soon flying the line-bosses and section-bosses over the areas for which they were responsible As early as the first day a line-boss saw a threatened break and asked if we could land somewhere so he could run back and throw some extra men into the breach We wouldn't land but we hovered a few feet above the brush on a ridge-top and he jumped out This quickly became standard procedure On the third day there was a major breach and we were asked if we could fly reinforcements to a ridge up which the fire was racing We flew in 200 men from the valley floor in $3\frac{1}{2}$ minute round trips that would have otherwise required $1\frac{1}{2}$ hours of laborious climbing round the mountain and up the other side By the end of the fire we were placing entire squads at practically any desired point with all their equipment and supplies, and then supplying them with hot food from the central kitchen and relieving them at the end of their stint Today the helicopter is one of the most valuable tools employed in fighting fire in mountainous terrain, where there are exposed rock surfaces or low brush It cannot be used to the same advantage in flat, heavily forested areas, due to the lack of immediately available landing or hovering spots Incidentally, to further amplify the statement I made as to turbulence in power-line patrol, we were naturally pleased to discover that we could operate with far greater ease and closer proximity than the fixed-wing aircraft also employed on these fires This was true even amongst jagged peaks, with relatively strong winds and the terrific temperatures caused by normal summer heat and a fire raging over thousands of acres

With the qualification that I am no doubt prejudiced, although I am a fixed-wing pilot, I should like to state as my opinion that there is nothing in aviation requiring more skill from a pilot than the following manoeuvre landing a loaded helicopter for the first time at a density altitude requiring full power merely to hover six inches above the ground, in a spot such as the saddle between two peaks, smaller in area than the circumference of his rotor blades and with shifting winds of 10—15 miles velocity Once he commits himself under these conditions he has to be right If he misjudges he may be lucky and have a sheer drop in which to regain flying speed, but if the drop isn't sheer, he hasn't much chance Practically all operators flying helicopters on contracts above 5,000 feet in the mountains have had accidents like these

(6) *Training* There is no doubt that more training is being done by the military of various countries than by private operators, but it certainly qualifies for my definition of an important field of work As a matter of fact,

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there is no line dividing the field between public and private operations because there are instances, such as in France, of private operators training pilots for the military Practically all the major helicopter manufacturers have pilot training schools for their own personnel The courses vary from a general minimum of 20 hours to as much as 50 hours As a matter of fact, in our own training programme we devote an additional 50 hours for a new pilot to what we call limited work in which the pilot flies no passengers and only light loads of freight Thus during his first 100 hours at the controls he either has an experienced instructor with him or he has a large margin of power available in emergencies because he is flying light In my opinion almost anyone who can drive a car can be taught to fly a helicopter under power Landing a helicopter, particularly spot landings, without power is another matter Auto-rotation from any position within range, to a 10 foot square spot, is extremely difficult, requiring a very high order of skill We have had pilots that could do this in all wind velocities without a slide within thirty hours We have also released a pilot, temporarily hired, with 1,200 accident-free helicopter hours who never was able to measure up and was therefore not basically a safe pilot, but rather, a lucky one

I believe these six fields are the present important employers of private helicopter contractors There are many other uses of course, but I do not believe they qualify under my definition of an important field as one in which three or more operators annually fly more than 500 hours each Probably every operator flew passengers for short rides when helicopters were a novelty in his area Also every operator, to greatly varying degrees, has flown helicopters for publicity purposes Some companies have even been organized for this purpose alone In my opinion it is a temporary field because as viewers become more sophisticated the helicopter is forced to become competitive with fixed-wing aircraft and at present-day helicopter prices that's a losing battle A fairly important field, but one which I do not believe qualifies, is the use of the helicopter as a camera platform Our own company has furnished helicopters as camera platforms for a number of motion pictures and for many newspaper and magazine photographs I am sure all private operators have had contracts of this nature but though they may be very lucrative per hour, they tend to be of short duration No doubt I have either underestimated or overlooked some important fields of work in the foregoing, in which case I apologize in advance to the adherents to that field The statements I have just been making, and will be making, have to be made largely from personal knowledge, as there is no library of reference material on my subject I hope my errors will be corrected in discussion afterwards or through correspondence so that the Association will have a record of available material if there is any interest

(V) Future Important Fields

There are a number of fields, both public and private, which already come very close to qualifying as important fields of helicopter work There is no question in my mind that in a very short time they certainly will become important if they are not already

