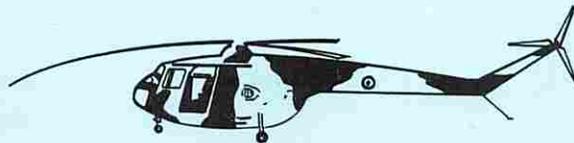
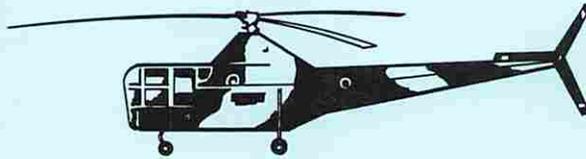


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# HELICOPTERS IN THE ROYAL AIR FORCE 1950-60

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Wing Commander J.R. Dowling, MBE, DFC, AFC



Ministry of Defence

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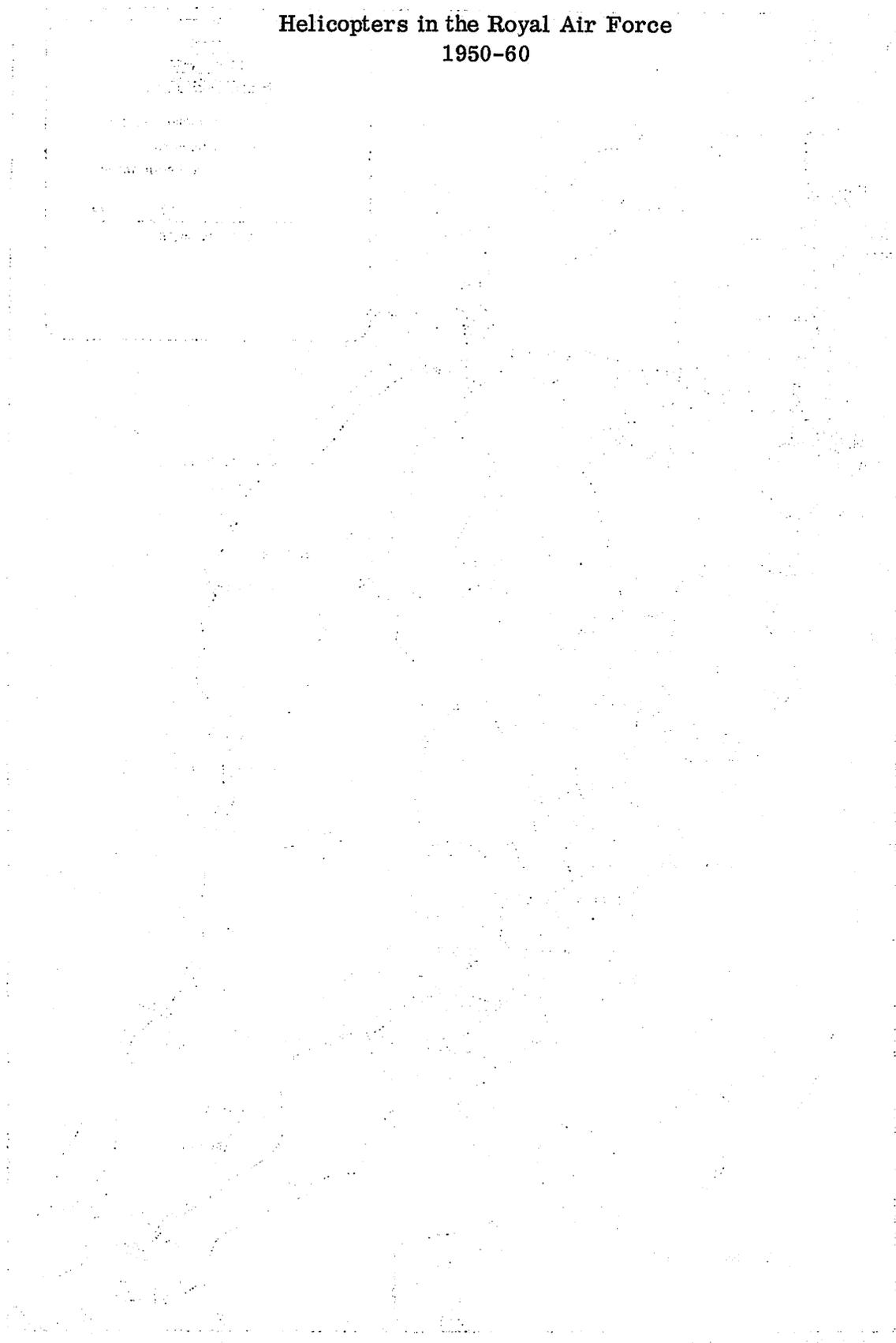
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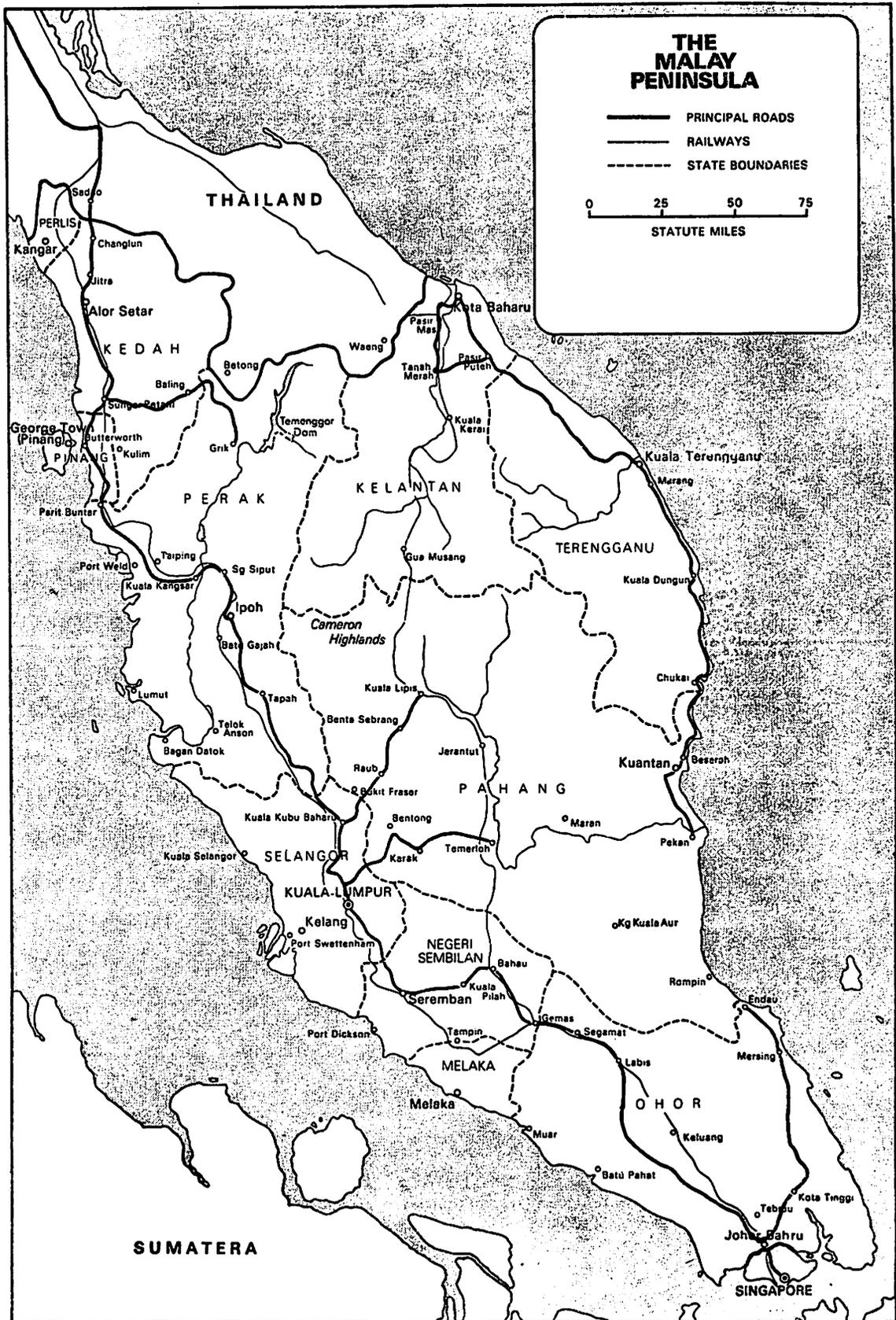
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**HELICOPTERS  
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## FOREWORD BY DUS(AIR)

There are times when plans for the writing of history must be as flexible as history in the making and when opportunities fortuitously offered must be seized. In 1974 it was hoped to take advantage of a temporary surplus of RAF officers awaiting posting to secure the attachment to AHB(RAF) of an officer who could undertake research for a history of Search and Rescue.

The Air Secretary's branch suggested that Wg Cdr J R Dowling, MBE, DFC, AFC should be attached to AHB(RAF) for an undefined period. This was a most fortunate turn of events. Though the study of Search and Rescue had to be postponed, John Dowling began research on the origin and developing role of helicopters in the Royal Air Force.

The present publication is the result of his studies and is only the first contribution to what will become a valuable history. It is hoped that Wg Cdr Dowling may be able to complete his history in due course.

J H NELSON

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J H NELSON

## AUTHOR'S NOTE

The sections remaining to be completed for this part of the RAF helicopter history are those which are perhaps of more immediate interest to today's readers - an account of the life and activities of individual helicopter units during the first two phases (1950-60) and the annexes in which the aircraft used in this period are described technically and from the pilot's point of view. The unit histories will include an account of the use of helicopters during the EOKA struggle in Cyprus (No 284 Squadron) and the preliminaries to the foundation of the UK-based Support Helicopter Force (the Joint Experimental Helicopter Unit - JEHU).

The growth of the UK SAR helicopter force during the 1950s will be described in the course of the unit histories of Nos 275 and 22 Squadrons and should be readily appreciated by readers with no experience of helicopters or helicopter operations since they follow immediately after the chapters describing the background against which the RAF helicopter force as a whole grew up.

The period to be covered in the second part of the history - from 1960 to 1975 - will lend itself admirably to the same sort of treatment, especially as the individual unit histories, being both more numerous and more eventful in character, will stand out more clearly against their background in presenting a well rounded picture of the way in which the RAF helicopter force reached its present state.

J R D

## ABBREVIATIONS

AAC	Army Air Corps
AAEE	Aeroplane and Armament Experimental Establishment
AFEE	Airborne Forces Experimental Establishment
AFME	Air Forces, Middle East
AHQ	Air Headquarters
AOC	Air Officer Commanding
AOP	Air Observation Post
ASWDU	Air/Sea Warfare Development Unit
BEA	British European Airways
CAS	Chief of the Air Staff
CFS	Central Flying School
C-in-C	Commander-in-Chief
C of G	Centre of Gravity
DCAS	Deputy Chief of the Air Staff
DCIGS	Deputy Chief of the Imperial General Staff
DRPC	Defence Research Policy Committee
FEAF	Far East Air Force

ABBREVIATIONS (Contd)

GLO	Ground Liaison Officer
GOC	General Officer Commanding
JEHU	Joint Experimental Helicopter Unit
LST	Landing Ship Tanks
LZ	Landing Zone
MEAF	Middle East Air Force
OR	Operational Requirement
ORC	Operational Requirements Committee
RAE	Royal Aircraft Establishment
RFC	Royal Flying Corps
SACEUR	Supreme Allied Commander Europe
SAR	Search and Rescue
SARAH	Search and Rescue Aerial Homing
SAS	Special Air Service
VCAS	Vice Chief of the Air Staff
VTOL	Vertical Take Off and Landing

## INTRODUCTION

The history of helicopters in the Royal Air Force starts at the point when they were first employed operationally in 1950 in Malaya. The earlier period, when autogiros gave way to helicopters with no real operational capability, is outlined in the Prologue.

The history of RAF helicopters thereafter is divided into four phases, the first dealing only with the Casualty Evacuation Flight in the Far East, which proved the readiness of the helicopter to enter the field of military operations and laid the foundation for the subsequent expansion.

In the second phase the growth of the helicopter forces was restricted not only by financial constraints but also by the limited operational capability of the available aircraft, many desirable roles for the helicopter being excluded simply because they were beyond the scope of the aircraft then in service.

At the end of this second phase however there came a significant breakthrough with the arrival of the Whirlwind Mk 10 and Belvedere, equipped with turbine engines with their great advantage in power/weight ratio.

The third phase thus belongs to the Whirlwinds, the Belvederes and later the Wessex, with the Borneo and AFME operations occupying the centre of the stage.

The fourth phase covers the formation and operations of the Puma/Wessex squadrons as a tactical helicopter army support force in the NATO context, with the Northern Ireland operations as the main example of various other activities undertaken after 1970.

Running continuously from 1953 and in parallel with these aircraft type developments is the Search and Rescue helicopter force in the UK maritime environment, and also, after 1954, the Central Flying School helicopter unit. Both of these appear in each phase after the first, as do the communications helicopters of The Queen's Flight and the Metropolitan Communications Squadron.

In each phase an outline is given of the policy considerations at Ministry level which affected the choice and procurement of helicopters, and incidentally dictated the scope of role development, and so ultimately the rate of helicopter type development.

The background to the RAF's responsibility for the procurement of helicopters for army tasks but not for the Royal Navy is explained in Chapter 1.

## PROLOGUE (1)

The Royal Air Force came into existence in 1918, that is near the point when the dream of early helicopter inventors of achieving vertical take-off and landing was in sight of realisation, but before any truly useful solution had been proved. The side by side contra rotating rotor arrangement with two forward facing propellers designed by Sir George Cayley in the early 1800s was the earliest effort of any practical significance in this field, significant also because that side by side twin rotor idea was later chosen by Focke to produce the first practical helicopter, and also forms the latest configuration for tilt rotor/wing VTOL aircraft. In 1842 a single rotor helicopter model weighing 44 lb designed by W H Phillips is reported to have 'crossed two fields' with a tip jet driven rotor powered by gas produced from the combustion of a mixture of charcoal, nitre and gypsum, and in 1859 the first British patent was granted to Henry Bright for a scheme comprising contra rotating co-axial rotors. In 1893 Sir Charles Parsons experimented with a rotor driven by a steam engine and in 1905 a comparatively large machine was built by Denny having six 25 ft diameter lifting screws and is reported to have left the ground briefly. In 1908 Breguet finally succeeded in matching with a helicopter the Wright brothers' success with the fixed wing aeroplane.

The mechanical difficulties with rotating wings led to a comparatively rapid advance in fixed wing development and in the 1920s and 1930s the rotary wing field had come to be regarded as an eccentric sideline in aeronautical development and even tended to generate ridicule.

In later years (after 1950) the RAF was to suffer a good deal of uninformed criticism by new enthusiasts for having apparently failed to grasp the potential of the helicopter with adequate enthusiasm, but the true perspective derived from the facts leads to a different conclusion. Even inside the RAF itself during the helicopter renaissance of the mid 1950s there was inevitable frustration due to the inability of the technical and commercial system as a whole to meet the sudden urgent demand for useful helicopters and the Air Ministry inevitably came in for a large share of the criticism. In fact the Air Ministry had already itself experienced some thirty years earlier the frustrations being felt by its later critics. In 1923 when even the continued existence of the five-year-old independent Air Force required strenuous defence in Parliament, the Air Ministry announced a prize of £50,000 for the successful completion of certain flight tests of 'a helicopter or equivalent flying machine'. This attracted a censorious comment by the Council of the Royal Aeronautical Society that such an offer 'gave a wrong view of the relative values of serious work on well established lines (ie fixed

wing aircraft) and such highly speculative constructions as the helicopter'.

In this environment Louis Brennan built and tested a helicopter at the Royal Aircraft Establishment(RAE), Farnborough in 1925. It had a 60 ft diameter rotor driven by two propellers mounted at the blade tips and connected to a centrally mounted rotary engine. A crash in 1926 brought this work to an end. In 1928 Vittorio Isacco, who had been experimenting on the Continent for some years, came to England and built a helicopter to a contract from the Air Ministry, but it never flew.

Just as fixed wing development leapt ahead of rotary wing development for technical reasons, autogiros started to occupy the centre of the stage for rotary wing aircraft because they were technically simpler to design and build than helicopters. Juan de la Cierva, having experimented with a number of unsuccessful models, achieved in 1923 his first autogiro flight. In 1925 he demonstrated his C6 Autogiro\* at the RAE, Farnborough and the Air Ministry was sufficiently enthusiastic to order a number of them. As a result, the Cierva Autogiro Company was formed to handle the patent rights etc, the construction work being done by A V Roe Ltd.

One consequence of this purchase of Cierva autogiros by the Air Ministry was that the RAE became involved and a good deal of investigatory work into the theory and mechanism of the flapping rotor was generated. The autogiro became quite popular and demand for it grew. Series production was set up not only in the United Kingdom but also abroad, under licence, especially in the United States and France. Flying demonstrations were given in many parts of the world, one notable one being by R A C Brie (later as a wing commander in the RAF to generate the first helicopter procurement in quantity for British forces)\*\* who, in the mid 1930s, demonstrated the capability of the autogiro to land and take off from a ship - the Italian cruiser Fiume - in the Mediterranean. In 1932 the Cierva Flying School was created and operated at Hanworth under H A (Alan) Marsh as Chief Instructor until the outbreak of war in 1939.\*\*\* In this period nearly 10,000 hours were flown and 368 people qualified as autogiro pilots.

---

\*'Autogiro' was the registered trade mark for the autogiros produced under the licence of the Cierva Autogiro Company.

\*\*Brie flew as an observer in the First World War with the Royal Flying Corps, afterwards becoming a pilot in the RAF. He was on the RAF Reserve of Officers from 1922 and test pilot for Cierva from 1930.

\*\*\*Alan Marsh was originally a flight sergeant pilot in the RAF between the wars. He was commissioned on rejoining the RAF in 1939 and, after about two years in the RAE at Farnborough, took command of No 1448 Rota Autogiro Flight in place of Wing Commander Brie, who had been sent to the United States for autogiro deck landing trials.

Also in 1932 the first successful direct control autogiro was flown in which attitude control was achieved by direct tilting of the rotor hub and thus rotor thrust, rather than by elevators and ailerons as in previous machines. This advance produced the C30 autogiro, six of which were purchased by the Air Ministry in 1934 for the RAF School of Army Co-operation at Old Sarum. Other orders followed and the ultimate development of the Cierva autogiro followed soon after: the C40 with jump take-off ability.\* The Air Ministry obtained 5 C40s in 1939.\*\*

---

\*The jump take-off was achieved by applying engine power to spin the rotor at low blade pitch angle in excess of auto rotation speed before take off, and causing the blades to revert to their normal pitch angle when the engine torque was directed to the traction propeller instead of to the rotor shaft. This caused the machine to jump off the ground where rotor speed could be maintained by the acquisition of forward speed by means of the propeller. The blade pitch change was achieved automatically by tilting the blade hinges so that application of torque through the rotor shaft caused the blades to reduce pitch temporarily while the rotor was being accelerated by engine power. The pilot had no means of increasing blade angles for landing.