(A) FUTURE PUBLIC HELICOPTER OPERATIONS

Although I have listed passenger transportation as a presently important field it is obvious that the burgeoning of this field awaits only the advent

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of large, twin-engine helicopters with more reasonable seat-mile costs Unquestionably aerodrome-mid-city shuttle, inter-city traffic and perhaps eventually commuter services will become the big public and private helicopter operations Nonetheless there are at least three other public fields that I believe will become more important than they are now

(1) *Police patrol* Several municipalities have experimented with helicopters in their police work, New York being the outstanding example This city employs several small helicopters flown by members of its police force They are equipped with pontoons and have done some very good work in the harbour area of the city, particularly rescue They have been used for various surveys from the air, especially on traffic problems I believe they have also been used in actual traffic direction by radio during certain peak load periods If helicopter prices come down measurably within the next ten years, particularly utilizing ram or pulse jet propulsion on the blade tips thus possibly providing twin-engine safety, I believe many municipalities will incorporate helicopters into their police patrol systems

(2) *Border patrol* Until the millenium, at which time political and economic borders will cease to exist between countries, some countries will always have border patrol problems Smuggling, whether of material or people, is one of the oldest occupations of man In the United States at the moment, our border patrol is having a most difficult time coping with "wetbacks" These are Mexican nationals who derived their name from their method of entry, which was simply to swim the Rio Grande Economic opportunities are so much better for them in the United States than in Mexican border states that large numbers have been illegally flocking over Helicopters have been employed already for border patrol but they are still too costly to justify large scale use They present many very apparent advantages for this work because they combine the airplanes' ability to survey large areas with the automobiles' or boats' capability to provide immediate interrogation I am sure they will be used in large numbers when they become available at lower prices

(3) *Ice-breaking reconnaissance* This is a fairly limited field but it already is becoming an important one To my knowledge helicopters have already been employed more than experimentally by the Danes in Greenland, and by the Canadians and Americans in their respective ice-seized commercial waters The helicopter can operate from the deck of the ice-breaker itself and has proven to be a great time saver, thus in turn saving significant amounts of money In these waters ice varies greatly in thickness, particularly pack ice An experienced observer can spot these differences quickly from the air and direct the ice-breaker into the thinner areas thus speeding the passage of the boat Large open areas of water can be missed completely by the look-out on the mast of the ice-breaker but they can be spotted easily by the helicopter only a few hundred feet higher up The helicopter can even be used for planting and blowing dynamite in advance of the ship if need should arise, and finally it provides physical contact between ship and shore when distances are not too great I believe this use of the helicopter will increase, now that the Arctic is assuming strategic values which it has never before possessed

(4) *General rescue* The helicopter has now become an established rescue instrument by the military There are helicopter rescue squadrons

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stationed all over the world which are there not only for military purposes but which have been used repeatedly during civil disasters such as the floods in Holland and England and the avalanches in Austria Except for the excellent Osterman organization in Sweden, however, I don't believe there is another private organization anywhere employing helicopters for ambulance service and general rescue work Only the military of the various countries are now providing limited service Even the United States Coast Guard, which is a quasi-military body, does not employ helicopters to an extent commensurate with its responsibilities although it was the first employer of helicopters This deficiency of our Coast Guard and of all other groups which are engaged in various phases of rescue work is chargeable only to the high cost of helicopter service When a £2,500 helicopter with twin-engine safety becomes available I'm sure that Coast Guard services everywhere will be equipped with them and also that private ambulance companies will spring up in sizable numbers Even without this extremely stringent price demand I believe the advent of large twin-engine helicopters will stimulate the use of helicopters by large public agencies

(B) FUTURE PRIVATE HELICOPTER OPERATIONS

I may easily be wrong when I do not list some of the following fields under present rather than future important fields To the best of my knowledge, however, there have not been three separate operators flying more than 500 hours each annually, in any of these fields of helicopter activity