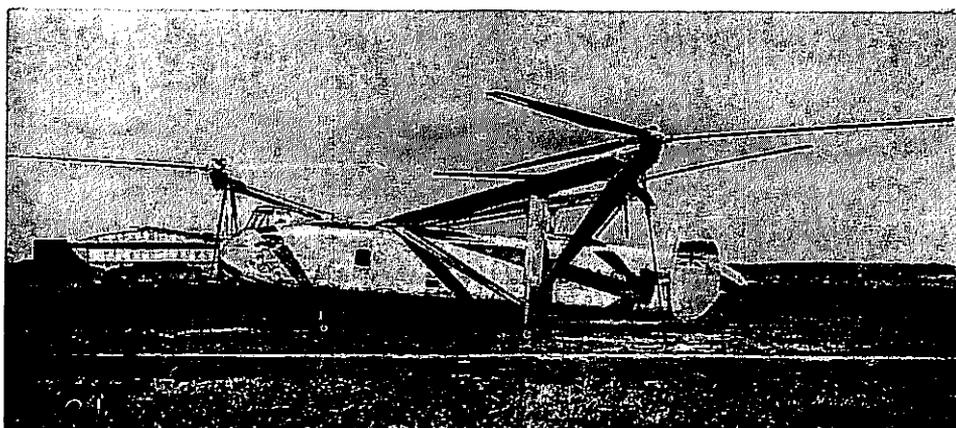
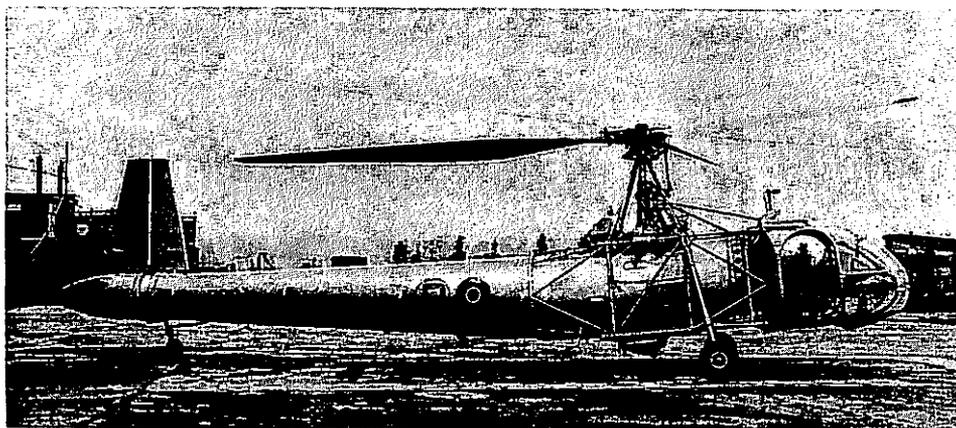
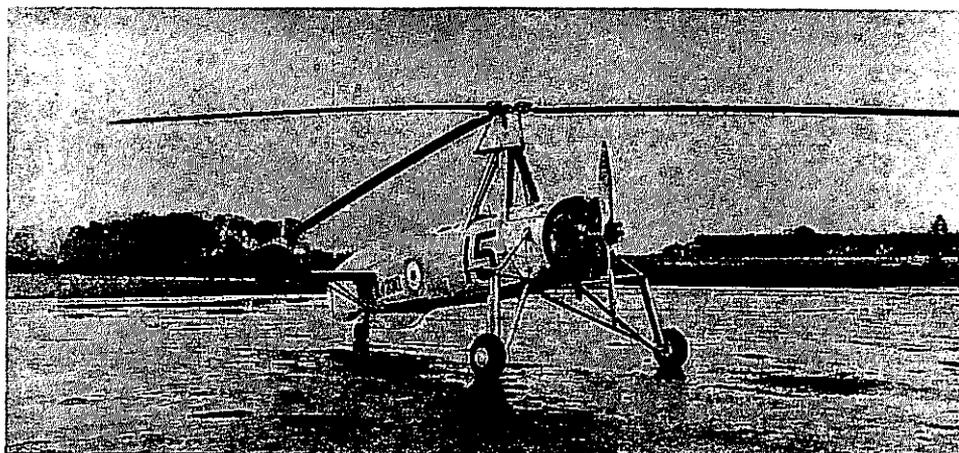
\*\*Closely associated with the Cierva Company was G & J Weir Ltd which, under licence, built a number of small autogiros, W1, W2, W3 and W4. The last had a direct take-off capability and was demonstrated in 1936 at Hounslow Heath together with the Cierva C40 autogiro. In 1937 Weir turned its attention to the helicopter and built the W5 and W6 which were side by side configurations. Both flew successfully, but the outbreak of war put an end to them. At about the same time Raoul Hafner, who had built two experimental helicopters in Austria and then come to England in 1933, formed AR III Construction (Hafner Gyroplane) Company and built an autogiro which first flew in 1935. It differed from the Cierva machines mainly in its rotor control and blade suspension which were like those in modern helicopters. Thus, instead of tilting the rotor hub, it achieved tilt of the rotor disc by cyclic feathering; it also had collective pitch under the pilot's control. As a result, not only could it perform more controllable jump take-offs, but the degree of control for zero speed landings was greatly increased. Weir in postwar years gave birth, through the Cierva Autogiro Company which it then controlled, to the Air Horse and Skeeter helicopters, while Raoul Hafner, after designing the Rotachute rotary wing glider during the war, went on to design the Sycamore and Belvedere helicopters.

## Wartime Developments

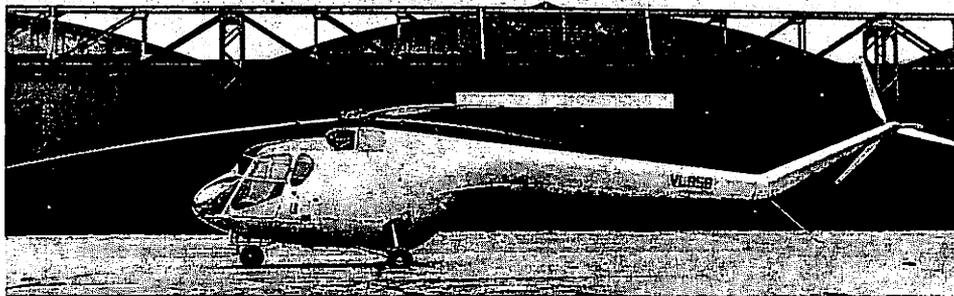
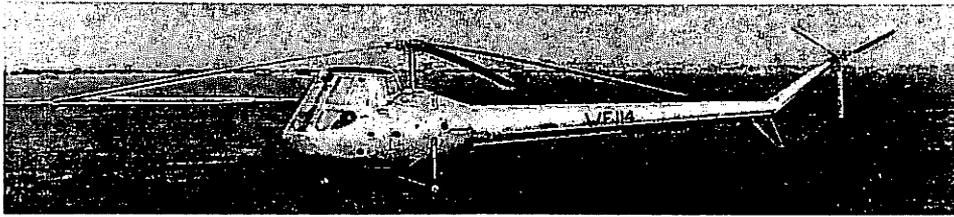
At the start of the Second World War the Air Ministry sent two of the C40 autogiros with RAF pilots to France for Army Co-operation duties, but the aircraft did not return after the evacuation from Dunkirk. All the remaining autogiros, including civil C30s and C40s which had been promptly requisitioned, about 16 in all, were collected at RAF Duxford, given the RAF title of rota and formed into No 1448 Rota Calibration Flight under Squadron Leader Brie. Its task was to provide facilities for the calibration of radar sites, work hitherto attempted clumsily by barrage balloons which proved of very limited use. The autogiros could not hover (except in very strong winds) but they could orbit at the required spots and heights while performing a turn of sufficiently small radius to achieve the desired effect for the radar operations. The technique was successful. No 1448 Flight was re-formed in 1943 at Halton as No 529 Autogiro Squadron under Alan Marsh then a squadron leader.

For radar calibration work the individual rotas operated as independent units with a pilot, engine fitter and a rigger. These 'units' moved around the coastal radar stations in much the same way as operational helicopters were to do later with their crewmen. After navigating to the required points, usually over the sea, a sea marker was dropped and the rota then performed a very tight orbit over the marker at various heights as required to enable the ground radar station to calibrate its equipment. During the war, No 529 Squadron carried out almost all the ground radar calibration in the country and in five years over 9,000 hours were flown. It moved to Upper Culham Farm at Henley on Thames in 1944 and was not disbanded until October 1945.

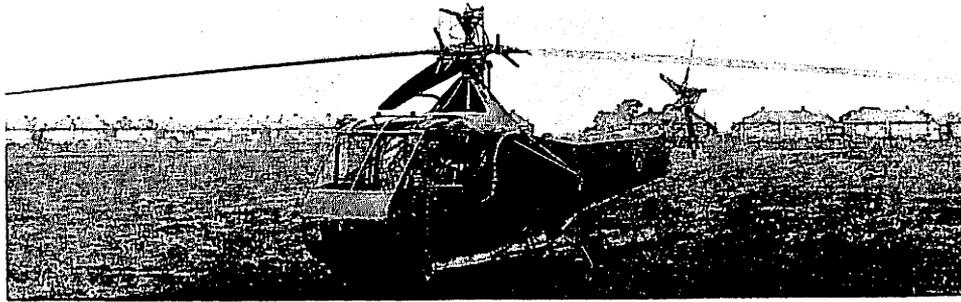
Shortly after handing over No 1448 Flight to Squadron Leader Marsh in 1941, Wing Commander Brie (as he had then become) was loaned to the Admiralty which had now become interested in the possibility of employing the autogiro for anti-submarine convoy protection. Brie, who had demonstrated the Cierva autogiro on the cruiser Fiume in the 1930s, joined the British Air Commission in the United States and achieved the first landing of an autogiro on a small platform mounted on a merchant ship (the Empire Mersey) in Chesapeake Bay. This was done in a PA 39 of the Autogiro Company of America - an American version of the C40 and one of seven ordered by the Air Ministry for radar calibration purposes. Igor Sikorsky witnessed these trials and Brie received an invitation to see his experimental single seat helicopter, the VS-300, in early 1942. He was much impressed, and later sought and obtained an opportunity to fly its production successor - the YR-4 (later known in England as the Hoverfly 1).



*Top:* the C30 autogiro, the RAF's first rotary wing aircraft. Named Rota, it was used during the Second World War for ground radar calibration. *Centre:* the Cierva W9 (1947), one of the early series of experimental helicopters by Weir. *Below:* the Cierva W11 or Airhorse (1948).



*Top:* the Cierva Skeeter (1950) - much development work was needed to bring it into service in the mid 1950s. *Centre:* the first prototype of the Bristol 171 (1947) which entered RAF service in 1952 as the Sycamore. *Below:* the Fairey Gyrodyne, the preferred choice for the FEAF Casualty Evacuation Flight, but not put into production. Torque balancing was provided by an offset forward facing propeller on the end of the stub wing on the starboard side. Leonides engines as in the Sycamore and Dragonfly.



*Top:* the Sikorsky R-4 (1944), the first helicopter to enter RAF service (1945), as the Hoverfly 1. *Below:* the Sikorsky R-6, which entered RAF service in 1945 as the Hoverfly 2; here being flown by Major N. Gow of No 1906 AOP Flight. Note the central collective lever; the pilot must sit on the opposite side from the stretcher which has to be on the starboard side because of cyclic control limitations.



wasting force. One R-6 was retained for the King's Flight, flown by Flying Officer A J Lee and Flight Lieutenant E B Trubshaw (later test pilot on the Concorde), and was used chiefly for delivering mail between Aberdeen and Balmoral. It was not replaced when it was eventually damaged while landing. A few were maintained by the Royal Navy for SAR development and training until the Dragonfly appeared in 1950, and the remaining R-6s were allotted to the Army for AOP development work - No 1901 Flight of No 657 AOP Squadron being formed for the purpose at Andover in May 1947 (Captains N Gow, P Wilson and R Smith). This RAF unit with Army pilots did a considerable amount of demonstration and AOP trial work and managed to prolong its life as No 1906 Flight to within a few months of receiving Sycamores as replacements in September 1951, so maintaining a substantially continuous existence until the formation of the separate Army Aviation organisation in 1957.\*

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\*Although its early life belongs in this Prologue and extends in diminishing strength through Phase 1 (1950-52), the main operational life of No 1906 AOP Helicopter Flight is part of Phase 2.

PHASE 1

1950-52

## CHAPTER 1 (1)

### RAF RESPONSIBILITY FOR THE PROVISION OF HELICOPTER SUPPORT

In order to explain the responsibility of the RAF for the provision of adequate helicopters for Army support, as well as the competition between the Navy and the Air Force for the limited supplies of Dragonfly and Whirlwind helicopters available during the Malayan Emergency, the relationship between the Services in this respect needs clarification - a relationship which goes back to the formation of the RAF itself, the allocation of responsibilities at that time and the changes which were negotiated subsequently. What happened then bears a striking resemblance to later developments in the helicopter world and the relevance of recounting the salient features of these events here will become readily apparent.

It is usual to regard the history of the RAF as beginning with the amalgamation of the Royal Flying Corps (RFC) and the Royal Naval Air Service (RNAS) in 1918, but in fact the original flying service established in 1912 was one body - the RFC - comprising a Naval and a Military Wing maintained at the expense of and administered by the Admiralty and the War Office respectively. There was also established a single Royal Aircraft Factory, common to both Services, and a Central Flying School. From the very first there was a tendency for the two Wings to drift apart and by the start of the First World War the Naval Wing of the RFC had already changed its title to the Royal Naval Air Service. With the outbreak of hostilities the separation of the two Wings was virtually complete. For the first two and a half years of the war the two branches of the Air Service developed independently, both in organisation and supply, the RFC all in France, and the RNAS consequently charged by Lord Kitchener with responsibility for home defence. Each Service placed orders for aircraft, equipment and engines with the Royal Aircraft Factory, or with civilian firms as seemed expedient at the moment. The result was described in 1922 by the Lord Privy Seal (Austen Chamberlain) as a 'fierce inter-departmental competition in a market having inadequate resources, a haphazard, accidental and therefore dangerous arrangement involving overlapping and waste of effort, one Department bidding against another in the distribution and application of available resources, not according to a considered view of the Country's needs, but to relative skill in securing departmental advantage'.

Many detailed examples of this confusion are described elsewhere, for example by Hilary St George Saunders in his account of the rise of British air power in Per Ardua. He includes a reference to problems arising from

French aircraft industry involvement - yet another echo from the past of subsequent events in the helicopter world. In the context of the First World War, however, he described French shortages of materials which resulted in manufacturers being induced to fulfil orders only 'by a process of bargaining in which it is hard not to detect the essential features of blackmail and bribery', and gives examples. The point was that in Britain not only were there two quite separate policies for the choice and employment of aircraft, but no policy at all for the coordination of supply.

The first attempt at setting up a coordinating body - the Joint War Air Committee - lasted less than two months, its chairman, Lord Derby resigning on the grounds that the committee, having no executive powers, had no authority either. Later in the same year - 1916 - it was succeeded by an Air Board under the chairmanship of Lord Curzon, charged with recommending to the two Services the types of aircraft they should order and coordinating the supply of material to prevent competition between them. Such was the antagonism of the Admiralty, however, to any interference with its plans, that the Air Board's power merely to 'recommend' a course of action was quite inadequate to achieve effective coordination. When in late 1916 the Admiralty obtained Treasury sanction to spend some £3,000,000 on aircraft and engines without reference to the Air Board, a formal protest was met merely by a formal denial of the Board's right to protest.

In November 1916 Asquith was replaced by Lloyd George. The new government widened the powers of the Air Board and transferred responsibility for the design and supply of aircraft from the Admiralty and War Office to the Ministry of Munitions. The new Board under Lord Cowdray was thus an embryonic Air Ministry and the Aeronautical Department of the Ministry of Munitions became in effect a Ministry of Aircraft Supply, although the actual power of the Air Board to direct policy had to await the report by General Smuts in August 1917 recommending the formation of an Air Ministry. The Air Council was established on 21 December 1917 and the Royal Air Force on 1 April 1918 under Sir Hugh Trenchard.

The formation of the RAF was thus no easy option, but one stage in a series of attempts to coordinate the air arms of the Army and the Navy and to foster the development of air power in its own right. The opposition was intense and while the arguments for an independent Air Force may have been convincing to many, it was the pressure of events, including the bombing of London, which forced the government to act and resolve the dispute. No sooner was the war over however than the Admiralty set to work to reverse the decision and, supported by the War Office, mounted a political campaign to separate the Fleet Air Arm from the RAF. An essential element in all the arguments for and against was the question: who was to be responsible

for the selection of aircraft and equipment, which turned out in later years to be at the root of the matter, particularly in the case of helicopters. In the House of Commons debate on the Navy Estimates of 1922 Austen Chamberlain, now Leader of the House, resisted the proposal to dismantle the RAF in the course of a long speech in which he reviewed all the stages which had been gone through in order to achieve the formation of the Air Ministry, adding: 'It will be seen that it was war experience which led to the creation of the Air Ministry, and to the constitution of a homogeneous Air Force. It was not theory derived from speculation in the past, but it was practical experience, after trying a great many other experiments, and the deficiencies which they left, that proved to the Government in the pressure of the War, and for the successful conduct of the War, the necessity of creating the system now in force. . . . . However elaborate the machinery for coordination, whatever the goodwill and the desire to cooperate between the different Departments, it was found during the War supremely difficult to achieve full efficiency in the Air Services as long as those Services remained divided - part under the War Office and part under the Admiralty. As long as the supply of machines and engines remained under the two Departments, there resulted only a disastrous and wasteful competition.'

At a later point in the debate the Prime Minister was careful to point out that he was describing a solution which would hold good for the foreseeable future, adding: 'If the Air Services were required only as an adjunct to the Naval and Military Services, there would be much to be said for their reabsorption, though I do not think that even then the case would be conclusive, for there would remain the necessity for preventing the kind of competition which took place with such unhappy results during the War.' The Admiralty, however, maintained unrelenting pressure for many years and nearly twenty years after the end of the First World War, in 1937, the Fleet Air Arm was divorced from the RAF and placed wholly under Admiralty control, along with the responsibility for the choice of aircraft and equipment. Another twenty years or so later, in 1957, the Army followed suit and an independent Army Air Corps came into existence. It did not, however, assume responsibility for all army support aviation since this was clearly impossible, including as it must all transport as well as ground attack aircraft. The line was drawn at aircraft with an all-up-weight of 4,000 lb, the Corps' roles being restricted to AOP and light liaison. The RAF was therefore left with the responsibility of providing the Army with cargo and troop lift and a casualty evacuation service.

The appearance of the helicopter can now be seen to have recreated, in principle at least, all the problems which the Air Force had been designed to solve, but with three contestants where before there had been only two.

Without it the Fleet Air Arm would have ceased to exist, the last Naval fixed wing pilots' course having been completed in 1968 - and without helicopters the Army Air Corps could scarcely have gained a separate existence.

The restriction of 4,000 lb all-up-weight for Army aircraft prevented the Army Air Corps from entering into direct competition with the Navy and the Air Force for the supply of helicopters, at least until after 1960 by which time the Fairey, Saunders Roe and Bristol Aeroplane Company helicopter divisions had been absorbed by Westland, and the suppressed - but in time inevitably successful - ambitions of the new Corps had succeeded in eroding the all-up-weight limitation. Apart from orders for comparatively large numbers of small helicopters, it was not until the fourth phase of RAF helicopter development (the Wessex and Puma) in the early 1970s that Army orders for the Lynx emerged as a potential challenge to the RAF position.

In the three main conflicts involving British helicopters between the end of the Second World War and 1966 - Malaya, Suez and Borneo - it proved necessary to bring in Naval helicopters to supplement those of the RAF in the task of army support. At Suez the RAF contribution was provided through the short-lived Army/RAF Joint Experimental Helicopter Unit. In Malaya the diversion to the RAF of helicopters ordered by the Navy was most reluctantly agreed and came about only as the result of an overriding decision by the Chiefs of Staff in response to the demands of General Templer. Experience has shown therefore that in time of peace the ambitions of the Air branches of the Army and the Navy have led to the disintegration of the system of centralised control of resources, and in war it has been necessary to bring in an external authority to impose whatever degree of unity of effort could be achieved in the time available.

To sum up, the RAF has played no part in the choice of Naval aircraft since 1937, but has been wholly responsible for selecting the helicopters used by and for the Army (except for the AOP and light liaison roles where the choice has been the responsibility of the Army since 1957). These facts explain why the Air Ministry found itself the target of Army criticism in the areas of both development and supply (the shortage of helicopters being always acute), while at the same time being obliged to compete with the Navy for limited production facilities - once Treasury approval had been obtained to buy helicopters to support the Army.

The procedure for ordering aircraft consisted of constructing a formal operational requirement (OR) which the Ministry of Supply, controlling research and development, would attempt to match with a suitable aircraft type. It was normal procedure to consult with the Ministry of Supply to see what might be available, so avoiding the risk of constructing a totally

impracticable requirement. This was, in fact, the fate of the first helicopter OR, drawn up to meet troop and cargo lifting tasks; failure in this case was inevitable because there were no helicopters in production at the time from which to assess with reasonable accuracy what could be achieved. Thus OR 280 prepared in 1949 had to be withdrawn and reconstructed as two separate ORs in 1954 matching current technological developments.

Such was the background against which Air Ministry policy evolved and decisions were taken during the helicopter renaissance in the 1950s, a renaissance which sprang from the need to evacuate battle casualties from the jungles of Malaya. The response to this emergency requirement was the provision of three Dragonfly HC Mk 2 helicopters based in Singapore from 1950; and it was their activities in the following two years which provided the 'launching pad' for all subsequent RAF helicopter development (with the exception of that of the SAR units, whose origins were quite separate). To understand the problems and tensions which arose in the course of this development, it is essential to distinguish between two quite different attitudes held by helicopter proponents. Without this understanding many of the decisions taken and much of what resulted will seem strangely inappropriate.

In the 1930s and 1940s RAF leadership in this new field of aeronautics was accepted as natural; radar calibration, field trials, army cooperation were all obvious outlets. The idea of wings whirling above the aircraft to achieve take-off and landing may not then have seemed so outrageous an alternative to rushing along the ground out of control and with inadequate brakes as it did a short time later when fixed wing aircraft had acquired a relatively conventional image. The question was rather what could be achieved in terms of vertical take-off and landing (VTOL) performance than what purposes could be served thereby. To question the rationale or even the economics of encouraging rotary wing development would have seemed absurd and irrelevant. The advantages would have been obvious and it was not until several years later that the epithet conventional came to be used when comparing fixed wing aircraft with helicopters.

It was however the failure of early autogiros and helicopters to achieve a performance which had any true military relevance which came to determine the different attitudes of the three Services towards rotary wing development. A serious intention to proceed with the helicopter in a hard unfriendly financial climate could be based on one or other of two assessments: that there would inevitably be an infinite variety of tasks arising in the future merely by reason of the helicopter's existence (the doctrine of inherent flexibility), or that the tasks for which it was needed were solely helicopter tasks and unsuited to fixed wing aircraft.

An example in this second case would be the Naval need to move and hover over the sea, while the ambition to airlift practically everything an army uses is characteristic of land forces worldwide. The RAF therefore was left without an identifiable single service use for the helicopter and in 1948 had to withdraw except for a residual and theoretical interest in maritime applications and a 'toe hold' in the AOP role - No 1906 AOP Flight was maintained by the RAF ostensibly for this purpose at the insistence of the Army. The result was that the Royal Navy demanded sea hovering for anti-submarine work and sea rescue from the very earliest days - and thirty years later was making exactly the same case, having added only such specialised applications as anti-surface ship weapon launching and troop carrying roles as they were developed elsewhere. The Army meanwhile had conceived a virtually unlimited number of roles for helicopters to match its constantly developing pattern of operations and equipment.

The RAF shared the Navy's interest in anti-submarine and SAR work, but not as an exclusive helicopter role, and the Army's enthusiasm for the inherent flexibility of rotary wing aircraft, but not to the exclusion of other and more important aspects of air power. It felt however that it had nearly had its fingers badly burned by a premature venture into the helicopter field and was determined to be more careful in the future.

The RAF's helicopter policy thus became in 1948 one of waiting for tasks to arise, and has remained so ever since in the face of the ever increasing pressures of financial stringency. Bids had therefore to be not only exclusively appropriate to helicopters but also to have a clear priority over other air operational demands. The case had to be made and the resulting conflict of priorities resolved before the first steps could be taken to fulfil any task with helicopters.

For more than half of the twenty years of maximum helicopter expansion after 1950, therefore, events must be seen against the background of a clear, consistent but highly specialised Naval requirement which virtually monopolised Britain's limited helicopter manufacturing capacity. At the same time the RAF was obliged to meet a succession of emergencies worldwide without having had the opportunity to respond by other than theoretical contingency planning in the helicopter field.

Meanwhile the Army was applying increasing pressure to develop the range of helicopter tasks, but found itself compelled to formulate its demands within the restraints imposed by the currently accepted definition of the roles appropriate to Army Aviation and the RAF policy of establishing in advance that the proposed task was not only essential but also exclusive to the

helicopter. Thus discussion centred on AOP, then AOP and light liaison, followed by light liaison and reconnaissance, although the true demand was for an adequate supply of helicopters with which to develop all the helicopter support roles which were found to be fully established by 1970.

Although the roles of tactical troop movement and logistic resupply by helicopter remained at least officially an RAF responsibility, the formation of an independent Army Air Corps in 1957 went a long way towards relieving the psychological frustrations inherent in the situation. The twin constraints of financial stringency and limited industrial capacity remained however, although the shortage of suitable helicopters was now no longer blamed automatically on the RAF alone.

A further element was that while in the fixed wing field it was large-scale military demand which engendered rapid development with consequent benefit to the civil market, financial limitations made the reverse true of the helicopter, at least in Britain. All the early development was aimed at the civil market, with the RAF buying in emergency whatever was immediately available. Thus the great range of promising developments by Short (Air Horse), Bristol (large tandem rotor helicopters), Percival (low pressure tip driven rotor), Fairey (Rotodyne), Westland (larger developments of Sikorsky helicopters) and others all withered away and eventually disappeared completely, leaving the field to helicopter manufacturers in the United States, where huge purchases of crude and barely satisfactory helicopters by the armed forces were of great benefit to the aircraft industry - with consequent long term advantages for helicopter development - but also in the short term vitiated the drive towards radical research and innovation.

Into this partial vacuum the French aircraft industry was able to insert the whole range of Sud Aviation helicopter developments and by 1965 the RAF was committed to a mixture of these and American designs made under licence by the only manufacturer remaining in Britain - Westland Aircraft Ltd. In the meantime the postponement of the large (medium lift) helicopter for yet another year on the grounds of economy had become an annual event.

## CHAPTER 2

### THE MALAYAN EMERGENCY I

The call, when it came, for the RAF to start actual helicopter operations was clear and urgent. It originated in the Far East and was addressed to the Chiefs of Staff in London on 8 March 1949. (1) Operations against 'bandit gangs'\*, the signal stated, were likely to intensify in the coming year in the more remote jungle areas of Malaya. They were being hindered or even cancelled because of the need to carry wounded men for long distances through the jungle. The remedy was to use helicopters whose presence would also have a considerable effect on the morale of the troops. The signal specified no particular type of helicopter or required performance, but referred to 'production models of a British helicopter likely to be available in the autumn'. Three were requested for casualty evacuation trials. (2)

In the Air Ministry it was remembered that the possibility of using helicopters for casualty evacuation had been mooted in the latter part of 1948, but that in the absence of a firm Air Staff requirement and an agreed establishment, no unit could be formed. (3) But to meet such a need was described as a long term policy and the Ministry of Supply had been asked to investigate the possibilities. As a result of their studies, the aircraft they had in mind were the Fairey Gyrodyne and the Bristol 171 (Sycamore), but neither was expected to be in production before 1951. The Admiralty, however, already had in production at Westland the British version of the American S-51, and if speed of response was the most important criterion, this rather less satisfactory type would probably meet the Malayan casualty evacuation requirement. The Admiralty were reluctantly prepared to release three aircraft from the production line after their first six had been completed.

Note was duly taken of the urgency of the Malayan requirement and the threat to a successful outcome to the military operations there, and the Commanders-in-Chief, Far East were told that the best solution was being sought. Ministerial pressure was also evident and a question in the House of Commons by Sir Anthony Eden (later Lord Avon) elicited a response from the Minister of Defence (Mr Shinwell) that helicopters would be sent. The War Office, while deeply concerned, was content to leave the choice of aircraft and the manning of the unit to the RAF. There was no argument about those aspects.

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\*Later known officially as communist terrorists.

The choice of aircraft, however, had a dramatic effect on later helicopter development and provides an insight into the level of understanding current at the time. The Gyrodyne, Sycamore (Bristol 171) and Dragonfly (S-51) were compared in terms of performance, suitability, availability (by far the most important element in these discussions) and cost; a significant difference was expected between the three main contenders and they were accordingly graded in terms of effectiveness in the order listed above.

Information, however, on performance was inadequate and proved to be optimistic. The Skeeter, for example, which was also considered briefly, was thought to be able to lift a casualty but was disqualified because it would not have been able to carry a nursing attendant as well to look after him. In fact, the Skeeter would not have been able to carry a pilot under Malayan conditions, and the performance of the Dragonfly too was similarly over-estimated (see below p 28 ).

An element of confusion had been introduced by the Ministry of Supply advice given at an Air Ministry meeting which suggested that even if the Dragonfly was chosen because the better candidate, the Gyrodyne, was not available, there need be little concern over the lack of tropical trials for the Dragonfly so long as it was to operate only in Malaya - because the atmospheric conditions there were believed not to be tropical and the reduction in performance compared with that in an English summer would be only slight. (4)

This extraordinary misconception seems to have been accepted without comment. Indeed, the chairman of the meeting noted that even if tropical trials were not needed for the Dragonfly when destined for Malaya, they would eventually be needed for the aircraft finally chosen because it would have to be able to operate anywhere, that is by implication in more difficult climates!

The Sycamore did not show up very well in the course of these comparisons mainly because there seemed little chance of it being ready in time. There was also adverse comment from the Far East about the alleged inadequate height of its main rotor above ground obstacles. Three years later it was to prove so vastly superior in performance to the Dragonfly that it replaced it and for twenty years was operated successfully in all theatres where helicopters were used.

As the Gyrodyne never went to Malaya there is no evidence about it under those conditions. However, its projected performance was greatly superior to that of both the Sycamore and the Dragonfly and it was also preferred by the medical staffs because the casualties were carried internally, unlike in the Dragonfly, and lengthwise, unlike the athwartships arrangement in the

Sycamore which they disliked. At no time was the radically different aerodynamic principle of the Gyrodyne a factor in the discussion, except that its mechanical simplicity was commented on favourably by the Ministry of Supply. Nevertheless, the Gyrodyne was preferred by the Air Staff and although the need for haste eventually dictated the decision to send three Dragonflys to the Far East initially 'for experimental purposes', that is with strong misgivings, the Air Staff intention originally was to replace them as soon as possible by enough Gyrodynes to form a complete unit with 100 per cent backing. Shortly afterwards, however, one of the two prototype Gyrodynes crashed, killing the test crew, and the type was not proceeded with in that form. By the time it reappeared some years later with a tip propulsion rotor, both the RAF and the Navy were committed to pure helicopter types.

There remained the problem of crews for the new unit and it was decided that 25 ground crew would be trained at the manufacturers (Westland) and that they, together with a technical representative of the firm, would be enough. Thus the RAF was now entering the helicopter field with actual operations in prospect and with only three operational aircraft which were, practically speaking, irreplaceable. As for pilots, expertise in this field had not been husbanded, the time scale was short and training facilities were uncertain - although it was assumed that Westland could oblige. In the event, they were unable to provide the training for the four pilots needed immediately.

Personnel records showed four pilots still in the Service who had helicopter experience. One however was due to leave shortly (Brian Trubshaw); the other three were given a mere 15-hour familiarisation course on the Dragonfly at AFEE and sent to the Far East where it was discovered that one of them had a hearing defect which made it impossible for him to use headphones - a disability which did not prevent him from being sent on initially to Malaya, but made it essential to replace him as soon as possible.\* Two vacancies thus remained and were filled by volunteers who still needed the basic helicopter training which Westland were unable to provide.

In this situation the only option was to call on the Admiralty for help, although it was later realised that as the first Dragonfly had only just been delivered to the squadron selected (No 705) the Navy was scarcely in a position to offer normal training facilities, a conclusion which was borne out

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\*He was a test pilot at AFEE where apparently it was usual for some of the helicopter pilots to fly bare headed, the reason given being that this enabled them to detect more easily by ear any significant changes in rotor speed! Whether this practice had caused the hearing defect or merely allowed it to go unnoticed is not known.

by the stark facts on the day the two RAF pilots arrived in Gosport. The first Dragonfly was lying on its side outside the flight office, a tangled mass of twisted rotor blades. The embarrassed squadron commander (Lieutenant Commander J Suthers) explained that further machines were being assembled and everyone would soon get the hang of them. Meanwhile, some of the old R-4s from the 1945-48 era were still available and although on no account were they to be trusted at heights above six feet they could still be used for initial hovering practice.

Thus the Far East Air Force Casualty Evacuation Flight came into being in May 1950 with three Dragonfly helicopters whose performance in the tropics was unknown, two pilots with some limited Hoverfly experience and a brief Dragonfly conversion course at AFEE, and two more whose experience consisted only of a period of mutual pioneering with the Navy at Gosport - none had any helicopter experience overseas.\* The unit however was a resounding success from the very beginning and operated throughout Malaya for 20 months before losing its first aircraft to the far from neutral jungle. It grew in time into a fully fledged squadron and practically every type of task and technique was developed as a matter of necessity with the sole exception of winch operations for which the aircraft performance was inadequate. The true significance of these events was that they demonstrated that the provision of a tactical troop carrying helicopter squadron was now a necessity.

#### OPERATIONAL CONDITIONS (5)

The arrival of the helicopter in the Far East almost coincided with the appointment of Sir Harold Briggs as Director of Operations to coordinate the efforts of military and civilian authorities in anti-terrorist operations. The first outburst of communist activity had slackened off, but in late 1949 a second and more organised offensive began. The 'Briggs Plan' consisted in essence of concentrating the scattered and mainly Chinese 'squatter' farmers into defensible 'new villages', so forcing the terrorists to operate in the jungle fringes, and enabling the military authorities to withdraw their long range jungle patrols except for specialised units. The plan took some two years to implement - although it had the effect of reducing the terrorists to near starvation almost at once - and patrolling continued on a substantial scale throughout that period together with a number of larger coordinated operations.

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\*Flight Lieutenant K Fry, Flying Officer A Lee, Flight Lieutenant J R Dowling, with Flight Lieutenant A J Clarke in reserve with the Far East Communications Squadron.

The expression 'jungle fringes' should not be thought of in terms of European woodland. Almost every area not under cultivation in Malaya consists of either primary or secondary jungle, the former made up of continuous forest with an average tree height of 180 feet (roughly the height of Nelson's Column in Trafalgar Square, London), and the latter of extremely dense and often almost impenetrable undergrowth up to 60 feet deep. A patrol's rate of travel on foot varied greatly, depending on the nature of the surface and the general topography, but was generally found to be about three miles a day in primary jungle and 500-1,000 yards a day in secondary jungle, rates which might be reduced if there were casualties to be carried. For the RAF the restriction of operations to jungle fringes merely altered the distances to be flown. The problems of operating helicopters remained because, although the existence of roads near the scene of operations made it possible for the final operating base to be close by and fuel loads to be satisfactorily low, it in no way reduced the reliance placed by ground troops on helicopters if there were casualties to be removed. Nor did it reduce the problems faced by the ground forces in finding or making clearings large enough to allow helicopters of extremely limited power to descend or climb away among such tall obstructions.

#### Weather

The weather in Malaya is conditioned by the north-east monsoon in 'winter' months and the south-west monsoon in 'summer' months. Except on the east coast, which experiences strong on-shore winds during the north-east monsoon, there is little difference in seasonal weather or temperature throughout the year at the low levels used by helicopters. Winds have a generally small value at transit cruising heights of 2,000-3,000 feet and only very local and extremely variable effects at tree-top height. There was no wind at all where helicopters were confronted by their main problems, that is, at the bottom of clearings, although great care had to be taken to face into any slight wind there might be while entering or emerging from a clearing.

The main problems were low cloud, heavy rain and turbulence. There seemed to be no reliable pattern of weather, although low stratus, impenetrable because it mingled with the tree tops, could be expected for about three hours after dawn and also after the passage of heavy rain. Thunderstorms could be expected anywhere and nearly always over the hills, especially after midday, and turbulence was then at its worst. Heavy rain had to be avoided because of its effect on the rotor blades and because it restricted visibility; the Dragonfly was particularly bad in this respect because of its curved perspex surfaces and the impracticability of fitting them with wipers.

Turbulence produced control problems for the early helicopter pilot rather

than the bumps characteristic of fixed wing flight and was particularly unpleasant because of the limited control margins of the Dragonfly coupled with the often impractical provision for obtaining a satisfactory centre of gravity position. This is described below, as is also the reason why an aircraft on its way to lift a casualty normally had its C of G on the aft limits (see p 31 ). In this situation, in order to obtain a reasonable cruising speed of 60 knots, the stick was often held hard against its forward stops for up to 20 minutes at a time. As the effect of up currents is to increase both rotor and air speed, the nose up pitching and rapid throttle and pitch adjustments needed to regain control were particularly tiresome in turbulence. No-one on the unit was knowledgeable or experienced enough to realise the potentially dangerous effects of flying for such long periods on the limits of cyclic control, but it is difficult in retrospect to see what the alternative was. Disposable ballast in the cabin would have greatly increased the risk of vortex ring during the steepest descents, which were already often being done beyond the limits of control in terms of power.\*

Temperature and humidity conditions significant for helicopters were encountered at the bottom of jungle clearings and it was not necessary to

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\*Vortex ring is a phenomenon which may be experienced when the helicopter flight direction is at right angles to the plane of the rotor disc when the relative airflow is from below - for example, during a powered vertical descent in still air. If the downward flow of air produced by the rotor (induced flow) is balanced by the upward flow resulting from the rate of descent (relative flow), the result is reduced mass flow through the rotor disc and a vortex at its periphery. The effect is a very greatly increased rate of descent for a given engine power, coupled with a marked instability in aircraft attitude and therefore direction. The recovery consists of re-establishing air flow through the rotor disc. This may be either upwards air flow by reducing power and blade pitch (involving loss of height of several hundred feet) or by increasing the downward flow by a large increase in engine power or by establishing forward flight or by a combination of these two. So, if vortex ring is allowed to develop when a helicopter is in a confined space and already with maximum engine power applied, the resulting loss of control is not recoverable. When the descending helicopter gets close enough to the ground to experience ground cushion effect (below 50 feet) the vortex ring phenomenon disappears, but the ground effect may take some seconds to be established. An element of luck thus appears in whether or not the rate of descent is too great to allow the ground effect to decelerate the helicopter sufficiently to avoid damage before it makes contact. A further element of luck is involved in whether this point of inadvertent touchdown is suitable to allow the aircraft to remain upright.

measure them scientifically to realise that both were usually at higher values than those measured by the meteorological instruments at the nearest airfield. Attempts to do so showed that they were extremely variable in the jungle, but values of 100 degrees Fahrenheit and 100 per cent humidity had to be expected, that is 10-20 per cent higher than open space measurements. It is likely that this was one of the main reasons for the extraordinary underestimation of aircraft performance in preliminary calculations. Blade distortion due to damp and tropical rain had a variable effect which had been foreseen, at least in principle.

### Distribution of Bases

The main RAF bases in the Far East were all in Singapore Island; during the emergency in Malaya however Kuala Lumpur was the main centre of flying operations. In the later stages Butterworth assumed progressively more importance in the support role, but there were no other purely RAF flying bases in the Federation. The Dragonfly helicopters, based at Changi, had a cruising speed of 60-65 knots and an endurance of about three hours with a full fuel load. On transit flights it was prudent not to stray too far from recognised communication features - roads, railways or rivers - not only because a failure of the single engine would almost certainly be fatal if there was no space into which to attempt an engine off landing, but also for the more important reason that the irrecoverable loss of a virtually irreplaceable helicopter would have had a crippling effect on the ability of the unit to maintain a continuous standby to meet emergency calls, an essential feature of its usefulness and credibility in the eyes of the troops in the jungle. The helicopters were regarded as so valuable that until the expansion in 1953 flights across large areas of jungle were accompanied whenever possible by a fixed wing escort - usually an AOP Flight Auster.

In addition, the Dragonflies had no instrument flying capability, could not fly at night in this area, and had to avoid flying in heavy rain because of the risk of damage to the wooden-ribbed fabric-covered rotor blades. They carried only VHF radio and used 100 octane fuel. As a result of all this, operations more than 30 miles from Singapore had much of the character of an 'ad hoc' safari. All first line servicing equipment had to travel with the aircraft, including grease guns, engine oil, hydraulic fluid and an extremely bulky fuel filter, as well as sten guns and ammunition, and jungle survival kit. Refuelling had to be arranged by air drop (in four gallon disposable tins) wherever the helicopter found itself obliged to stop, the pilot using either Army or police radio or, if fortunately available, the civil telephone to make the demand. For most of the time these were the only channels for reporting progress or receiving new tasking.