(1) *Passenger Transport* I believe this year this field will qualify as an important private helicopter use New York Airways and Los Angeles Airways have both had passenger services for some time but I classify them with Sabena as public helicopter operators because their operations are supported almost entirely by government pay However, National Airlines and Mohawk Airlines have recently started helicopter passenger services without direct mail subsidies and I believe others will soon follow, without doubt it will become a major, if not *the* major private helicopter field All of the worlds principal airlines have been watching closely the development of large twin-engine helicopters capable of sustaining flight on one engine and I have no doubt that the availability of the Bristol 173, the Fairey Rotodyne or the Sikorsky S-56 at reasonable prices will bring some of these airlines into the field The first users will probably combine aerodrome-mid-city shuttle with inter-city feeder services in the same manner in which Sabena is now covering Belgium and parts of several bordering countries Eventually I believe the helicopter will take over all air-transportation for journeys of less than 200 miles and possibly even further, depending on speed and cost developments The largest possibility for helicopter passenger transportation is commuter service, however Admittedly this vision is a bit dim but the continuing decentralization of cities makes it a certainty in my opinion Obviously this use requires a very large, low seat-mile cost helicopter but it would not have to be high speed because the distances would always be very small It will probably start first in cities such as Los Angeles where the metropolitan area is very large and there is no rapid transit system

(2) *Whaling and fish spotting* One of the first demonstrations that we made with one of our helicopters was a landing on the stern of a tuna boat

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in San Diego, California The use of helicopters for fish-spotting was obvious but the deterrent then, which still applies to a certain extent, was the high cost for an uncertain value The value has since been proven for tuna work but the cost still prevents large scale use In whale-spotting it has been easier to fix the value, because time itself is more valuable, also a whaler is much bigger than a tuna boat, operating on a much bigger budget, so that a helicopter gets to be a smaller part of the operating cost I believe it is fair to say that helicopters have now emerged from an experimental status for whale spotting and that this season will mark their status as a permanent tool The work is dangerous certainly, so long as single-engine equipment is employed Anytime a non-seaworthy single-engine aircraft is flown over water for long periods out of sight of rescuers it must be considered dangerous, and doubly so in the Antarctic Nevertheless I think it is quite possible that twin-engine helicopters may eventually replace to a considerable degree the fleet of small killer boats now employed by the whaler for the actual chase I can see no unsurmountable technical problem in equipping a large helicopter with harpoons for the kill and large floats to mark the carcasses The advantages are obvious, In terms of numbers of helicopters the field is limited simply because the kill of whales is limited but I'm sure it will always be an important field of work for private helicopter contractors and I believe fish-spotting will also become important

(3) *Cargo Transport* No doubt all helicopter contractors have carried cargo to relatively inaccessible spots at one time or another In our own case we have contracted repeatedly for assignments as varied as a waterwell placed on a mountain side to a complete church flown from the rim to the floor of the Grand Canyon But these were all small, intermittent contracts A helicopter contractor could not build a business around them I believe the first significant contract in this field was obtained by Okanagan in Canada when they were engaged to assist in the Kitimat project of the Aluminium Company of Canada They have done a magnificent job there under very difficult flying conditions requiring a high order of pilot skill They have unquestionably proven that under certain terrain conditions a helicopter can be an economical freight-transport vehicle and I am equally sure that this use of the helicopter will spread

(4) *Ranching and farming uses* Helicopters have already been employed on several of the large cattle ranches of the United States to herd cattle during round-up and for patrolling fences They can do practically everything a man on horseback can do and many things besides, such as flushing a steer out of heavy brush For the wide open cattle spaces of countries like the United States, Argentina and Australia the helicopter would be a boon were it not for the cost The same applies to farming There are mechanized farms in California of from ten to fifty thousand acres in which the farmer sits in a central office and directs the activities of the farm by radio telephone One farmer I know employs 5 small trucks, 10 enormous diesel trucks, four combines and a single engine aircraft at harvest time all directed by radio-telephone from his office After one hour demonstration in which he was able to talk in person to his foremen at widely scattered points on the 30,000 acre farm, he was tremendously enthusiastic about using helicopters for his own and his foremen's transportation That is, he was enthusiastic until he heard the price, and at that time, 1948, they were £3,400 cheaper than the same one is now In my opinion a very large

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field for the private use of helicopters is on large ranches and farms throughout the world But this field will have to wait until a very cheap, safe helicopter becomes available And when this helicopter becomes available it no doubt will reveal many other uses that are now hidden behind a price barrier

(VI) Public Versus Private Helicopter Operating

There certainly will always be public helicopter operations such as police and rescue work in which there can be no profit motive Nevertheless I believe there is beginning to be a gradual trend away from government operation of any function which can embody a profit motive, and not only in America but in Europe I firmly believe that man has never devised anything more conductive to maximum service with minimum waste than a competitive profit motive, regardless of function For this reason I hope that private operators will be given the opportunity in Europe as well as in America to prove this statement in the largest field of all for helicopter operations , passenger transport As I have pointed out, helicopter mail delivery will become simply an adjunct of commuter or feeder services, except possibly for rural deliveries if a really cheap helicopter becomes available Therefore we have only passenger transport to consider in a discussion of public versus private helicopter operating Passenger transport can be broken down into three fields, aerodrome-mid-city shuttle, inter-city feeder service and commuter service