In these circumstances the presence of the Auster flights of No 656 Air OP Squadron (RAF) on airstrips at Johore Bahru, Seremban, Taiping and Termerloh was of very great assistance. They did not store the 100 octane fuel needed by the helicopters and had no hangars or permanent servicing facilities, but they did have RAF ground crews and static, if not permanent, domestic accommodation. More important, they had Army pilots who were thoroughly trained as professional aviators and had an absolutely expert knowledge of their local area and what was going on within it. Best of all, they had the ground stations of the AOP M/F radio 'net' through which voice communication was possible between all the flights as well as with any Auster, whether airborne or not, throughout the Federation. They could also talk to the troops on the ground, which the helicopter could not do except when directly overhead using a walkie-talkie (Type 88) set.

There were additional ground stations on the AOP 'net' at Kuala Lumpur, where the AOP squadron headquarters and HQ Flight were based, and also at RAF Changi. The result was that if the helicopter pilot could get to an Auster flight or even to a strip which had an Auster on it at the time, he could speak both to his base at Changi and to his tasking authority at Kuala Lumpur, as required. This facility had important operational implications as will be readily apparent.

#### Tasking and Control

The helicopters belonging to the Far East Air Force were placed under the operational control of Air Headquarters Malaya based at Changi. By the time they arrived, however, operational control of air activity in the Federation was being exercised by the Advanced Air Headquarters established at Kuala Lumpur alongside the Army Headquarters, Malaya District, which directed all military operations connected with the emergency. Unfortunately, with the helicopters based at Changi on Singapore Island and therefore under the direct control of the main AHQ until they crossed the Johore Straits and entered the area controlled by the Advanced AHQ, the main AHQ represented a further link in the tasking chain and one which was not only superior to the Advanced AHQ operations staff who were processing tasks, but also completely divorced from the military staffs at Kuala Lumpur who were submitting bids.

This arrangement sometimes caused needless delays in warning the Casualty Evacuation Flight to prepare for action, the difficulty being that the steps to be taken varied greatly, depending on the distance involved, the numbers and types of casualty (walking, sitting, lying), whether immediate life or death considerations applied, enemy tactics, and especially what type of clearing existed or was in the course of preparation. As there was no way of de-

fuelling the Dragonfly short of dismantling part of the fuel system, the regular standby fuel load permitted one hour of flight only - this was necessary to enable tasks to be undertaken within 30 miles of Singapore.

Not only was tasking often delayed for these reasons, but also in the early months there was nearly always a shortage of detailed information of the kind described above, and no easy way in which the helicopter pilot could obtain by question and answer the facts which were vital to him but which often seemed of doubtful relevance to some or all of the links in the chain. Thus a very elementary problem in communication and tasking appeared in a highly critical form at the outset and it was purely fortuitous that the AOP radio 'net' had a terminal at Changi and that the set was located in the same building as the helicopter flight. It was discovered that all the detailed information the helicopter pilots needed could be obtained by an AOP Auster wherever the incident had occurred. It could then be passed directly to the pilot on standby at Changi who would also have the opportunity to finalise any further details connected with the transit arrangements and timings. In this way the pilots usually received prior warnings of tasks and frequently knew far more about the essential details than the tasking authorities themselves.

Later it became possible to feed this information directly into the tasking chain and Advanced AHQ Malaya learned to use AOP Austers as a vital reconnaissance element before accepting a helicopter task. The Auster pilots quickly became expert at assessing whether or not a clearing would prove acceptable to a helicopter pilot. If not, they could either advise the ground troops on what was needed to bring the clearing up to standard or instruct them how to move to a better position near by. The Auster pilot's judgement in these matters was entirely reliable and came to be trusted implicitly. During the time of the Casualty Evacuation Flight all the casualties whose lives depended on minimum delay in obtaining treatment were saved because of the preparations made by the Auster pilots while the helicopter was beating its laborious way to the scene. Once there, the helicopter pilot's task was further simplified because not only were the ground troops properly organised to receive the helicopter, but also the Auster was able to escort it to the site in an area often strange to the helicopter pilot but quite familiar to the Auster pilot. In this way vital time was saved and a waste of valuable helicopter hours avoided. As a communication link with the outside world the Auster was invaluable.

### Operating Techniques

In Malayan jungle conditions of temperature, humidity and a total absence of wind, it was found that the Dragonfly could not be expected to hover outside ground effect with more than 30 minutes' fuel (at cruising consumption rate)

and a payload of 200 lb, that is one passenger, and even then hovering could not be relied upon. For take-off in a jungle clearing with no approach or climb out path it would be necessary to climb vertically about 180 feet. Sometimes the Dragonfly would just manage this, but often it would not. Very small variations in temperature or humidity could occur and make all the difference between success and failure in a delicately balanced manoeuvre, but a more significant and even more unpredictable variable was distortion of the rotor blades due to heat, damp, weather and wear. Tropical rain on the rotor blades even when stationary was liable to accelerate a tendency for the fabric to lift away from the rib formers, and if this happened the blades were ruined; even a slight degree of distortion, too small to be detected visually, could have a very marked effect on rotor performance.

The troops themselves varied considerably in weight: the lightest Malay or Gurkha might be no more than half the weight of some of the others, the King's African Rifles or Fijians for example, and the average British soldier would be somewhere in between. It was also usual for a soldier being evacuated by helicopter to have his kit thrown in after him, but after one or two experiences in which the kitbag appeared to have been filled with pig iron, it became standard practice to refuse to carry any kit out of deep clearings - a procedure which the troops found very difficult to understand. Again, because of the risk of the engine not restarting from the aircraft's internal accumulator, it was never shut down in a clearing unless some special circumstance made this absolutely essential. The pilot was therefore unable to let go of the controls and still less to judge the weight of what was being loaded into the helicopter, other than by watching carefully the amount of physical effort which seemed to be employed in carrying it.\*

Control range was so limited that the aircraft's centre of gravity had to be adjusted for all significant weight changes in the cabin. Six  $17\frac{1}{2}$  lb lead weights were provided for this inconvenient procedure and stowages for them were constructed in the nose of the aircraft behind the instrument panel and near the base of the tail cone externally on either side. The two weights were to be moved from the front to the rear stowage for each passenger carried in the cabin, but to transfer these weights in a clearing with no crewman and the pilot unable to let go of the controls was usually out of the

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\*On one occasion when the pilot became suspicious of the weight of a sack which the troops were proposing to load, because of the way they were handling it, he insisted on inspecting the contents. He was shocked to find that it contained five or six severed heads - high priority freight for bandit identification, as it was impractical at that time to carry the bodies out complete.

question. In any case to carry all six weights would have left inadequate aircraft performance with a heavy passenger; the practice therefore was to carry two weights in the forward stowage, two on the floor under the stretcher carrier at the back of the cabin and none in the rear stowage, and so fly into the clearing with the C of G on the aft permissible limit. The aircraft then embarked one passenger and flew out with the C of G nearer to the forward permissible limit. On at least one occasion when the ground surface did not permit landing and loading was being carried out at the low hover - fortunately in a large and comparatively open area - a second soldier unexpectedly climbed into the hovering helicopter which immediately dashed off into forward flight. The pilot just succeeded in translating this inadvertent manoeuvre into a continuous steep turn while shouting for the baffled man to jump out.

As it was not the practice at that time to fit either torquemeters or blade pitch indicators, there was no accurate way of measuring engine performance without tying the aircraft to the ground, applying full take-off power and pitch, and observing the rotor speed achieved. This manoeuvre required a comparatively elaborate fixed facility which existed only at Changi. As the test did not reveal any loss of climbing power which might be due to blade deterioration, diagnosis of the cause of a vertical climb performance which seemed even worse than usual was often difficult.

To measure vertical climb performance an arbitrary standard of 200 feet per minute was decided upon for a payload of 200 lb and 30 minutes' fuel load - seemingly quite fast but in fact involving motion which is scarcely discernible except when near to fixed objects for comparison: it would, for example, take between 50 seconds and one minute to reach treetop height. It was also very important to detect any diminution in the rate of vertical climb out of clearings, because if the climb stopped before the aircraft could transfer to forward flight, there would be insufficient power to hover and the aircraft would start to sink. The circumstances would then be ideal for the onset of vortex ring and a very hard landing.\*

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\*An emergency procedure was developed for the Dragonfly for use if the aircraft climbing vertically was almost clear of the trees but showed signs of stopping the climb too soon to allow transition to forward flight. The collective pitch lever was raised slightly and the extra power to prevent consequent over-pitching obtained by reducing the tail rotor pitch to zero by application of half right rudder. This resulted in a small if temporary surge of lift which raised the aircraft about 20 feet while in an accelerating turn on the spot to the right. On reaching treetop height the aircraft was flung into forward flight in whatever direction it happened to be facing. This dangerous  
(continued on foot of next page)

As for practical purposes it had to be assumed that there would be insufficient power to hover outside ground effect, provision was needed for transition to forward flight at about 100 feet after acceleration to this height from within ground effect. It was also desirable - for reasons of visibility as well as performance and the avoidance of vortex ring - to be able to keep moving forward during the descent for landing until about 50 feet from the ground. Both these requirements could be met if there was a gap in the trees on one side of the clearing, and consequently the minimum requirement first put forward was a clearance area with surrounding obstructions forming a 45 degree slope in at least one direction, with a 30 degree slope preferred. When helicopters with better power margins became available, this requirement was retained to give added safety and better visibility during the descent. The ground clearance requirement consisted of a circle 30 yards in diameter cleared to ground level, with a further 10 yards all round with obstacles no higher than two feet. These requirements were rarely met in Malaya, but they became the standard criteria demanded for tactical helicopters for the next 25 years or more. The space required on the ground could be reduced if the angle of descent was more shallow, but there was no way of devising a formula for this which would be simple enough for ground troops to use to make their own adjustments. They had to do their best to meet the standard criteria and the helicopter pilot had then to assess the results and decide whether the task was acceptable or not.

The size of the clearing demanded was in fact a compromise between aircraft safety requirements and the difficulties involved in clearing areas of jungle. The ground troops would often find the requirements impossible to achieve and the pilot had always to guard against asking for too much. On the other hand, to accept a clearing which was too dangerous was to risk losing the aircraft and with it the chance of helping an unknown number of future casualties. Each new clearing had to be reassessed, and with special care when the casualty was dying. These considerations, together with the

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procedure had to be used in severe conditions when the ground troops were still unaware of the helicopter's limitations in vertical performance and the need for inclined approach and take-off paths. There was considerable argument subsequently as to the theoretical efficacy of this manoeuvre, but what was often not appreciated was that extra power was made available to the main rotor by thus unloading the tail rotor, and although this diminished in proportion with the rate of turn and consequent reduction in blade true air speed, an advantage, albeit diminishing, was obtained so long as the rate of turn was increasing. The early Dragonfly pilots were very conscious of this brief advantage on the occasions when the procedure had to be used.

strain of flying a manually controlled, single-engined helicopter over many miles of primary jungle imposed a high degree of stress on the helicopter pilots of this period.

#### OPERATIONS (5)

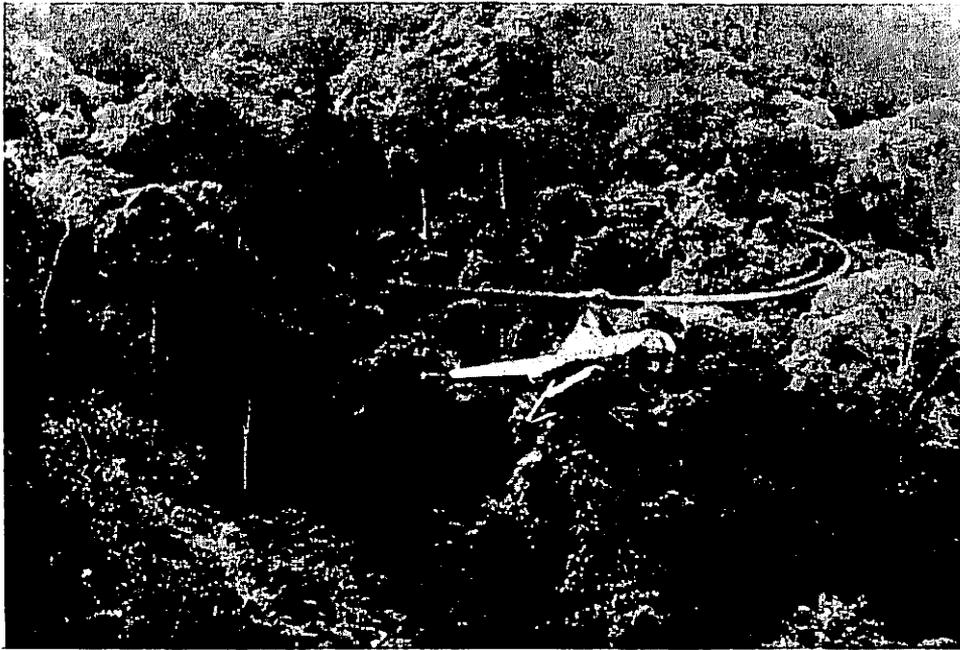
The FEAF Casualty Evacuation Flight formed officially on 1 May 1950 at Kuala Lumpur, although it was not to reside there for another two years. In addition to its three officers (pilots), it had thirteen airmen, with three NCOs from an Air Ministry Aircraft Servicing Development Party attached to assist with the assembly of the three crated Dragonfly HC 2s which had arrived by sea during April and also with the training of the servicing crews.

The aircraft were assembled and test flown at Seletar during April and May, the first helicopter flight in the colony of Singapore taking place on 22 April. The flight moved to its permanent base at Changi on 22 May and began operational trials immediately. It was not however thought practical to move the technical support away from Singapore at this early stage.

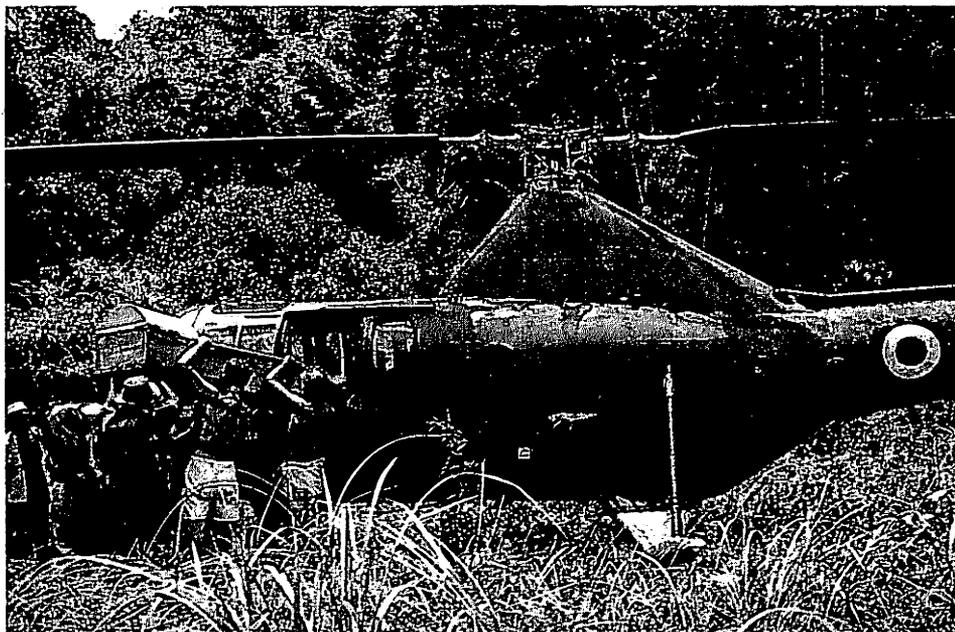
These operational trials lasted two months and were followed by the submission of reports and recommendations (though casualty operations did in fact start at once). After winching trials\* and stretcher pannier demonstrations in the breezy atmosphere of Changi a jungle clearing was made available by the Far East Land Forces (FARELF) Jungle School in south Johore and on 12 June a helicopter landed in a clearing for the first time. It became apparent immediately however that there was no possibility of carrying a stretcher pannier if the aircraft was to have a reasonable chance of negotiating jungle clearings in the operational areas. This conclusion was confirmed by one of the helicopter pilots who had gone up to Kuala Lumpur to carry out helicopter trials at 4,000 feet at Fraser's Hill, and

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\*The hydraulic hoists provided with the first three Dragonflies were installed in the ordinary course of assembling the aircraft, and successful trials were carried out at Changi. The performance of the Dragonfly in jungle conditions, however, precluded their use while hovering outside ground effect, and the occasions on which the hoist would have been useful when the aircraft was able to get within ground effect for hovering were soon judged to be so rare that the equipment had no practical role. Moreover, the weight penalty (110 lb) was found to be wholly unacceptable for jungle operations and the time taken to fit and remove the hoist precluded its use on an occasional basis. After a few weeks the Dragonfly hoist was discarded and never refitted.



*Top:* initial handling trials in Malaya in 1950. The Dragonfly HC 2 has a starboard external pannier fitted. The condensation in the tip vortice shows the high level of humidity. *Below:* initial handling trials in Malaya in 1950 - the external pannier for the Dragonfly HC 2 with a practice casualty.



*Top:* the Dragonfly basket stretcher, which replaced the external pannier, being used to load a casualty in north Malaya in 1952. *Below:* a casualty receiving medical attention in transit in the Dragonfly basket stretcher, Malaya 1950.

had then made a brief experimental sortie over the central mountain range to the AOP Auster strip at Temerloh.\*

There were in any case objections too from the medical authorities, who had at one stage practically ruled out the Dragonfly on account of its external stowage. Flying in the stretcher panniers was a terrifying experience: the patient was completely enclosed in a metal coffin-like structure, his vision restricted - through small perspex panels at the head - to the whirling rotor hub. There was also considerable vibration.

Consequently, one of the first tasks of the engineering officer who joined the unit in June 1950 was to help in the design of a stretcher and stretcher carrier which could be stowed internally without modifying the aircraft. This was quickly done and consisted of a lightweight platform (canvas on a metal frame) fitted to the cabin floor and door sill, projecting diagonally forward out of the door far enough to accommodate the foot of the stretcher. The latter was a coffin-shaped basket about 12 inches deep and able to accommodate virtually any combination of ad hoc splints and bandages. It was fixed to the platform with four quick-release spring-loaded pegs and cost an insignificant sum of money having been custom built by a basket furniture maker in Changi village. After approval in July 1950 this admirable arrangement was the only stretcher used in the Dragonfly throughout its service in the Far East.\*\*

In the first weeks the helicopter unit was engaged in discovering the capabilities of its aircraft, and also enjoying a formidable number of visits from important personages, civil and military. It was however only half way through the month of June when the first casualty evacuation call was

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\*The specification had asked for a helicopter to lift two casualties and a nursing attendant and fly for over an hour at 75 knots. In practice, the Dragonfly in Malaya, though designed to carry two patients in external panniers, could not carry even one with both panniers fitted, and flying with only one pannier produced control problems. With both panniers removed and the casualty carried as the sole passenger inside, it could only lift vertically from a jungle clearing with enough fuel for 30 minutes' flight at 60 knots.

\*\*The disadvantage was that the casualties were not wholly inside the aircraft, but this had to be accepted. On many occasions too, when the helicopter was unable to land because of the wetness or unevenness of the ground, the stretcher could not be loaded and the casualty had to be bundled in by any means. Even with severely injured patients this was clearly preferable to inevitable death in the jungle.

received. On 14 June 1950 a British soldier, shot in the foot during one of the frequent ambushes of the night train from Singapore to Kuala Lumpur, was brought to Changi by helicopter from the Auster strip at Segamat, which was waterlogged at the time, so inaugurating RAF helicopter operations a few weeks before the first American operational helicopter sorties in Korea. Five days later a Gurkha soldier with glandular fever became the first casualty to be lifted from a jungle clearing, and on 28 June 1950 a Malay constable with gunshot wounds in the thigh became the first casualty whose life can be said to have been saved by the helicopter when he was lifted from a village compound in south Johore direct to the British Military Hospital at Johore Bahru. At the end of June a fourth pilot arrived to replace the non-effective member of the trio.

This splendid start to helicopter operations in Malaya went some way towards convincing the very large number of sceptical observers that the helicopter might have to be taken seriously after all. It also had the effect of translating some of the existing enthusiasm into euphoria, particularly among the ground troops.