(A) Aerodrome Mid-City Shuttle

This will be the field requiring the least capital investment and therefore the field affording the greatest amount of competition if permitted to develop privately I see no reason why two or more operators couldn't fly from a large airport like London Airport to several different mid-city spots adjacent to taxi and tube facilities They would be regulated of course, in the same manner in which taxi and limousine services are regulated, except for more stringent safety requirements Thus this service would be provided without government investment and at no greater cost to the user In truth private operation not only decreases governmental investment requirements but increases governmental tax revenues Basically I believe there can be only three valid reasons for governmental operation of helicopters These are in instances when a need must be filled and private operators cannot or will not perform, in instances where there can be only one operator and therefore no competition and in instances where the government can do the work much more cheaply An example of this type of operation is rescue work where there can be no profit motive and yet the work must be done Aerodrome-mid-city shuttle in my opinion is not one of these instances On a long term basis the fares of a governmental operation would not be cheaper simply because profit was eliminated as proven by todays airfares I believe no government owned airline charges substantially lower fares over international routes than private operators and yet the private operator must not only make his costs but a profit, in order to exist The other reasons certainly will not apply as I am sure there will be plenty of operators anxious to get into this field when economical equipment becomes available There may be some value in an uneconomical trial operation before this equipment becomes available but when it does I feel the service should be sold out to private operators

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(B) INTER-CITY FEEDER SERVICE

As soon as an economically attractive helicopter becomes available for aerodrome-mid-city shuttle it will also be used for service between cities not too distant from each other Here again I am sure public or governmental operation could not do the job more cheaply nor do I believe there will be any dearth of private competitors No doubt the juiciest routes such as London-Birmingham-Manchester will generate the most competition and no doubt also there will be areas that will never attract private helicopter passenger service Except for defence reasons however, I do not see this last possibility as anything other than a very cogent argument against governmental operation in that area In other words if private operators cannot afford to provide helicopter service to a particular area that should itself be enough to prevent governmental operation in that area

(C) COMMUTER SERVICE

Although commuter service is some distance away in time I believe everything I have said relating to inter-city feeder services applies equally here with the possible exception of competition There would be less opportunity for side-by-side competition on commuter services than on inter-city feeder services or aerodrome-mid-city shuttle Nevertheless I believe private operators should be given an opportunity to show what they can do It is obvious from what I have said that I am not an unbiased observer relative to the merits of public versus private operation of helicopters, nor as an officer of a British helicopter company am I disinterested in the future of helicopter passenger transportation in the United Kingdom Trying to be as impartial as possible under these circumstances I do feel, however, that there is a strong case for purely private operation of helicopters under practically all circumstances anywhere in the world

(VII) EQUIPMENT

(A) PRICE

In any discussion of helicopter equipment among private contractors the dominant factor is price The initial cost of purchase figures in the total cost of operation to a greater extent with helicopters than with any other piece of non-specialized motive equipment The minimum cost for a new certificated helicopter today is more than £12,000 which means anything from £4 to £10 per flying hour for depreciation alone depending upon utilization Even this cost is minor compared to the cost of parts continually being replaced Parts cost naturally reflects original purchase cost but sometimes it seems that if all the parts of one helicopter were purchased separately, the cost would be considerably greater than the assembled machine For instance, the steel shaft on our helicopters connecting the transmission to the rotor-blades is about four feet long with very little machining It costs almost £300 and is certainly no exception All helicopter manufacturers will tell you that they are well aware that they have priced themselves out of a considerable market but, they all add, the inexorable facts of cost accounting prevent anything else Insofar as todays helicopters are concerned I am sure they are right Helicopters in use today demand far too much in the way of pilot skill in auto-rotation ever to become a good bet for mass-production Even with a heavy gamble on a production run of perhaps 500 machines per month for two years, I doubt if the price could be lowered

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very much below £6,000 in any event Therefore, the only hope for a cheap mass-produced helicopter lies in an entirely new machine Fortunately it appears that that machine also possesses the possibility for twin-engine safety which I believe is the best way to large scale private use of helicopters I believe that machine will be some version of either the ram or pulse jet helicopter There are successful single-rotor, double-bladed ram and pulse jet helicopters flying today with two blade-tip engines costing less than £50 each In one case the engine cost is only £18 The machines are so simple that they surely can be manufactured for less than £2,500 with at least a 500 pound payload The main obstacle appears to be fuel consumption but due to the present military interest in these machines I do not believe it is unreasonable to hope for a sharp decrease Even today, if the purchase price was really low, there would be buyers because fuel costs would be more than off-set by purchase price and subsequent parts costs I feel it cannot be emphasized too strongly that there are myriads of uses for helicopters that await only a low purchase price Speed, altitude performance, range, payload , all are secondary when compared with original price in a discussion of helicopter sales possibilities

(B) SMALL, MEDIUM AND LARGE HELICOPTERS

For convenience I classify helicopters as small, medium, and large In each classification there are several of the rotor and engine types but only the single-rotor, single-engine helicopter has achieved any wide commercial use Even in the military the single-engine tandem is the only other helicopter with what can be called considerable use although the Kaman synchropter, which is a variation of the lateral type, is getting into production Nevertheless each type has some advantages

(1) *Small helicopters*

For ease in discussion I define a small helicopter as any helicopter with a capacity of from one to six seats including the pilots seat In my opinion there is no doubt that the single-rotor helicopter is the best configuration for this category Blade loss through wear and accidents is the highest single replacement cost of our operations and I believe this would apply equally to all operations with small helicopters Therefore, given roughly the same payload for horsepower, the helicopter with the fewest rotor blades will be the most economical The next most costly items are the transmission and rotor hub systems This doesn't count the engine which would be about the same for all types A single rotor helicopter naturally has simpler transmission and rotor hub systems and therefore is cheaper here too The other three basic helicopter types , tandem, lateral and co-axial, all have more complicated transmission and rotor hub systems From an aerodynamic standpoint the advocates of each type claim formidable advantages For small helicopters nothing really matters except cost of operation, providing payload is not too disparate Admittedly there is a centre of gravity advantage on the part of the tandem and theoretically the tandem and lateral possess greater engine efficiency because there is no need for torque compensation as in the single-rotor We needn't consider the co-axial type at all because there are none of any size in use today As a matter of fact only the Piasecki tandem and the Kaman lateral or synchropter are in use today as examples of these types in the small helicopter classification No doubt the advantages attributed to these helicopters exist but for small helicopters the

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overwhelmingly important factor is cost of operation and it is my opinion that for this classification the single-rotor helicopter is the cheapest to operate None of the types mentioned which are now in use have more than one engine Twin-engines for this classification will have to await ram or pulse-jets

(2) *Medium helicopters*

My definition of this classification is any helicopter with from seven to nineteen seats including the pilots seat In this category we can eliminate the lateral as well as the co-axial types because there are none beyond the design stage For this size helicopter the tandem begins to look better, particularly from a centre of gravity position Still, the transmission and hub systems are again more complicated than on the single-rotor and therefore if the single-rotor can carry the same load, even though more restricted as to disposition, I believe it to be the better configuration for this size Most of the present examples of the two types such as the Piasecki, Bell, Westland-Sikorsky and Sikorsky are single-engine so we needn't consider twin-engine, the Bristol 173 being the only twin-engined machine flying in this category

(3) *Large helicopters*

From the two previous definitions it follows that a large helicopter is any helicopter capable of carrying twenty or more people There are no helicopters in this classification in general use today but Sikorsky, Piasecki, Bristol and Fairey are not far off For this size machine I must admit that I'm out of depth in a discussion of relative advantages I have no idea what the best configuration might be except that, to a layman, it would seem that there is a limit to what you can hang under one rotor On the other hand the Kellet-Hughes " Flying-Crane ' had rotor blades far bigger than practically anyone thought was possible before they were built Also I believe Sikorsky feel there is no theoretical limit to rotor-blade size except turning power available if cost is disregarded There seem to be definite advantages to each type being built for this size They all are twin-engine so again, we need not discuss engines The single-rotor adherents claim simplicity, the tandem builders claim centre of gravity movement freedom and fuselage space and the combination gyrodyn-converta-plane builders claim speed without sacrificing hovering performance I can't help feeling however, that here again cost will be the deciding factor These machines will be almost entirely for passenger travel because they will be so expensive that only the high utilization of scheduled services could justify them There will be a few specialized freight applications of course, such as car ferry or oil-rig placement, but in the first case utilization will also be high and in the second, alternative costs make even limited utilization attractive As there are no machines of this size in use today we will have to wait and see