The distances covered in these operations were very short and the heights above sea level were negligible. Most important of all, no very small or very deep jungle clearing had yet been negotiated and no communications problems had occurred. In sum, anyone who believed that true VTOL flight in deep jungle was now well established had a great deal to learn in the following months.

In fact, there were three significant failures in the course of the very next month and no successes (apart from the stream of demonstrations given to important onlookers and the formal acceptance of the locally designed stretcher basket and platform). Of the three attempted casualty evacuations, the first could not be carried out because the clearing was far too small; the second involved a flight of over 350 miles only to find that the task involved operating on a cliff face and well outside the capabilities of the helicopter; and the third required a flight of nearly 400 miles before it was discovered that the call was a false alarm brought about by a misunderstanding due to communication difficulties. So many wasted flying hours could not be tolerated; the solution lay in the coordination of operations through and with the Auster flight of No 656 AOP Squadron.

In the following month a single long-range casualty evacuation marked a turning point in three respects. The patient was a Malay soldier with serious gunshot wounds received during a river ambush in Kelantan state

(corresponding in Malaya to the geographical position of Northumberland in England).\* A Dakota escort was provided for that part of the flight which lay east and north of Kuala Lumpur (corresponding to Birmingham). This was the last occasion on which such elaborate assistance was given, and in the event the Dakota pilot erroneously declared the landing site to be inadequate for the helicopter.

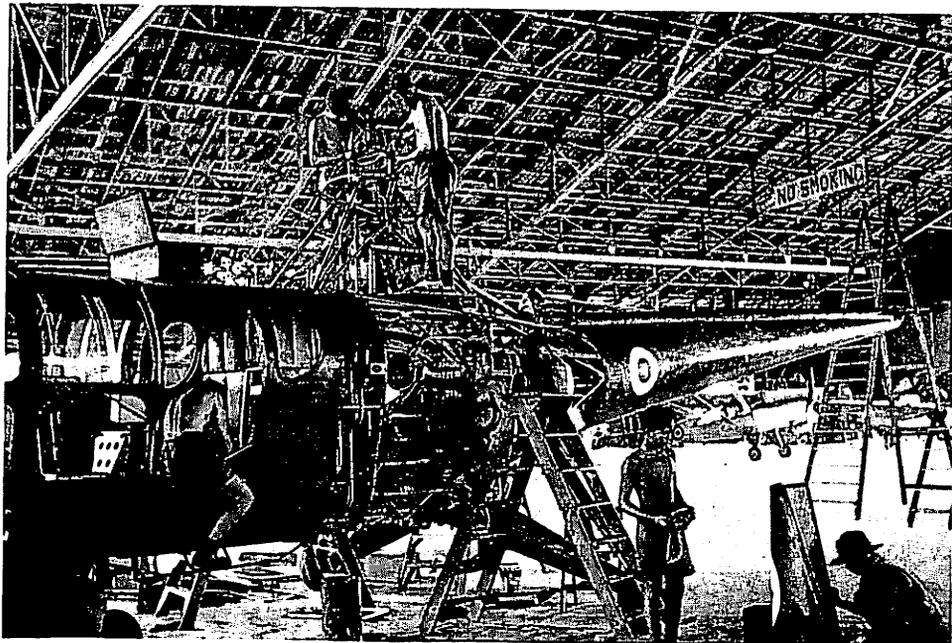
The new basket stretcher was now used for the first time and its value was immediately apparent. The patient's wounds had been very bulkily dressed and he was in great pain when moved; the basket however provided very satisfactory restraint. He was also apparently in extremis, resigned to death and with good reason as without the helicopter his situation would have been hopeless. Tended and encouraged by a second pilot in the aircraft he showed a dramatic recovery in spirits when the open rice fields and coconut trees near Kota Bharu (corresponding to Newcastle) came into view. Had he travelled in the external litter it is more than likely that he would have died from shock.

This was the last occasion on which two pilots were carried; the intention had been to provide both training and experience in unfamiliar territory, and also to relieve the strain of long hours of flying. The Mk II Dragonfly had manual controls and required an awkward hunched forward sitting position to operate them, always in the atmosphere of a tropical greenhouse. In addition, the pilot was busily engaged throughout the flight maintaining continuous control of the rotor RPM with the manual throttle. He had also another problem to face: the Dragonfly was provided with elastic cords in parallel with the control cables to counter steady control forces in one direction, and electric motors controlled by a switch on the cyclic stick (trimmer) to alter their tension as flight conditions varied the feedback loads. Unfortunately, the randomly varying control forces were of a magnitude which, when coupled with the vibration, made it difficult for any but quite experienced pilots to detect whether these electric motors were giving assistance or not.

As experience was gained, the pilots found that they began to match the three-hour endurance of the helicopter, but that it was usually necessary to lie down in the shade for 20 minutes afterwards. There were however other tasks to be carried out - refuelling the helicopter from four-gallon cans,

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\*To enable the relative positions of the places mentioned to be more easily appreciated they are compared with roughly corresponding places in England, where for example the Isle of Wight corresponds to Singapore, and the Scottish border to the Malay/Thai border.



*Top:* refuelling a Dragonfly in the rain from an air-dropped 'flimsy' petrol can in Malaya. *Below:* Dragonfly servicing at Changi (1950-53); an Auster Mk V of No 656 AOP Squadron is seen in the background.

greasing 20 or so points on the rotor hubs and transmission (after each five hours' flying), and removing or replacing all the gear which had to be carried but was taken out before setting off on the actual jungle lift. More urgent was the need to rectify, or at least diagnose, each technical defect as it became evident. For these tasks a qualified technician was needed, and so was born the helicopter crewman, a technician first and a pilot's assistant second. In place of a relief pilot, therefore, senior NCO aircraft fitters were carried, able to deal with both engine and airframe faults. Later, experienced corporal engine or airframe fitters were employed, who had learned enough of the others' duties to carry them out satisfactorily. This practice had yet to receive the formal approval of the engineering staffs, but it was dictated by common sense and operational necessity, and worked well.

There was no shortage of enthusiastic volunteers for the work - enthusiasm being an essential prerequisite - but although these men accepted most of the risks which were part of the aircrew task and all the discomforts of these particular duties, it proved impossible to find any way within Service regulations of providing an appropriate financial reward. Twenty years later the problem of obtaining a fully satisfactory helicopter crewman policy still remained, made worse by economic pressures.\*

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\*When purely search and rescue units (as opposed to transport support) were formed for operations in the coastal areas of the United Kingdom, the helicopter crewman task became so highly specialised that it clearly called for a full time aircrew category, and later when crewmen began to operate from the lower end of the winch cable they earned many flying awards for bravery. But in point of fact the first two helicopter crewmen awards were to technicians employed as support helicopter crewmen, Sergeant Bowman and Flight Sergeant Moss, the senior NCOs successively in charge of the Casualty Evacuation Flight servicing groundcrew. They were not formally described as crewmen as the role had no official existence until later and they had no official aircrew status. Both however did so much operational flying with the Casualty Evacuation Flight Dragonflies that they received the distinction as aircraft fitters of being awarded the AFM and DFM respectively at the end of their tours. The citations refer to them as 'crewmen technicians' and record the comparatively large amount of flying they carried out and the numerous operations in which they took part; stress is also laid on their courage and resourcefulness and on the fact that 'the risks were always apparent'.

## The Later Months of 1950

By the end of 1950 the unit was exceeding its planned flying task as a matter of course, so many and so varied were the demands upon it. In the course of a few days in December, for example, a single helicopter rescued a Chinese woman from near the Thai border; flew the AOC Malaya to Kallang (the Singapore civil airport), where it carried out a rescue demonstration, with its winch fitted for the occasion; and then was back near the Thai border again on the following day to evacuate a Malay soldier.

It was however the case of the Chinese woman which was most instructive. She had been found, one of a party of four bandits, suffering from malignant malaria and semi-starvation, and with ulcers and maggots between her toes. All four terrorists were naked, one was wounded but escaped, and two died of starvation; in all, a dramatic illustration of the effects of the food denial policy contained in the Briggs Plan, and of the contrast between life as usual in the controlled areas and the dire conditions outside them. It was also a contrast which the helicopter crews experienced at close quarters and in rapid succession.

The year 1950 closed with the Maria Hertogh riots in Singapore when hysterical and disorganised Muslim mobs roamed the streets. The city was rapidly placed under curfew and a helicopter loaded with tear gas grenades provided for police use. None of the grenades were in fact used because whenever the helicopter appeared all activity ceased and everyone stood still to stare up at it. Apart from this the helicopter's reconnaissance capability was of the utmost value; the only occasion on which a helicopter had appeared previously in this role was when a Hoverfly of No 1906 AOP Flight had been similarly employed in May of the same year during Communist rioting in Berlin.

By the end of the year, after six months of operations, the Casualty Evacuation Flight had evacuated 29 casualties, established new operational techniques, and enabled Air Headquarters to issue an operation order embodying the lessons learned so far in what amounted to standard operating procedures. Included was an official statement of the role of the AOP Flight Austers in reconnaissance and escort duties for the helicopters.

A gradual shift in role however was already becoming apparent. Casualty evacuation remained the primary function of the unit and had first priority throughout, but the enormous tactical potential of the helicopter was too obvious to be ignored. The Chinese woman terrorist mentioned above was certainly a casualty, but her evacuation by helicopter would have been required in any case for intelligence purposes. Again, when the helicopter

pilot arrived at the starting point for an evacuation he would quite commonly find a soldier waiting to be carried in to replace the one due to be brought out. In the light of subsequent developments, this can be seen as an embryonic form of tactical troop movement, while the spare batteries and radio replacements which were often carried on the outward flight were elementary resupply.

Flying the High Commissioner (Mr Malcolm Macdonald) between his residence in south Johore (Bukit Serene) and his office in Phoenix Park, Singapore was becoming a frequent task and anticipated the wide use of the helicopter by General Templer in Kuala Lumpur, General Harding in Cyprus and many others elsewhere, for reasons partly of speed but more especially of security. Again, in January 1951 the helicopter was called upon to assist a government sponsored party carrying out a survey for a possible road route between Kota Bharu (corresponding to Newcastle) and Grik (corresponding to Windermere) to be built out of American aid funds (Operation Noel).

The party had crossed the wild and mountainous, bandit-infested jungle which lay across the northern part of the country and emerged at the remote hamlet of Grik. It had failed however to complete the vital contour plotting owing to the failure of the party's barometer. To repair the omission on foot would have taken several months and considerable military support; the helicopter completed the task in an hour and a half by hovering at various points on the Perak river. In those circumstances it was hardly necessary to argue the propriety of using a casualty evacuation flight in such a role, and it also seemed sheer common sense for the crewman to spray the surrounding jungle with sten gun fire before the aircraft settled into the hover. The principle was thus established of arming the support helicopters with removable crewman-operated machine guns for prophylactic defensive fire - a tactic often used thereafter and reaffirmed, after much discussion, twenty years later for the Wessex and Puma force.

Grik was the scene of another incident one late afternoon a few weeks later when a policeman reported that he had just escaped being ambushed by four terrorists at a spot only three miles away on the road to Kroh. Ambushes late in the day were one of the bandits' favourite ploys as they were well aware of the comparatively long time which the security forces took to respond by surface travel and could usually count on no action being taken until the following morning. On this occasion however, although the helicopter pilot had completed his task for the day and was preparing to night stop, the opportunity was too good to miss. A soldier was seated in the doorway of the helicopter armed with a Bren gun and not more than ten minutes later the patch of secondary jungle where the terrorists were hiding was thoroughly sprayed at close range with two magazines of Bren.

This incident must be classed as a rapid reaction air strike, and although the follow up next day did not discover direct evidence of terrorist casualties, the speedy and aggressive response must have caused some urgent reappraisal of tactics. Such activity was not, however, accepted as an established role for the helicopter.

### The Next Two Years

In the following six months the Casualty Evacuation Flight, still with only three Dragonflys, continued to maintain its daily standby successfully and evacuated a further 42 casualties from positions throughout Malaya. It also added further roles to its repertoire: search and rescue in the case of a Brigand pilot who baled out after an air strike (he was unfortunately found dead) and crop spraying. A small area of grass (15 acres) specially maintained by Singapore Cold Storage for the only herd of dairy cows in the country had become infested by some type of insect, so threatening the city's only source of fresh milk. Rapid action was therefore required: a spray rig was locally designed, built and fitted, and the helicopter completed the task in under three hours.

By the middle of 1951 resettlement under the Briggs Plan was largely complete and regular troop activity could be restricted to the jungle fringes, deeper penetration being limited to special forays by the Malayan Scouts, a commando type force under Colonel Calvert which was later to become part of the Special Air Service Regiment (SAS). It was therefore the Malayan Scouts who began to absorb an increasing proportion of the helicopter effort, and after a brief lull for reorganisation in August activity rose once again to its previous level and then began to exceed it. There were special reasons too for this close association with the Malayan Scouts: they had a higher sickness rate because their patrols tended to last for several weeks; they suffered a number of accidental self-inflicted injuries because their techniques involved a great deal of work with explosives; and most important of all, they were now the troops most likely to meet the enemy in comparatively large numbers, as his jungle fringe activities tended to be conducted by very small parties.

Helicopter tasks however were now expanding beyond the capability of the three aircraft available. The Dragonflys were also becoming more difficult to maintain: not only were the rotor blades and electrical components in repeated conflict with the damp conditions, but the general spares provisioning also was inadequate. This last fault was due at least in part to the unit's origins. It had been described as experimental with no expectation that it would have to last for more than a year, and there were some who believed that its life span would be even shorter. Additionally, the sole reason for

acquiring the Dragonflies in the first place was to meet the needs of the Malayan Emergency and by late 1949 there was some hope that it would be over before the helicopters needed replacing.

In the Far East, however, it had become clear within six months of the unit's arrival that three helicopters would not be enough and in January 1951 Far East Air Force asked for two more. The Air Ministry agreed and duly raised the unit establishment - an action which unfortunately had no immediate result because the situation at home was, if anything, more difficult than before.

Then, in October 1951, after sixteen months without a major accident, the Casualty Evacuation Flight lost its first aircraft. The cause was almost certainly some sort of technical failure of engine or airframe, but this could not be established from the evidence because the aircraft fell back into the deep jungle clearing from which it was attempting to climb with a Gurkha casualty in the basket and was completely wrecked. Both pilot and passenger suffered only superficial injuries - a remarkable testimony to the basket stretcher design - and each was individually evacuated next day by another Dragonfly. It proved operationally impracticable to put an investigating team into the jungle at this point in the remote hope of determining the cause of the accident. Meanwhile the helicopter flight was reduced to two aircraft.

Simultaneously it began to suffer severely from a shortage of spares and the next three months were very lean. There followed however a sustained burst of activity in February and March 1952 during which the two remaining helicopters broke all previous records in flying hours and in the number of casualty evacuations, mainly in the course of two notable large-scale operations, one a planned support operation and the other the emergency rescue of a complete jungle patrol. Both attracted widespread interest and helped to crystallise the view that larger helicopters were needed to function in a tactical role. Some account of these operations from the helicopter pilot's viewpoint will serve to illustrate what took place in the course of many other similar operations at about that time.

The objective of Operation Helsby in February 1952 was the evacuation of the entire population of the remote Belum valley in the far north of Malaya. Lying very close to the Thai border, it is a wild and mountainous part of the country where the main ridges run north and south, and the only inhabitants are a handful of aborigines. The valley itself lies in the centre of this region and is in contrast to it, running east and west and possessing a flat floor. This was cultivated by a group of some 200 Patani Malays, who were almost totally cut off from the rest of the country, being visited by the district officer in Grik only every six months or so (his mode of travel on the two week

journey being at one time an elephant). Because of their remoteness and their position astride the bandit routes to and from the Thai border they were wholly under the domination of the terrorists and were obliged to grow rice for them - a further consequence of the food denial aspect of the Briggs Plan. That they were doing so was clear from photographic reconnaissance. Resettlement was therefore desirable and with it the destruction of existing crops.

The operation marked the first use of parachute troops (SAS) in Malaya, who were to mop up any terrorists caught in the valley and provide organisation and protection while the move was being supervised. It was not however a drop into primary jungle, a technique which was developed more fully later, although a few of the parachute troops ended up in the trees. For the helicopters it was ideal country because although the landing sites on the generally wet surface of the valley were small, vertical performance was scarcely needed; flight time from Grik was 45 minutes.

Between 8 February and 9 March 1952, 21 SAS casualties were evacuated to Grik and also 15 Patani Malays who for one reason or another were unable to join the difficult trek out of the valley on foot, shepherded by the SAS. Passengers in and out also included the district officer and his assistant, a medical officer, the colonel of the SAS and the GOC Malaya District. Obviously however the whole operation could have been carried out in the space of a few days with a smaller number of troops and no casualties if troop carrying helicopters had been available.

As it was, with only two Dragonflies in Malaya - the replacement for the one which had crashed in October had arrived but was not yet operational - neither aircraft could be allotted exclusively to Operation Helsby. Both had to dash to and fro to deal with other casualties elsewhere in Malaya and then return to Grik to run the shuttle service to the Belum valley carrying one or two passengers on each sortie.

At the same time as Operation Helsby another helicopter operation of equal significance was taking place. This however was unplanned. At the beginning of February a patrol of the Cameronians - seventeen men in all, including a civilian reporter, an Iban tracker and a terrorist who had surrendered, with a tracker dog - entered an area of primary jungle, mostly swamp, near Sungei Tinggi (corresponding to Stafford) not far from Kuala Lumpur. The patrol was expected to last for about three or four days. On 7 February they requested their first casualty evacuation, but the terrain was so appalling that their first attempt at making a suitable clearing was unsuccessful. On the following day after much effort the helicopter managed



A typical clearing cut in Malaya in 1952, used in this case for the evacuation of a complete patrol of the Cameronians (see pp 46, 48). A supply drop parachute is used as a marker and the platform from which the helicopter is loaded while hovering can be seen just above it.

with great difficulty to evacuate the casualty and rejoined the other aircraft at Grik for Operation Helsby. Three weeks later and still manoeuvring laboriously through the jungle swamp in pursuit of a party of terrorists, the patrol had two further casualties. On this occasion two unsuccessful attempts were made to reach them before the clearing was made adequate and the evacuation completed. The aircraft then returned once again to Grik.

At the beginning of March the patrol was still in the jungle and in dire straits because of the proximity of the enemy, and their own exhaustion and sickness. The swamp level too was rising. After careful consultation with the helicopter pilot the decision was taken to evacuate the whole party by helicopter, in spite of the awkward implications of having to do so one man at a time, and with only one helicopter and no reserve. It was also stipulated by the Army that if the operation took more than one day, not less than six men had to be left overnight.

As usual, the work of the reconnaissance Auster pilot had been excellent and when the helicopter joined him on the Auster strip at Sungei Tinggi the patrol had made a very deep and narrow, but satisfactorily elongated, clearing (about 70 yards long) with a platform at the deep end from which the soldiers could jump into the hovering helicopter, landing being out of the question on the surfaces available. The distance from the Auster strip was estimated at a three or four day march and a ten minute flight by Dragonfly. The Auster pilot had arranged tins of 100 octane fuel, enabling the helicopter to be refuelled after each 20 minute sortie, and also a supply of batteries in case the frequent engine starts which would be necessary proved too much for the aircraft's internal accumulator.

The helicopter was able to start the evacuation on the afternoon of 2 March and after successfully extracting six of the soldiers retired at last light to Kuala Lumpur. Early next morning, the usual low stratus cleared well, the helicopter remained serviceable and the lift was continued - a nerve wrecking experience for all concerned as the patrol was progressively reduced below a viable size. The dog handler obviously had to travel with his dog, but as he was the only one who could pick the animal up he had to throw it into the hovering helicopter before he could climb in himself. The last man in the clearing - the patrol commander, Lieutenant Cameron - stood on the platform with his radio strapped on his back, gun cocked in one hand and a grenade in the other, waiting hopefully for the helicopter to return. The task was completed by midday on 3 March and the helicopter then set off to Kampong Kuala Aur (corresponding to East Anglia) where a police casualty was evacuated that afternoon.

Operation Helsby and the Cameronian patrol evacuation took place shortly before the three Commanders-in-Chief in Singapore formulated and submitted their bids in mid 1952 for more helicopters, and for a larger type of aircraft able to carry troops for tactical deployments. Indeed, by the time that a trickle of new Dragonflys and pilots started to arrive in the later part of 1952, the pre-planned attendance of helicopters at the scene of major operations had become standard procedure.

Examples of the great development in helicopter activity are provided by the events of July and August 1952, when three major ground operations - Habitual, Pilchard and Hive - attracted pre-planned helicopter attendance and required a total of 40 casualty evacuations. Reconnaissance sorties were flown in searches for a crashed Dakota and a Hornet, mis-aimed bombs were plotted, an eye kept on enemy movements after air strikes, and area patrols mounted for Army commanders. It was also becoming possible to establish detachments specifically for these purposes, instead of operating the helicopters exclusively from Changi, and during this period temporary detachments were mounted at Kuantan (corresponding to Boston), Kuala Lumpur, Seremban (corresponding to Warwick) and Grik.

It was at about this time that preparations were being made for the next major development in the anti-terrorist campaign, the establishment of jungle forts. By now the terrorists had been effectively denied food and support from the populated areas and were relying more and more on the jungle dwelling aborigines, the Sakai. The plan therefore was to create permanent centres in the remote jungle areas where the Sakai could be persuaded to settle and where administrative and medical services could be provided; these centres could also act as bases from which military and eventually police authority could be extended over each area and its aborigine population. Helicopters were later to play a vital role in the establishment and maintenance of these jungle forts (it was only later that they acquired airstrips); in the meantime the Casualty Evacuation Flight contributed by providing (in mid 1952) transport and support for the reconnaissance parties responsible for siting the first of these vital new centres.

It was in November 1952 while engaged in this task that a helicopter crew first found itself under active attack on the ground. Senior Army and police officers had been flown into the site of the first fort (Fort Legap, corresponding to Huddersfield) for a tour of inspection when it was attacked by a sizeable force of terrorists. Pilot and passengers had to join the SAS troops in defensive positions to beat off the attack. The helicopter happily escaped damage and the take-off was made behind a hail of covering fire without waiting for the Auster escort which was due to arrive later.

In the previous month the first aircraft loss due to pilot error had occurred. One of the newly arrived pilots landed in a clearing where the troops had failed to prepare the landing point adequately. Being inexperienced the pilot placed too much reliance on their efforts and committed himself to a full landing. The ground collapsed under one wheel, the helicopter fell over and although no-one was badly hurt the aircraft was wrecked.

One further pointer to future activities was an experiment carried out by scientists in December 1952 employing the Dragonfly spray rig which had previously come to the rescue of Singapore's dairy pastures. The aim of the experiment was to test the feasibility of destroying the small hidden areas of cultivation on which the terrorists were becoming increasingly dependent in their attempts to obtain food supplies in the remote jungle areas. The results were very promising.

The last two months of 1952 and the first month of 1953 saw the beginning of the build up of the Casualty Evacuation Flight into No 194 (Helicopter) Squadron. Two Dragonfly Mk 4s were received, with metal blades and hydraulically assisted controls, and three new pilots appeared. A permanent detachment at Kuala Lumpur was established. But in the very last month of operation as a flight (January 1953) the first fatality occurred when one of the new aircraft flown by one of the new pilots, with a senior policeman and an Army officer on board, lost a rotor blade at 3,000 feet owing to a fracture in the rotor head. The aircraft fell to the ground disintegrating on the way; all aboard were killed.

The Casualty Evacuation Flight had been in existence for two years and four months, had evacuated 265 casualties, pioneered operational helicopter techniques in support of ground forces in the most difficult conditions of climate and terrain in the world, with grossly underpowered aircraft, and had experienced only one major accident due to pilot error - inexperience. The foundations for No 194 and later helicopter squadrons were thus well and truly laid.

#### DEVELOPMENTS IN WHITEHALL (6)

In June 1950 the helicopter proponents in the Royal Air Force had listed its military roles as casualty evacuation, AOP and seaward defence, but their arguments had been opposed on the grounds that its usefulness had not been demonstrated. A proposal to provide a VIP helicopter link between Northolt and the Air Ministry roof was also first put forward at about this time, but received no support partly because of the expense and partly because examination revealed that the Air Ministry roof could not easily be strengthened.

However, in August 1950 (that is, two months after helicopter operations had begun in Malaya) the Air Staff issued the first helicopter operational requirement - OR 280 - which foresaw the need for an air transportable helicopter with four seats (including that of the pilot), a speed of about 75 knots, a range of about 400 nautical miles, and the ability to hover at 5,000 feet outside ground effect. Its roles were to be primarily ambulance, with easy conversion to passenger and freight carrying, signal line laying and rescue duties. Three months later in November the Air Ministry pointed out to the Ministry of Supply that it was not enough merely to wait for civil developments in the helicopter field in the hope that something useful or easily adaptable to Service needs would appear, and strongly urged that research and development in this field be accelerated.

By the end of 1950 the two RAF helicopter units in the United Kingdom equipped with R-4s - No 1906 AOP Flight and the Air/Sea Warfare Development Unit (ASWDU) at Coastal Command - were arguing strongly for re-equipment with the Sycamore helicopter; the War Office however in its Land/Air Warfare Policy Statement No 9 concluded that two types were needed, one for AOP and one for light communications. The former requirement was aimed at the Sycamore, the latter at the Saunders Roe Skeeter. The Air Staff was not convinced by the arguments in favour of two types for these roles, but the replacement in due course of the Hoverflies in No 1906 AOP Flight and ASWDU by Sycamores was agreed, and ASWDU with its four Sycamores was seen as developing eventually into a SAR unit with 16 helicopters.

However FEAF's bid in early 1951 for two more helicopters for service in Malaya was to be met by Dragonflies and not Sycamores partly because of the technical difficulties of adding a second type to the hard pressed unit in Singapore and partly because the Sycamore was still not ready for operational use. (7) The problem was, also, that only Westland were producing Dragonflies and all were reserved for an Admiralty order which would take up to two years to complete at the expected rate of production of four a month; and what was obvious to the Air Ministry - that there was no alternative to the FEAF bid being met out of this Admiralty order - was by no means obvious to the Admiralty. Explanations therefore took most of 1951 and it was not until October that the Admiralty announced that the very earliest date for releasing the two Dragonflies from their programme would be April 1952. (8)

As October 1951 was also the month in which the FEAF Casualty Evacuation Flight lost its first aircraft, a stream of very urgent signals reached the Air Ministry from Singapore stressing the importance of an early delivery of the two Dragonflies approved at the beginning of the year and at the same time

arguing the case for a third aircraft which would bring the unit's establishment to six. In December the Admiralty agreed to release one Dragonfly and to explore the possibility of finding a second; their existing plans however were on no account to be interfered with. (9)

The promised Naval Dragonfly was transferred to FEAF by February 1952, thus restoring the Casualty Evacuation Flight to its original strength of three aircraft exactly one year after an establishment increase of two had been agreed. By now, however, FEAF's demands were becoming very insistent and in February 1952 a claim was put forward for straight priority over the Navy. Reference was made to that earlier occasion on which access to materials in short supply had been gained exclusively by one Service and to the conclusion of the ensuing Smuts Committee in 1917 that the formation of a unified air service was more economically efficient than separate air arms in the Army and the Royal Navy. FEAF argued that while the Navy was interested in establishing (inter alia) a rescue service for their carrier aircraft, lives were actually at stake in Malaya where there was demonstrably no alternative means of rescue. (10) The Air Ministry replied that FEAF's position was appreciated and that in addition to the three Dragonflies already in Singapore a fourth aircraft might be expected in March, a fifth in August and a sixth in September, with a seventh in March 1953 which would ultimately have to be returned to the Navy. (11)

Helicopters however had made their mark in Malaya and there was no going back. The Air Ministry's piecemeal approach was brushed aside and in May 1952 the Commanders-in-Chief in the Far East submitted a bid for a squadron of 12 helicopters immediately and for its establishment to rise to 18 in 1953 with six larger helicopters for tactical troop movements in addition. General Sir Gerald Templer, the newly appointed Governor of Malaya, added a footnote: the bid was undoubtedly justified but further examination was needed and the true requirement was likely to be of the order of 50 larger aircraft.\*

A reappraisal of the situation revealed that apart from comparatively large Naval holdings the available stock of Dragonflies could be counted in twos and threes. Westland production had turned out to be slightly higher than had been expected (five a month instead of four), but this increase was compensated for by the somewhat embarrassing fact that sales had been arranged in small quantities to France, Belgium, Egypt and Yugoslavia and an Iraqi bid

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\*He had succeeded Sir Henry Gurney, who had been murdered in a terrorist ambush on the road from Kuala Lumpur to Fraser's Hill, and had assumed the dual role of Governor and Director of Operations.

was receiving favourable consideration. (12) Any interference with these sales was generally opposed by the Foreign Office; however, in most cases the aircraft were either powered by American Pratt and Whitney engines or prepared to a standard which made them unsuitable for Malaya. The fundamental problems with the Dragonfly remained the slow production rate and the fact that to increase it would require capital investment out of the defence budget - a quite unacceptable proposal at that time. The Chiefs of Staff therefore decided that Naval priorities would have to be adjusted so as to release the required number of Dragonflies for Malaya.

This was however by no means the end of the helicopter problem. All the first Whirlwinds had been ordered for the Navy programme and even if they were diverted to the RAF there was no hope of their being ready in time to meet the Malayan requirement in 1952-53. Further, the only source of larger helicopters was the United States and attempts to obtain the American S-55 under the provisions of the US Aid Programme became bogged down in legal difficulties (for example, the status of Malaya as a colonial dependency). The alternative was to start the Naval build up with a squadron of American S-55s supplied as part of the NATO defence forces and - in response to pressure from General Templer for the provision of tactical troop lift helicopters in Malaya - to divert this squadron temporarily to the Far East until it could be replaced by Whirlwinds diverted to the RAF. American agreement was obtained in October.\* (13)

The stage was thus prepared in the middle of 1952 for a steady build up of Dragonflies to a planned squadron strength of 12 by the end of the year and 18 in 1953, and for the addition of a squadron of Naval S-55s in 1953, to be replaced in due course by RAF Whirlwinds.

While Malayan requirements were being met, the broader issues were not neglected. In March 1951 the Army made the first of many bids for a helicopter lift of 10,000 lb payload and requested the formation of a development unit of three Bristol 173s. By itself, this expensive proposal found little favour, but when a few months later the Naval and Air Staffs jointly put forward a bid for a helicopter in the maritime role with much the same performance as the Bristol 173, the idea seemed more attractive. There was also a British European Airways requirement for a 30/40 seat helicopter with a 10,000 lb payload and a radius of action of 150 nautical miles.

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\*As the squadron was officially part of the NATO anti-submarine force it was considered necessary for the Navy to operate the S-55s while they were in Malaya.

Towards the end of 1951 the general feeling in the Air Staff was that helicopters had reached the same stage as fixed wing aircraft in 1910: there were definite uses for them, but insufficient experience to determine precise roles and therefore to define proper operational requirements. It was considered, however, that the achievements of the Casualty Evacuation Flight in Malaya, together with Naval experience in the sea rescue role, justified in principle proceeding with the projected SAR unit for Coastal Command.

The belief that the helicopter had a role to play was confirmed by American experience in Korea and in 1951 an official American report stated that the versatility of the helicopter as an instrument of war had received formal recognition in the United States. Indeed in 1950, before Korea, the United States had 105 helicopters on order; by the end of 1951 this figure had risen to 2,085. (14)

In January 1952 British Service bids for helicopters included, in addition to Malayan requirements, 16 Whirlwinds or Sycamores for SAR (including a bid by Fighter Command); 4 Dragonflies and 4 Whirlwinds for No 1903 AOP Flight in Korea; 3 Sycamores, 3 Skeeters and 3 Whirlwinds for a flying training squadron; 4 Sycamores and 2 Whirlwinds for Transport Command; 3 Whirlwinds for technical spares delivery; and 4 Bristol 173s for the maritime/army heavy lift requirements. There was also a bid for 20 helicopters for civil defence in time of war. (15) These extravagant and consequently (with the exception of the SAR role) unsuccessful proposals serve to indicate the swing of opinion in the first 18 months after the Casualty Evacuation Flight was established.

In June 1952 the Air Council approved a general transport squadron with an establishment of 18 S-51s and 6 S-55s for use in Malaya while the emergency lasted, and also approved in principle SAR flights for Fighter and Coastal Commands with 4 S-51s and 4 S-55s respectively, and 3 Bristol 171 twin rotor, twin engined helicopters for evaluation. Further orders were to await the results of the expected defence review. (16)

## PHASE 2

1953-60

### INTRODUCTION

The second phase of RAF helicopter development stretches from 1953 to 1960, but excludes the turbine engined helicopter units which were introduced shortly before the end of the period. They belong to the start of Phase 3.

It was during this second phase that the helicopter became a useful aircraft in widespread demand and several operational helicopter units were born in various parts of the world. The period begins with the formation of helicopter squadrons in Malaya immediately after Phase 1 and in the Malayan context continues until the end of the emergency there. Overseas units were formed in the Mediterranean and Aden areas as well as Christmas Island under the Far East Air Force. In Europe helicopter units were formed at Sylt and in Northern Ireland, while elsewhere in the United Kingdom Search and Rescue squadrons, the Central Flying School helicopter unit and the Joint Experimental Helicopter Unit came into being in the course of this second phase. Helicopter sections were introduced into The Queen's Flight and the Metropolitan Communications Squadron. The helicopter types involved during this period were the Sycamore Mk 14, the Skeeter and the Whirlwind Mks 2 and 4.

## CHAPTER 3

### THE MALAYAN EMERGENCY II

The turning point in the development of the tactical helicopter had been reached in principle in 1952 in Malaya, coincidentally with the much more ambitious American operations in Korea. The impetus in the British case came from the High Commissioner and Director of Operations in Malaya, Sir Gerald Templer, and the beginning of 1953 saw this initiative coming to fruition.

The Mk 2 Dragonflys were now being rapidly replaced by the metal bladed Mk 4s with hydraulic power assisted controls. Payload was not increased because the aircraft was now heavier, but the overall performance and consequently the safety margins were improved and, more important, were more accurately predictable. The power assisted controls allowed a much greater degree of precision in control movements and so of efficiency, and reduced the physical strain involved.

The three original Casualty Evacuation Flight pilots (Flight Lieutenants K Fry, A J Lee and J R Dowling) were tour expired at the end of 1952, but Flight Lieutenant Dowling was retained for a further nine months (partly to carry out operational trials on the Sycamore) and he, together with the three newcomers who had joined the unit during 1952 (Flight Lieutenants A J Clarke and G L Jacques, and Master Pilot Cox), continued to meet the operational tasks by means of a detachment at Kuala Lumpur, and provided training for the new No 194 Squadron forming at Sembawang in Singapore under the command of Squadron Leader D R G Henderson. At the outset the squadron had six Dragonflys against an establishment of twelve, but by the end of April 1953 its strength had risen to 11. (1)

In the meantime No 848 Squadron (Royal Navy) with ten American built S-55s had arrived at Sembawang in HMS PERSEUS on 8 January 1953 under the command of Lieutenant Commander Suthers, who had provided the training facilities for two of the Casualty Evacuation Flight pilots in 1950, a coincidence which made the introduction of the Naval squadron to helicopter operations in Malaya comparatively easy. Nos 848 and 194 Squadrons jointly formed the operational strength of No 303 Wing (Wing Commander W R Williams), which was established at Sembawang on 2 February 1953 with operational control of both squadrons, and administrative and training control of No 194 Squadron. Administrative services for the RAF squadron were provided during this period by RAF Tengah, and for the Naval squadron by RNAS Sembawang. (2)

The policy directive for No 194 Squadron listed its roles as follows:

- a. the tactical movement of troops, including the reinforcement of outposts;
- b. tactical reconnaissance;
- c. casualty evacuation from forward areas;
- d. search and rescue.

The relegation of the casualty evacuation role to third place did not represent a diminution of its importance: on the contrary, it was now possible to keep two aircraft at one hour readiness for this task instead of only one. What it did mean was that the tactical roles were now formally stated instead of being a departure from standard behaviour requiring special authorisation.

The new pilots on No 194 Squadron needed a considerable amount of training because the arrangements for their conversion and training at home had been less than satisfactory.\* With insufficient knowledge of helicopters and the pilot training required, the Air Ministry had been obliged to accept a pilot conversion course at Westland which specified little more than that it should include 50 hours flying (the generally accepted figure at that time). The pressure on the one and only test pilot originally entrusted with the training task at Westland had resulted in a very variable product. All the pilots arriving in Singapore had 50 hours training recorded, but in fact some had only six or seven hours dual instruction and one only just over four. (3)

The Naval squadron however was in the happy position of arriving as a fully manned unit in full flying practice (it had even had the opportunity to make a number of training flights from the carrier while on passage from the United Kingdom) and with a full complement of serviceable aircraft. All it needed was theatre conversion training, which would give it an introduction to the geography of the country and the manner in which operations were conducted. As with the RAF pilots this theatre familiarisation was carried out mainly by means of individual attachments lasting one or two weeks with the ubiquitous and ever helpful Auster flights of No 656 AOP Squadron. Performance trials were carried out immediately and established that the S-55s could carry five fully armed troops to large cleared spaces. They could also operate to small clearings, prepared to the same standards as for the Dragonfly, with four

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\*See below p. 104.

armed troops, but their cruising speed was no better than the Dragonfly's (about 60-65 knots). For casualty evacuation the S-55 could carry three stretcher cases and two walking patients; the aircraft was fitted with a winch and had a cargo hook underneath which was able to carry netted loads of up to 800 lb. (4)

For tactical troop deployments as opposed to casualty evacuation, it was clearly necessary to deplane troops from the hover in places where there was no one to prepare a landing site, a practice later known as 'roping'. True to tradition the Navy experimented with scrambling nets for this purpose, but these were swiftly abandoned - a soldier equipped for landing in an operational environment consists almost entirely of protuberances, some blunt and some extremely sharp. Contact with the scrambling net therefore produced a series of hopeless entanglements and the alternative of providing a thick rope knotted at intervals became standard practice.

In the event, the S-55s of No 848 Squadron had already carried out a triple casualty evacuation at Kuala Pilah (5) a week before the formation of No 303 Wing, and then in February were able to proceed immediately with transport operations, including 17 casualty evacuations and two tactical trooplifts, the second one of which was significant enough to be described in some detail. (6)

A Dragonfly pilot from the No 194 Squadron detachment at Kuala Lumpur had been briefed on 15 February to carry out a reconnaissance near Port Swettenham in the delta of the Klang river, an area of low lying wet land with much mangrove swamp. Near the seaward end of a long spit of cultivated ground surrounded on three sides by water or mangrove swamp was a small hut believed to be the home of Siew Hoong, the terrorist district committee chairman for the Pun district of West Selangor. All previous attempts to raid this hut had been abortive, because news of the entry of security forces at the landward end of the peninsula was easily transmitted to the terrorists at the other end. On this occasion however the intention was to approach overnight by sampan along the river and the purpose of the reconnaissance was to identify at surface level the entrance of the particular creek running from the river through the mangrove to the edge of the cultivated area near the hut. It was hoped that a dawn assault by boat from the end of this creek would achieve the necessary surprise.

The Dragonfly pilot however thought this a desperate plan and recognised the situation as one ideally suited to a troop assault using the S-55s. With his helicopter he called personally that same day at his own headquarters and that of the Army unit concerned to obtain agreement to this novel procedure. As further reconnaissance might mean the loss of surprise it was decided that the Dragonfly, flown by the same pilot, would lead three S-55s each with four soldiers.

They would fly at very low level down the river and along the creek to surround the hut at first light and within 30 seconds of the aircraft becoming audible to the inhabitants. The Dragonfly, with an armed soldier in the doorway, would be able to prevent anyone leaving the hut while the troops were deplaning for the assault. The operation was codenamed Wellington II.

The troops employed on this operation were mostly national servicemen, none of whom had ever been in a helicopter before. However, half an hour's troop training was carried out with the S-55s together with a brief practice formation sortie with the Dragonfly. It was found that the maximum speed which allowed the S-55s to keep up with their leader while manoeuvring was 50 knots. The operation was to be mounted at dawn on 16 February 1953.