(C) MAINTENANCE FACTORS

For equivalent horsepower, maintenance costs will always be higher for helicopters than for fixed-wing aircraft for the simple reason that there are more moving parts The helicopter does have some maintenance advantages such as accessibility but they are minor compared to the disadvantages during the initiation of a new type

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(1) *Incubation period*

Each time a new type aircraft is introduced into service it must go through an incubation period during which critical parts are carefully nurtured to the point where they can be trusted for definite lengths of flying time This process is infinitely more tortuous, and therefore costly, for a helicopter than for an equivalent fixed-wing aircraft Complete overhauls of complicated units like a transmission are very often mandatory after only 25 hours flying on new type helicopters It took several years of operation before it was possible to fly our Bell helicopters for more than 100 hours without a major overhaul Probably no aircraft has ever gone into service smoothly without experiencing mechanical difficulties of one sort or another Due to its mechanical complexity the helicopter is prone to have far more of these difficulties than a fixed-wing aircraft As a matter of fact, I believe that practically all makes of helicopters in extensive use today have actually had to be grounded for varying lengths of time, at one time or another, due to mechanical problems that have arisen This is certainly not true of equivalent horsepower fixed-wing aircraft This possibility of grounding is a very serious one to a small operator, in fact it can even be fatal to his operation Therefore he must attempt to compute this definite possibility in working out his capital requirements for a venture with a new type helicopter This gets to be an impossibility on a time-contract in an area of critical flying conditions which is far removed from the sources of parts supply If he wants the job he must take a gamble on the new machine which I believe is proportionately more of a gamble than a large airline has to take when incorporating a new fixed-wing aircraft type into its route network In addition to this grave risk of grounding at the beginning, the helicopter operator must also accept the very high cost of parts replacement in an attempt to prevent serious accidents and groundings Bearing replacement cost alone gets to be a major cost item at the inception of service with a new type helicopter Low transmission and rotor-blade life is much more costly, of course At one time one of the helicopter types which has seen extensive service had a main rotor-blade life of 100 hours Even today total rotor-blade life is far less than engine life because they cannot be continuously overhauled These are some of the reasons why helicopter operating is so much more expensive than operating an equivalent horsepower fixed-wing aircraft

(2) *Utilization possibilities*

Despite what I have just said it is possible to achieve very respectable utilization averages from todays proven helicopters, even in extremely remote places For example, we have two flying helicopters and one standby helicopter working on a contract in New Guinea We have worked in many areas of the world from the Arctic Circle to New Guinea and I don't believe there are many spots more remote from the European and American sources of parts supply than New Guinea With this 3-helicopter combination we are averaging almost 1,000 hours per machine annually in New Guinea, counting the standby helicopter This annual utilization is in no way near the limit I am sure that if there was a demand, today's proven helicopters could reach a utilization of from two to four thousand hours annually, depending upon the operator This rate of utilization can only be reached through unit replacement and all helicopter operators with proper capital

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employ this technique when their work demands a high number of flying hours It is possible to replace every moving part including the instruments on a Bell helicopter without taking it out of service at all during daylight hours and total time consumed is only two nights for three mechanics Similar times are possible on the only other two proven machines now in general use, the Sikorsky S-55 and the Hiller 360 Incidentally, I regard a helicopter as proven only after it has accumulated at least 100,000 hours of field work, that is utilization away from the factory The price that has to be paid for high helicopter utilization is a very heavy capital investment for parts even in work areas near basic parts supply On one of our operations we have used as many as seven spare engines for two flying helicopters Although this was high due to transport difficulties we have found it necessary to carry about twice the number of engines in stock than the number that we have been flying For the contract I have mentioned in New Guinea of two flying helicopters and one standby, we have a complete power-pack, which is all the moving parts of the helicopter assembled as one unit, with the exception of the controls and the instruments In addition we have four spare engines, small spares adequate to keep us flying for a year without a parts shipment and a fourth helicopter broken down into units such as the tail boom, the main frame, the undercarriage, the cockpit and nose section and the plastic bubble This disassembled fourth helicopter is largely to insure rapid rebuild after a major accident

(3) *Crashes and subsequent rebuilding*

In 1947 many of the large aviation underwriters entered the helicopter market When our American company started operations in the early spring of 1947 it was possible to insure a helicopter against crash for an annual premium of 5% of its value At this rate the underwriters were badly burned Several of them withdrew from the market completely and today the few that are left charge anywhere from 15% to 24% with 20% being about average They certainly cannot be blamed for this rate after what they have experienced Even at this rate the restrictions against night and over-water flying and special types of work plus heavy participation on the part of the insured in the form of a large deductible make insurance unattractive to an experienced operator We have had our share of major accidents but our average rebuild costs have never been more than the equivalent of a 10% insurance premium Obviously the best way to cut down maintenance costs, which includes rebuilding wrecks, is to prevent major accidents as far as it is humanly possible We define a major accident by the way, as any accident in which the main rotor blades strike the ground, because the result is always major damage The tremendous impact of the blades striking the ground tears the rest of the ship to pieces It is interesting, and very gratifying, to note however that no one has ever been hurt in our major accidents of which we have had over 15 since we started in 1947 The reason for this is that everything flies away from the cockpit and of course the pilot and his passengers are always strapped in securely After the dust had settled from our first major accident in 1948 our chief mechanic and I turned away from the resultant spaghetti and consigned it to the junk pile Since that time we have rebuilt many wrecks besides those of our own High insurance rates forced us to try to salvage what we could with such success that today we can rebuild any helicopter that hasn't burned badly Using our disassembled helicopter we can put a wreck back into the air in

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two weeks with two men and then the badly damaged parts such as tail booms and main frames are later rebuilt I believe we are technically still flying one of the oldest helicopters, old that is in terms of flying hours N100B, a Bell helicopter, has over 7800 hours to its credit This doesn't mean a thing of course because the only part from the original helicopter still remaining is its number Besides having been entirely converted from a closed cabin model to an open plexiglass bubble utility helicopter, it has been involved in three major accidents, each time requiring a complete rebuild Experienced rebuild men are vital to any operator who wants the lowest possible maintenance costs I have seen several helicopter mechanics discard a main frame as being too badly damaged to rebuild and then have an experienced man come in and do the job for a total cost including labour and materials of £80 A new frame would have cost £850 not counting freight and time loss

(VIII) Personnel

Operating helicopters either publicly or privately, is no different insofar as personnel are concerned than any other public or private enterprise The basic tenets of good business management apply to helicopter operation as well as to any business Obtaining good equipment and even obtaining contracts, are secondary to obtaining good personnel Any business is only as good as its personnel and if anything this is doubly true of helicopter contracting Obtaining, and then retaining good personnel for helicopter operating is very difficult because of its generally nomadic nature Pilots and mechanics are rarely in one spot for very long This puts a premium on the unmarried man but somehow it seems that most of the best helicopter pilots are married To counter this we have either made elaborate provisions for families in whichever area the contract was or we have started all over with an unmarried fixed-wing pilot and taught him helicopter flying There isn't much danger that he will get married right away in the areas where we work This procedure of training our own personnel rather than hiring a helicopter pilot or mechanic has worked out very well The disadvantage of cost is more than compensated for by the fact that you can be more selective and thus engage a higher calibre man Then too, he has an obligation to discharge which means he will work for you for at least two or three years This would sound like a strange statement to a railroad or bus executive or even to an airline executive but the truth is that there has always been a dearth of good, experienced helicopter pilots and mechanics This has been due mainly to the cost of training and the uncertainties of the helicopter business The result has been a sellers market in which salaries have grown out of all porportion to responsibilities Today a helicopter pilot can earn, within one to three years from the beginning of his training, a salary equal to a captain on one of the worlds great airlines I'm sure there is no need to compare responsibilities between the pilot of a three-place helicopter and the captain of an airliner However, that is the situation which prevails today and an operator simply must accept it as an unavoidable cost You might perhaps be interested to know that in the course of training American, Dutch, English, Indian and Australian personnel for our operations we have proven to our own satisfaction that no nation has a monopoly on basic intelligence or physical skill We have obtained high calibre personnel from all these nationalities

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(IX) Primitive Transportation Areas