The intention was to take off as soon as the horizon became visible (just before dawn), but at the moment of take-off it was discovered that the cockpit lighting had been removed from the Dragonfly concerned and not replaced - Dragonflies were not used for night flying in the Far East theatre. Consequently, the pilot could not see the all important rotor rev counter and an anxious 15 minutes passed before he had enough light to do so. After that however the operation went exactly as planned. Contact was made on VHF with the ground liaison officer (GLO) who had positioned his vehicle at Port Swettenham, and height was reduced to just above ground level (20 feet). Landmarks were followed without much difficulty, the formation being half way between line astern (to allow the Dragonfly to make rapid turns) and echelon (to avoid flying in one another's slipstream, all being at the same height). At the final landmark before the last straight run into the target, the S-55s were brought to line abreast and the order to break was given a moment later as the target came into sight. The four aircraft reached their hovering positions without difficulty and the troops were all disembarked within 30 seconds of the target coming into view. The S-55s then withdrew and landed alongside the GLO at Port Swettenham, where reinforcements were waiting in case they were needed.

The Dragonfly meanwhile was in a commanding position next to the target, hovering above the ground troops' field of fire with its gun trained on the doorway of the hut at a range of about 30 yards. As soon as the troops entered the hut, the Dragonfly landed and disembarked its armed passenger who now acted as liaison officer with the ground forces. The solitary occupant of the hut was captured without a shot being fired (not however Siew Hoong, as had been hoped), the S-55s were recalled to embark the troops and their prisoner, and everyone was back at their bases in time for breakfast. (7)

For the aircrews there were two lessons: it was unwise to discard cockpit lighting (or any other role equipment) merely because there was no formal intention to employ the aircraft in the role for which that equipment had been provided; and in the case of the S-55 the pilot needed a better method of signalling the troops to deplane than stamping his foot on the floor! The paratroop light signalling system subsequently adopted was an obvious requirement. It was also clear that troops could be taught to use the helicopter with only a very short period of training. (8) Further, the employment of a pathfinder helicopter with a fire capability had anticipated by some 20 years the procedure which the American forces developed independently and used in a more advanced form in Vietnam.

Indeed, Wellington II had a profound effect on operational planners and ground troops alike. Although it was appreciated that the target was altogether exceptional in the Malayan theatre, the scenes of most operations being able to accommodate only one helicopter at a time, the tactical troop movements which the S-55 made possible had been dramatically demonstrated within a few weeks of the unit's arrival. This new capability was accordingly exploited without further delay and by the end of 1953 the S-55s had carried 12,000 troops. (9) Paratroop trials using dummies were also initiated with the S-55s during February; the results were encouraging and the trials were satisfactorily completed by July. (10)

Troop carrying operations by the S-55s immediately revealed that there were certain basic considerations to be taken into account. First, the number of aircraft which could be employed was found to be limited by the size of both the delivery point and the departure area. Operation Commodore in May 1953, for example, was a maximum effort and eight S-55s were used, with the result that not only did the aircraft completely fill the Auster strip which was being used as the loading area, but flying hours were wasted in queueing at the delivery end of the shuttle because there was room for only one aircraft to land at a time. The conclusion was that it would have been more efficient to have used half the number of aircraft with a relief pilot in each. (11)

Second, where more than one landing site was being used a locally based controller was needed to direct each element of the lift to its correct destination. The first answer was to use a Dragonfly as an airborne command post or air coordinator, but as a ground controller was also needed with a VHF radio and direct contact with the unit being lifted, the air coordinator was later dispensed with and the despatch of a ground based operations controller from RAF Kuala Lumpur became standard practice. (12) From these control teams and the parallel units developed to support airborne

operations by fixed wing aircraft sprang the Mobile Air Operations Teams (MAOTS) which were later established in all three Services.

The third consideration was the training of the troops involved. In Malaya rehearsals with troops and helicopters were at first carried out automatically, but the very severe competition for helicopter flying hours led to this practice being questioned and may have unduly influenced the decision that, although no crewmen were carried in the aircraft and a very high proportion of the troops concerned were quite unused to any form of flying and many spoke no English, rehearsals were unnecessary, although desirable, and that a comprehensive briefing would be adequate. (13)

Problems of low level navigation and the identification of the correct landing zone (LZ) without the appropriate navigation equipment would be solved, so it was hoped, by using coloured smoke marking and fluorescent identification panels. The use of both did in fact become a standard procedure, but the practice of relying on a Dragonfly to provide a pathfinder and initial prophylactic strike service had to be abandoned after a few operations as far too wasteful and often impossible to arrange. Austers provided any smoke marking required and Brigands, and later Hornets, carried out precautionary air strikes when appropriate. (14)

Meanwhile, during the build up period in early 1953 No 194 Squadron was facing two major problems: a heavy pilot training commitment, as explained above, and an acute shortage of aircraft. After the fatal rotor head failure in January 1953 all the Dragonflies had been grounded and were released only after Magnaflux crack detection of the rotor hubs, a time consuming procedure which had to be repeated after every 100 flying hours (reduced to 50 hours when two hubs were found to be cracked). (15) Only with the arrival - more than six months later - of rotor hubs in which the spider arm threads were milled instead of cut (the eventual solution to the problem) was this requirement withdrawn. Consequently, for the first few months of 1953 the squadron's entire operational effort was provided by the small detachment at Kuala Lumpur, while the S-55s carried out that part of the task, mainly casualty evacuation, which the Dragonflies could not meet. The Sycamore at Kuala Lumpur, still undergoing trials, was also a considerable help in fulfilling operational tasks.

No 303 Wing at Sembawang therefore was fully stretched in providing enough serviceable Dragonflies to maintain both the detachment at Kuala Lumpur and the pilot training programme. Its difficulties were made worse by an organisational structure which was untidy in the extreme. Much of the Dragonfly second line servicing was carried out at Changi; the squadron headquarters was located at RNAS Sembawang; administrative services were

provided by Tengah; tasking was in the hands of the Advanced Air Headquarters at Kuala Lumpur. To remedy this, No 303 Wing proposed that all these functions should be centred on Kuala Lumpur, although the technical, office and domestic accommodation required there was not yet ready. Accordingly, both the wing and No 194 Squadron moved their headquarters to Kuala Lumpur on 1 May 1953, and the squadron's second line servicing followed two months later.

With RAF Kuala Lumpur, until then little more than a forward operating base under a wing commander, now in the process of becoming a full RAF station, it was natural and automatic for No 303 Wing to become the station flying wing, and for the second line servicing, along with the squadron engineering officer, to become part of the technical wing.\* (16) A further organisational change was made in February 1954 when No 303 Wing was disbanded as a separate unit and Air Headquarters Malaya moved from Singapore to Kuala Lumpur.

By the end of 1953 the Malayan Emergency was moving into its decisive phase. With the terrorists driven back into the jungle and away from the populated areas, the helicopter and its qualities of mobility and flexibility could be exploited to counter the enemy's natural advantage of inaccessibility and security from surprise. This was done in three ways: troop deployment and redeployment in the course of offensive patrol operations in selected areas; siting and supplying the jungle forts until airstrips had been built to take the Austers and Pioneers; and, following the experiments made at the end of 1952, locating the clearings which the terrorists were cultivating and destroying their crops with defoliant spray.

These crop spraying operations by helicopter began in August 1953 using the spray rig developed two years previously to spray the Singapore dairy herd grasslands. The chemical eventually chosen was a mixture of trioxine and diesolene - anything with a high toxic effect on human or animal life was avoided - carried, in the case of the Dragonfly, in a 40-gallon Hastings

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\*In view of later arguments about the respective merits of centralised as opposed to autonomous squadron-controlled servicing for helicopter units, it is important to note this early decision to centralise second line servicing and to observe that it was accepted without challenge; it made little difference at a time when No 194 Squadron was the only operational squadron fully based on the station (Naval second line servicing remained at Sembawang). The transfer of first line servicing to the technical wing was regarded as quite inappropriate and was never seriously considered.

engine oil tank fitted with an electric pump which fed the mixture into the spray boom, mounted athwartships, through which it was discharged at the rate of ten gallons a minute by means of metered nozzles. (17) A similar arrangement was devised for the S-55.

The location of the clearings to be sprayed was plotted by the AOP Austers and when a suitable group was found a spraying operation was mounted, the Auster pilot identifying the target and directing the helicopter accordingly. The technique was for the latter to fly at about treetop height (200-350 feet) at between 0 and 30 knots, according to terrain and altitude, and to traverse the clearing as often as necessary to cover it, with the crewman directing the pilot and at the same time controlling the electric pump which delivered the fluid. As the helicopters were operating over territory with no friendly troops below and sometimes obviously occupied by the enemy, these highly vulnerable spray runs were preceded by strafing air strikes which were normally carried out by a pair of Hornets. Their effectiveness could be measured by the fact that no helicopter was known to have been subjected to enemy fire while spraying. The effect of the chemical spray was to kill all vegetation and make the ground unusable for cultivation for some weeks.

Most of these spray operations took place in late 1953 and early 1954; they were codenamed Cyclone and numbered 1 to 5. (18) The AOP Austers filled the dual role of reconnaissance and providing smoke marking for the locations where the Hornet rocket and bomb strikes were required, and on at least one occasion this procedure was specially called for by a Dragonfly pilot who had seen four figures in the clearing he was about to spray. A Hornet strike was provided two minutes later. These spray operations lasted for three or four days and up to 20 clearings could be dealt with each day.

The Dragonfly proved to be quite a satisfactory vehicle for these tasks and after the first operation the S-55s were reserved for the trooping role which had a higher priority. (19) The shortage of helicopters in early 1954 put an end to crop spraying for a time and apart from a few Whirlwind sorties later that year, the technique was abandoned as the requirement diminished. The value of spraying operations had been proved, but by early 1955 the tide had irrevocably turned in Malaya. The establishment of the jungle forts had ended the inaccessibility of the remote jungle areas and at the same time provided the jungle dwelling Sakai with very welcome protection from terrorist demands. It was still vital, however, both to maintain the advances so far achieved and to keep up the pressure on the terrorists by mounting jungle sweeps by the military to make their position ultimately untenable. In both these aspects of the anti-terrorist campaign the helicopter had an essential role to play.

## TYPES OF RAF HELICOPTER USED IN THE MALAYAN EMERGENCY

The further development of the helicopter role in Malaya in the 1950s depended on the introduction of the Sycamore to replace the Dragonfly and of the Whirlwind Mk 4 to replace the S-55 from which it was derived.

### Introduction of the Sycamore Mk 14 in Malaya

What follows is an account of the Sycamore's first appearance in Malaya and of the experiences which dictated its final Service form, and its relationship to the Dragonfly for which it was the proposed replacement.

A comparison of the Sycamore with the Dragonfly in 1949 when it was first proposed to set up a Casualty Evacuation Flight showed little to choose between the two aircraft. The Sycamore was ruled out at the time for two reasons: it was not yet available and the low sweep of its main rotor was thought to be a disadvantage in jungle clearings. In addition the medical authorities were at that time dissatisfied with the athwartships stowage for casualties. In late 1952 when much more was known about the Sycamore and plans were being made to introduce it in the SAR role, the Vice Chief of the Air Staff came to the conclusion that the Sycamore was likely to be a great improvement on the Dragonfly and that if tropical trials confirmed current opinion, FEAF's doubts would disappear. (20) It was therefore arranged that as soon as the Sycamore Mk 10 at AAEE Boscombe Down had completed its trials there it would go to the Far East for tropical trials, still under the aegis of Boscombe Down, after which it would be handed over to FEAF for operational assessment.

The Sycamore was delivered to Singapore in a Bristol Freighter belonging to the Bristol Aeroplane Company in early 1953 and the Boscombe Down team then got down to work. Servicing was carried out by a small team advised by one of the manufacturers' representatives, David Vicary, who was accompanied by an enthusiastic member of their sales department, Alex Langfield. The helicopter pilots from the Casualty Evacuation Flight, who now formed the nucleus of No 194 Squadron and were acutely conscious of the marked difference in aircraft performance between flight into jungle clearings and over open airfields, watched the conduct of these trials with considerable surprise. Vertical climbs without airspeed were measured in light wind conditions by climbing to 2,000 feet while forming on a land rover driving down wind along the runway at the same speed as the wind under the direction of an observer with a hand held anemometer. The squadron pilots knew well that the dramatic effects on the rotor of the lightest wind, when at the limits of power, could be clearly seen against a background of trees but would scarcely register on the instruments normally available for

this kind of test flying. As the days went by surprise became tinged with impatience as the squadron pilots awaited their chance to fly this new aircraft and discover what it could really do: how many passengers could it lift from a clearing and at what height? (21) After a week or so the Boscombe Down team became dissatisfied with the irregularity of their results and transferred the trials to Kuala Lumpur in case more representative conditions could be found there. Consistent readings, however, were still not obtained and after another two or three weeks it was found that the wooden rotor blades, already far from new when the aircraft arrived, had suffered severe deterioration owing to the climatic conditions. Such defects as the swelling of the wooden members, the failure of glue joints and perhaps most damaging to morale dry rot had appeared and could be remedied only at Bristol. (22) Any further delay to the Boscombe Down team, however, was unacceptable both to them and to FEAF, and they returned home in mid March.

Fortunately the blade deterioration had not occurred before the squadron pilot who was to carry out the operational trials (Flight Lieutenant J R Dowling) had been converted to type. In this instance, conversion to type consisted of two hours' dual to first solo, one and a half hours' running landings and engine-off landings, and half an hour's night flying. In retrospect this allowance would seem hardly enough but in these particular circumstances it had to suffice.

The set of replacement blades arrived a month later and operational trials began at once. The new blades were in fine condition at the outset and this was thought to be the reason why no noticeable deterioration had occurred by the time the trials ended three months later in June 1953. (23) The original blade problem was thus submerged and no recognisable indication was present of the trouble which was to follow much later. In the light of subsequent events it would seem almost certain that the declining performance of the aircraft during the operational trials and noted in the trials report was due to blade distortion not identifiable by visual inspection rather than to engine deterioration as was suspected at the time.

The aircraft remained based at Kuala Lumpur but operated throughout Malaya, on occasions undertaking detached operations lasting several days accompanied by the permanent servicing team (Sergeant Feeley, LAC Williams and Mr Vicary of the Bristol Aeroplane Company).

The progress of these operational trials was of the greatest consequence in the development of the helicopter role for many years to come and the manner in which they were conducted was unusual in many respects. The Sycamore,

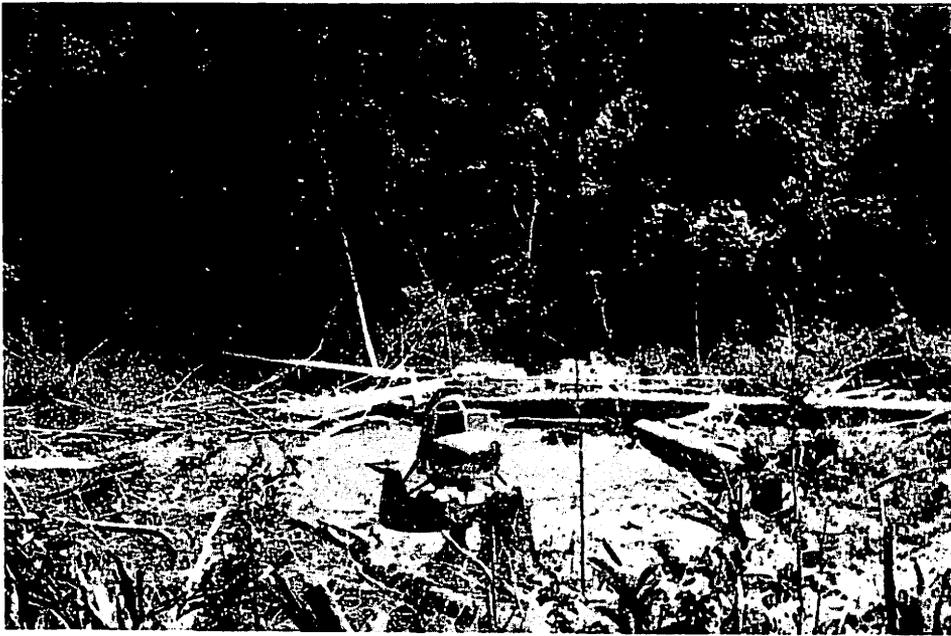
for example, though part of No 194 Squadron, was operated exclusively by the pilot detailed for the task.

The all important superiority of the Sycamore's vertical climb performance in still air over that of the Dragonfly was immediately apparent (although it deteriorated noticeably during the trial period). Further advantages were the relatively comfortable seating position (with pilot and observer side by side): the feeling of positive control which had been noticeably lacking in the Dragonfly: and the provision of a centre of gravity adjustment under the pilot's control, achieved by the electrical pumping of fluid between two tanks sited in the front and rear of the aircraft. What really established the aircraft in pilots' eyes, however, was the determination of the manufacturers to make whatever changes were needed as the result of operational experience on the direct advice of their service representative in the field, who, it was discovered later, was in almost daily communication with his company to which he reported everything that occurred and most of what was said, including crewroom comment. When normal RAF supply channels produced no positive results, he would obtain any special spares he needed direct from his company via the BOAC Comet service then newly operating into Singapore. The serviceability rate of the Sycamore therefore was always highly satisfactory. (24)

The trials lasted for just under three months, with some 100 hours flying in all the roles undertaken by the Dragonfly, and including some special communications flights for the High Commissioner. Because of its high serviceability rate the Sycamore was a very valuable operational asset to No 194 Squadron, then in a particularly difficult phase of its initial growth and suffering at the same time from severe technical problems with the Dragonfly rotor heads. It was hardly surprising, therefore, that the Sycamore began its operational life rather sooner than had been intended. On 10 April 1953, only three days after operational practice flights had begun, a casualty occurred in a clearing being cut for practice and training purposed by troops of 22 SAS, the position being only fifteen minutes flying time from Kuala Lumpur in an area known as Ulu Langat.\* The Sycamore, as the only serviceable helicopter available at Kuala Lumpur at the time, was used for the task and successfully lifted the casualty into the nearby British Military Hospital.

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\*The Ulu Langat clearing, considerably enlarged and thoroughly cleared, was used over the next four years as a pilot training clearing for crews at Kuala Lumpur and was regarded as a good example of what a standard clearing should be.

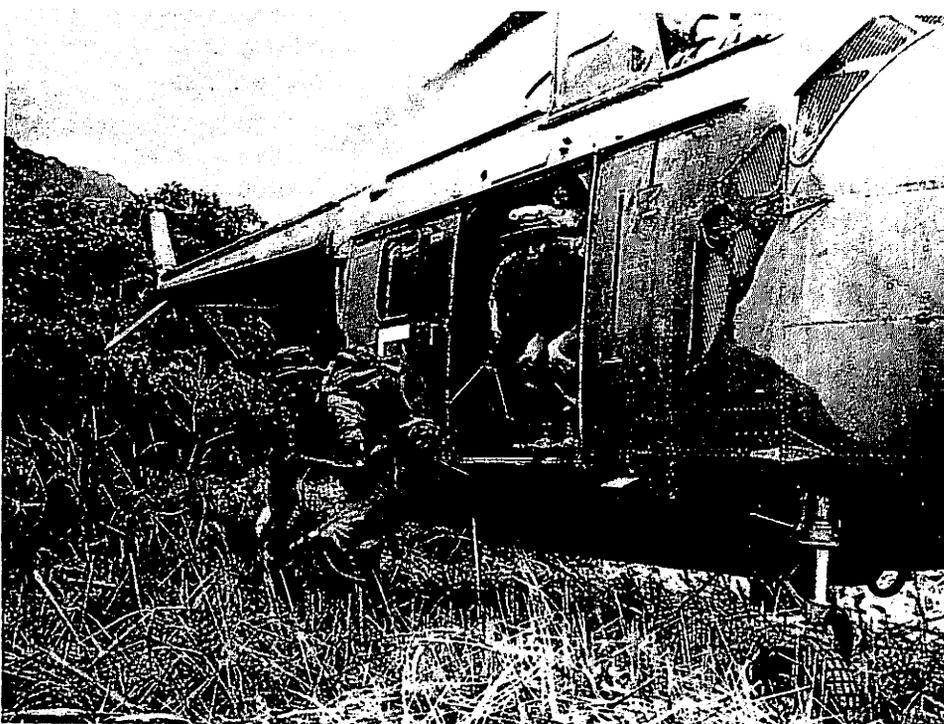


*Top:* operational trials with the Sycamore Mk 10 in Ulu Langat clearing near Kuala Lumpur in 1953. *Below:* a Sycamore Mk 14 of No 194 Squadron with a casualty.