As a conclusion to my discussion of helicopter operating I should like to describe what I believe will become a major use for helicopters of all sizes That will be the utilization of helicopters in primitive transportation areas These are areas in which there are no railroads or roads, no airstrips, no waterways They are areas in which all movement is on foot or by animals or where only very specialized vehicles may pass such as the swamp buggy I mentioned in the field of oil search These are the great remaining unexplored or little known areas of the world They include the Amazon basin, parts of Africa including both jungles and desert, the heart of the large south-west Pacific islands like New Guinea, Borneo, Sumatra and the Arctic and Antarctic areas including Greenland and northern Canada, and some of the worlds mountain ranges These areas have thus far resisted man's efforts to exploit them due to transportation difficulties but I believe the helicopter is the answer Specialized techniques are required for each area but they will be no problem for an experienced operator Bare mountains, desert and swamp are all relatively easy as they do not require clearings and therefore it is only a matter of obtaining skilled pilots Forest and jungle are quite different however because the helicopter operator must assume the entire responsibility for the penetration required, at least at the beginning Without this assumption the various commercial companies and governmental agencies interested in the particular jungle or forest area cannot be persuaded to try the helicopter as the answer for easy access Therefore the helicopter operator must build up a surveying and clearing organization capable of cutting its way into the heart of any jungle utilizing native labour trained on the spot with portable power-driven chainsaws These crews are supplied entirely from the air by the helicopters for which they are cutting clearings In New Guinea we have a crew of twenty natives with three supervisors which can cut one clearing 60 yards by 100 yards a day in what is quite possibly the heaviest rain forest anywhere It can be done this fast with a trained crew simply because they need only level everything to a maximum height of about six feet and then build a landing platform on the resultant jumble This clearing work is a nasty, sometimes dangerous business, but it can be done Once the clearings are cut the specialised personnel for whom the entire project is designed, such as geologists and geophysicists, can sail in over the trees, mud, insects and heat to a desired spot without even soiling their boots Where great weights must be lifted, weights that are too large for helicopters available today, road building machinery such as bull-dozers can be disassembled and flown in by helicopter to a clearing cut on the desired spot Then an airstrip can be constructed for large freight aircraft Thus even with today's helicopters these primitive transportation areas can not only be explored but exploited entirely from the air In my opinion this will be one of the most beneficial, and certainly one of the most interesting of the many uses helicopter operators will develop for this most versatile machine

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At the conclusion of the Lecture the Chairman said We are going to ask Mr Flint now to put on the film so that we get continuity between that and his remarks, and hope there will then be time for a few questions "

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COMMENTARY ON MR FLINT'S FILM

Mr Flint then showed an excellent colour film to the meeting, portraying his company's operational methods in the New Guinea jungles, and his commentary was most illuminating He explained that, when undertaking a contract in such terrain, the helicopter operator had to assume the entire responsibility for the penetration and provision of clearings required His company had trained a crew of 20 natives with three supervisors and they were engaged solely on this task Using portable power-driven chain saws, the crew could cut a clearing of 60 yards by 100 yards in a day and build a rudimentary landing platform for the helicopter on top of the resultant jumble

Film sequences from the air showed clearly the chain of clearings (spaced approximately two miles apart) which they had provided to ensure the helicopters' safety On their sorties into the heart of the jungle, carrying geologists or equipment in connection with the oil survey, the machines flew at a height of between 1,500 and 2,000 ft over the forest By adopting this procedure, they were always within gliding distance of a clearing should an emergency landing become necessary Their pilots almost invariably made precision autorotative landings, even at the base camp, in order to keep in constant practice

Other film sequences demonstrated the technique employed in taking off and climbing away from a clearing The trees were, on an average, 150 ft in height While flying within the limits of the clearing, below the level of the tree-tops, and to gain height at the best climbing speed of 45/50 m p h , all turns were made to the right This precaution ensured that in the unlikely but nevertheless possible event of tail rotor failure the resulting swing to the right would automatically turn the helicopter in towards the centre of the clearing and away from the forest A swing caused by power failure could be controlled by the rudder pedals These precautions, though not often needed in practice, were a necessary part of the operation If a forced landing did occur and repairs or replacement of parts was required, the maintenance personnel and equipment were flown into the clearing in another helicopter The servicing was then carried out on the spot

Skids or pontoons were equally satisfactory forms of landing gear In New Guinea they were operating two machines with skids, and one on pontoons which could also be used for river landings The passengers were carried in the cabin, but equipment for transportation was strapped on to two platforms specially fitted above the landing gear An average load under these difficult conditions was in the region of 400 lbs , but by operating a rapid shuttle service with the helicopters, many thousands of pounds of equipment had been moved into the jungle in an extremely short space of time

When weights had to be lifted which were too heavy for the helicopters in use, road-building machinery such as bulldozers could be dismantled and flown in by helicopter to a clearing cut at the desired location With this machinery an airstrip could then be constructed to allow freighters to bring in the heavy loads

* This commentary on Mr Flint s film was written by MR BASIL ARKELL and appeared in the issue of *Flight* of September 24th, 1954 It is reproduced by the kind permission of *Flight*

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