The final report on the Sycamore operational trials contained no surprises for the manufacturers because they had been kept so well informed throughout. Indeed the flow of information they had received from their technical representative in the Far East had been put to good use in modifying their Sycamore Mk 4, and consequently when the Air Ministry and the Ministry of Supply approached them to discuss the matter, practical solutions to the problems raised were, for the most part, already in existence. The initiative shown by the manufacturers, and the expense to which it had put them, had much to do with the substantial orders for production aircraft (Mk 14) which swiftly followed, and first deliveries to Malaya to replace the Dragonfly were being made within the year. A total of 178 Mk 14 Sycamores were eventually manufactured, of which the RAF and the Ministry of Supply received 115. Fifty went to the German Air Force, three to the Belgians, nine to the Royal Australian Navy and one to the Royal Australian Air Force. (25)

The Sycamore had certain handling peculiarities, the most prominent being direct manual cyclic control and powerful spring trimmers to balance stick forces. It was also necessary to displace the stick in opposition to these trimmers before take-off in order to avoid moving forward or rolling to the left during take-off. The lowness of the rotor blades, originally thought to be a disqualifying disability, was always a matter of concern when passengers were entering or leaving the aircraft and when there was foliage in and around landing sites, as there invariably was, but handling techniques and careful stick positioning were usually able to reduce these risks satisfactorily. (26)

The Sycamore might therefore seem an especially awkward aircraft, but apart from the problems of dual control, caused by the provision in the Sycamore Mk 14 of a single central collective lever, something of the same impression might be obtained when comparing the handling qualities of an advanced sports car with those of an old fashioned family saloon of equal power. In fact the analogy would be particularly apt; the initial discomfort of feeling the stick forces in contrast to the neutral feel of the hydraulic controls in the Dragonfly and Whirlwind was swiftly overcome by the Sycamore's rapid and precise response to its controls. The feeling of positive and direct contact with the main rotor through the stick gave a feeling of confidence and provided an immediate warning of the need to make adjustments to the flexible tabs on the blade trailing edges, by which the vibration caused by tracking and aerodynamic balancing errors had to be corrected with annoying frequency. Apart from these frequent rotor blade adjustment requirements, the Sycamore had a very satisfactory serviceability rate compared with both the Dragonfly and the Whirlwind Mk 4.



Malay troops deplaning from a Whirlwind Mk 4 of No 155 Squadron in Malaya in 1957.

The Sycamore was regarded with enthusiasm from the start in Malaya because of its advantages over the Dragonfly in cabin size and performance, its positive handling characteristics and larger control margins, and its high serviceability rate. It was a stimulating aircraft to fly and, with its positive stick feel and apparent stability, it came as a great relief after the Dragonfly. For the first half of its 20 years in RAF service it shared with the Whirlwind Mk 2 and 4 all the helicopter tasks undertaken by the RAF. As a result it was usually compared with the Whirlwind and often to its disadvantage because of its smaller cabin space. But in some circumstances, particularly at heights of 3,000 feet and above and at high temperatures as in Cyprus or Kenya, it proved superior to the Whirlwind Mk 2 in performance. Nevertheless the Sycamore was originally adopted as a light helicopter to replace the Dragonfly while the Whirlwind was described as a medium helicopter and thought of as a troop carrier. That the Sycamore was frequently a satisfactory, and sometimes even a better alternative in some theatres to the newer Whirlwind Mk 2 was a tribute to its advanced design, which dated from the mid 1940s. It became very popular with the pilots and when the last Dragonfly was replaced by the Sycamore in July 1956 there were few regrets and many long sighs of relief.

#### Introduction of the Whirlwind Mk 2/4 in Malaya

The Whirlwind, unlike the Sycamore, was not a new design, but a British copy of the American Sikorsky S-55 built under licence by Westland. It had the standard twist grip throttle and hydraulically assisted controls for cyclic stick and collective lever only, as in the Dragonfly. With its rotor head and blades derived from the S-51 it had obvious similarities in handling, but nevertheless represented a considerable step forward from the Dragonfly.

The Whirlwind was the first in a line of Sikorsky helicopters using the configuration in which the engine was housed in the nose with the pilot above and behind it, an arrangement which allowed a relatively capacious cabin directly beneath the rotor head and, combined with a larger offset of the flapping hinges, permitted loading and unloading without the very awkward centre of gravity compensatory adjustments necessary in the Dragonfly where the whole cabin was forward of the rotor head. In addition the Whirlwind had the advantage of a large cabin seating ten passengers.

Disappointment however was to follow because the aircraft turned out to be decidedly unsatisfactory in performance. It had been assumed, reasonably, that the British version of an American aircraft already in service would be broadly similar to its forbear in this respect and although the Whirlwind had undergone Ministry of Supply trials it had not been possible for any of these to take place in Malaya. Demonstrations too could be misleading: for

example, in 1951 an S-55 took part in an Army exercise on Salisbury Plain and with judiciously arranged refuelling on a cool day and a brisk wind flew several times with ten passengers on board. It was also claimed that the aircraft could carry six stretcher cases and an attendant, (27) whereas in severe conditions in Malaya, when the S-55 would be limited to four passengers the Whirlwind would be struggling to lift two. (28)

Worse, an anomaly in the redesigned fuel system resulted in some 40 gallons in the rear tanks being unusable in flight and in consequence the actual payload would be reduced to one soldier. (29) Even when this anomaly had been removed together with various safety features (including the fire extinguishing system and self sealing fuel tanks) the aircraft was still substantially heavier than the S-55 because certain parts were constructed from standard gauge materials and when the British standard varied from the American the thicker had to be used. Further, in these early days of helicopter operations it was not yet widely understood that a five per cent increase in the basic weight of the aircraft (which was approximately the increase in the weight of the Whirlwind over that of the S-55) was not a simple matter of a small reduction in range, but required a compensatory reduction in cabin payload (which could itself be as little as 11 per cent of the total weight). In limit conditions a variation in weight of less than one per cent could make the difference between a successful 200 feet a minute vertical climb and failure to rise from the ground cushion - and in Malaya that was often the same as being unable to take off at all.

The Whirlwind Mk 4 was derived from the Mk 2 by altering the supercharger ration from 10.1 to 12.1. The purpose of this modification was twofold: to improve performance at heights of 3,000 feet and above,\* and provide an emergency reserve of power below that height by permitting overboosting of the engine when vitally necessary. It was left to the pilot not to misuse this facility, which could be employed by merely turning the throttle twist grip. No mechanical obstruction existed to prevent this being done and in consequence there was a considerable risk of engine damage - leading to an engine change or at best a period of unserviceability while a special inspection was carried out - if overboosting had to be used. Additionally, it was easy enough for overboosting to occur accidentally either through mishandling or as

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\*The need for improved performance at higher altitudes was brought about by the changing character of anti-terrorist operations in 1954 and the need for the security forces to penetrate the more remote and mountainous jungle areas. The supercharger ratio change conferred the minimum improvement necessary to permit operations at higher altitudes.

an instinctive reaction to a dangerous situation. As a result, pilots' reports of such occurrences would on occasion take on some of the character of a confession and it says much for their self-discipline that there was never any evidence to suggest that these mishaps were being concealed.

The driving force behind the accelerated introduction of the Whirlwind into service in Malaya was the urgent need to relieve and then replace the hard worked Naval S-55s. High level discussions about the supply of additional S-55s from the United States were proving inconclusive and throughout 1954 the overriding preoccupation was the rate at which Whirlwinds could be obtained as an alternative. Further, as the S-55s were dependent on American spares the arrival of the Whirlwinds - after intense pressure - came as a considerable relief politically. (30)

However, even when a grossly inadequate performance had been improved by the measures described above, a further disappointment was to follow. Weighing and reweighing the aircraft as various items of equipment were removed revealed unexpected anomalies and, belatedly, the fact that if the aircraft was weighed with the blades on, the recorded centre of gravity position varied with the position of the blades. (31) More disturbing was the discovery that continuous flight with the centre of gravity position near either end of its permissible range - a state of affairs which the pilot would hardly notice because of the greatly improved control range as compared with the Dragonfly - caused a drastic reduction in the expected life of the main rotor drive shaft. (32)

The engine installation in the Whirlwinds, both Mk 2 and Mk 4, was the Pratt and Whitney Wasp which was also used in the Harvard, and of which large surplus stocks were available - some 300 in 1955. These engines were overhauled by BOAC under contract and subsequently modified for helicopter use by Alvis with dollar purchased conversion kits. (33) At times throughout their service in Malaya - where helicopter engines would spend a much higher proportion of their time at full power than would a fixed wing installation - the Wasp engines suffered from a number of faults. These included unexplained power deficiencies, very frequent magneto defects, oil starvation and consequent mechanical collapse, as well as incorrect assembly clearances, in the tappets for example. Starter troubles were also common. (34) That the Whirlwind Mk 4 was eventually employed with success in Malaya was therefore a triumph for the RAF engineering staffs and to some extent for the pilots as well.

For the latter the Whirlwind Mk 4, when serviceable, was pleasanter and easier to fly than the Dragonfly except for its awkward power limitations. Although it had full hydraulic assistance in cyclic and collective controls it

could be flown successfully for short periods in manual control in the event of hydraulic failure. Accurate flying in manual control however was an art which had to be acquired; the main difficulty lay in resisting the somewhat heavy lateral stick force which increased in proportion to the forward speed.\*

The Whirlwind was provided with duplicate hydraulic systems to guard against total failure, but such failures could and occasionally did occur. Duplication however did not extend to the operating jacks at the rotor head, and there was also a condition in which failure in one part of the system could cause all the hydraulic fluid - including that in the serviceable part of the system - to be exhausted. Regular practice flights in full manual control were therefore introduced at the outset, pilots being required to fly for about ten minutes before completing an airfield landing in full manual control.

At first this exercise had to be carried out monthly by every pilot and it was considered adequate if a pilot reverting to manual control in a genuine emergency could under Malayan conditions reach an open space or even an Auster strip in up to 30 minutes' flying at 45 knots - which was normally possible. Pilots with greater physical strength might manage a slightly higher speed or a slightly longer period. (35)

In October 1955, however, practice flights in manual control were forbidden in Malaya pending the installation of an emergency servo control modification. (36) The emergency servo system consisted of supplying engine oil pressure to assist the pilot with the lateral stick forces encountered when the hydraulic servo systems failed; it by no means balanced the heavy forces encountered, but merely reduced the side loading on the stick to some extent.

In February 1956 the restriction on practice flights in manual control was lifted, but mandatory monthly practices were not reintroduced, probably because flying hours were too valuable. It was also an uncomfortable and therefore unpopular exercise. Thereafter manual control came to be regarded as a great misfortune and one pilot who experienced it in May 1958 was so alarmed that although there was an Auster strip only a mile or so behind him, he did not dare to attempt the turn necessary to reach it. Instead, he laboured on for about 20 minutes in the approximate direction in which he was facing until he came to a small padang (village green) where he made a running landing under only partial control and had to brake the aircraft so fiercely that the tail cone jerked up into the main rotor disc causing

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\*The reactions of pilots to this feature provided a very revealing insight into their attitudes and opinions.

considerable damage. He was warmly congratulated on his survival and on avoiding the trees at the end of the padang. (37) Such was the shift in the official attitude to flight in manual control in the course of the first four years of operations.

#### POLICY DEVELOPMENTS TO MEET THE DEMAND FOR HELICOPTER SUPPORT IN MALAYA

By 1954 the problem of providing enough helicopters to meet the commitment in Malaya was causing the greatest concern at the highest political and military levels and a surge of activity in the policy-making and engineering fields. Time had always been short: with no tactical helicopter force previously envisaged, the task had been to assemble within a few months of Sir Gerald Templar's arrival as Director of Operations in late 1952 a fleet of suitable helicopters and the facilities for keeping them serviceable. Hence the use of the Naval S-55s as a stopgap and the plan to replace them with RAF Whirlwinds after a year, at the beginning of 1954. (38)

The commitment to the Director of Operations was plain: to provide a helicopter force to meet his clearly defined requirements. It should consist, according to his calculations, of enough medium helicopters to lift two infantry companies in different parts of the Federation on any one day, and periodically to lift the Federal Reserve Battalion of four infantry companies. (39) Further, by the beginning of 1955 medium helicopter support (Whirlwinds or S-55s) would be required to start one deep jungle operation every month and complete any previous operation; provide reliefs for two operations in progress; carry out 21 area domination operations and provide six airlifts of 90 men each against opportunity targets. In addition, up to five jungle forts required regular relief every six months and eight required monthly visits by teams of administrators.

For the light helicopters (Dragonflys or Sycamores) the task was estimated at two casualty evacuations, three communications and two tactical reconnaissance sorties every day.

For these tasks a minimum of ten medium and ten light helicopters would be required at any one time, or an establishment of 18 in each case. (40) To meet this requirement it was planned to provide 17 Whirlwinds plus three in reserve and 14 Sycamores with a gradual build up of Single Pioneers to undertake part of the communications task. As a precaution against delay in delivery, arrangements were also made to retain the Naval squadron of S-55s in Malaya at least until April 1955. (41)

It was a precaution which was soon to be justified: by mid 1954 the delays in the manufacture and clearance of the Whirlwind were causing considerable concern and the Ministry of Supply 'Controller of Aircraft release' (CA release) for the Sycamore Mk 14 which was due to replace the Dragonfly in the latter part of 1954 was also taking longer than expected. As a result the Air Ministry, mindful of General Templer's warning that the rapid build up of the helicopter force to its planned size was essential to success in the anti-terrorist campaign, (42) applied heavy pressure to the Ministry of Supply but was eventually forced to circumvent all normal procedures (including financial) (43) to arrange despatch by sea in May 1954 of both Whirlwinds and Sycamores before the pending CA releases were obtained. (44)

As the Sycamore had already undergone a brief operational trial period the haste with which it was despatched to the Far East did no harm. It performed well from the outset and progressively replaced the Dragonfly between October 1954 and July 1956. (45)

The Whirlwind however was in dire trouble immediately. The change in the supercharger ratio which produced the Mk 4 had been no more than a last minute attempt to improve performance for Malayan conditions (46) - the first supercharger modification being carried out at Seletar when the aircraft arrived there in mid 1954. It failed however to disguise the Whirlwind's gross inadequacy in other respects, and the fact that the Whirlwind's payload did not match even that of the Sycamore and was only marginally better than that of the Dragonfly (47) caused consternation among the RAF and Army authorities in Malaya, as did the revelation that some 40 gallons of fuel in the rear tanks - often the maximum fuel load in Malaya - was unusable in flight. (48)

The consequences of this setback could have been of the utmost seriousness as the success of forthcoming operations depended on the availability of the 10 S-55s a day (or their equivalent) as had been promised. 'I regret to tell you,' wrote the AOC Malaya to the Director of Operational Requirements (Air), 'that your wretched Whirlwind is a complete washout, mainly because of its average increase in weight of 374 pounds above the S-55 and its fantastic fuel system ... Apart from this the workmanship and inspection of the aircraft has been appalling ... However, the significant feature is that it cannot do the job for which we have it ...' (49) And by now the problem had reached ministerial level. (50)

The solution proposed by the new Director of Operations, General Bourne, in a report to the Chiefs of Staff (30 November 1954) was to retain No 848 Squadron beyond April 1955 and until further notice against his reiterated demand for 10 S-55s (or their equivalent) a day. (51) The eight S-55s which



*Top:* troops deplaning by rope from a Sycamore Mk 14 of No 194 Squadron in Malaya in 1956. *Below:* a Whirlwind Mk 4 of No 155 Squadron in a training clearing in Malaya.

remained in No 848 Squadron were expected to be reduced by wastage to six by December 1954; of these three or four could be available each day and by then there would also be four or five Whirlwind Mk 4s. If each of these carried between half and two thirds of the payload of the S-55, the daily availability would still be no more than the equivalent of six S-55s. (52) General Bourne did not describe this as merely inadequate; it would quite definitely place very severe restrictions on prospective operations, a statement which indicated the status which the helicopter had achieved after three years of activity. His recommendation therefore was for a further application to the United States to obtain more S-55s. (53)

The RAF was not alone in the Whirlwind fiasco. Five Naval Whirlwind Mk 1s (similar to the RAF Mk 2s) had been sent out to support the S-55s in No 848 Squadron when it had become known that it was to be retained in Malaya beyond the middle of 1954 and would therefore become a wasting force. With the same 10.1 supercharger ratio as the Mk 2, the Mk 1 was even more unsuitable than the Mk 4 for service in Malaya (54) and suffered from all its other defects. It could not be said however that the Mk 1 had been forced into service with undue haste, although it might be argued that the intention had never been to operate it inside Malaya but merely to use it as a replacement for the S-55 in the anti-submarine and SAR roles. The Mk 1s were therefore rejected even as support for the Sycamores, which were already being described as highly satisfactory and were normally carrying a useful load of three men in the communications role. (55)

A detailed examination of the situation by the Air Ministry and the Admiralty then followed at the end of which two conclusions were reached; first, that the five Mk 1s should be returned to the SAR role for which they had been intended, and second that there was no prospect of re-engining the RAF Whirlwinds before 1957, by which time the twin engined twin rotor Bristol 173 on order for SAR duties and as the Whirlwind replacement should be in service. (56) It was also agreed that an approach to the United States for more S-55s would be unwise as the original one year only diversion of No 848 Squadron from the NATO area had required the authority of the President himself (57) and the question of the squadron's withdrawal from Malaya might therefore be raised - the United States being generally unenthusiastic about giving assistance in colonial problems.

The solution therefore was to reduce aircraft weight by clearing the Mk 4 to fly without fire equipment, replacing self-sealing tanks with bag tanks and obtaining from the Ministry of Supply a list of all the equipment and structural members (cabin doors, cowlings etc) which could be removed for special operations. (58) Urgent action was also to be taken to modify the fuel system and remove the anomaly of the unusable fuel. By these means it was

hoped to reduce the performance gap between the Whirlwind Mk 4 and the S-55 from three troops carried to one, and, by retaining No 848 Squadron indefinitely, to meet the trooplift requirement of 10 S-55s a day with a mixture of S-55s and Whirlwind Mk 4s by the end of March 1955. (59)

Meanwhile, the Air Ministry suggested, the Sycamore could be used to some extent for trooplifts. The objection raised by FEAF had been that its low ground clearance made it unsuitable, but in fact the fuselage ground clearance of the Sycamore Mk 14 was greater than that of the Whirlwind and its smaller rotor ground clearance could often be offset by pilot handling technique (60) - a view which was fully justified when in later operations in Malaya the Sycamores carried out all helicopter tasks required, including troop deployment.

#### Technical and Supply Problems in the Whirlwinds and Sycamores in Malaya

Both Whirlwinds and Sycamores suffered severely during the main period of their employment in Malaya (1954-60) from chronic shortages of various classes of spares, and from incorrectly assembled or badly manufactured components sent out from the United Kingdom. The Whirlwinds, for example, were plagued from the outset by bad electrical connections and soldering, and by the inadequate weatherproofing of components. (61)

By February 1955 the modifications to the Whirlwind fuel system had been incorporated, but in May a long saga of servicing problems began when the first signs of trouble appeared in the wooden rotor blades of the Sycamore, a fault which remained uncured for the next four years. (62) The Whirlwind rotor also was not immune to blade problems as in August FEAF Headquarters reported that the Whirlwind rotor blades headed the list of unserviceability problems with servo control jacks in second place. (63)

In addition to the difficulties already mentioned (starter motor troubles in both aircraft types, a modification to the emergency servo system in the Whirlwind, and a succession of faults in its Wasp engines)\* there were other problems, notably a periodic slipping of the torque limiting clutch in the Sycamore transmission, often caused by inadequate degreasing of the units before despatch to Malaya (an aircraft crashed in 1956 in consequence) and tail cone attachment difficulties in the Whirlwind which led to a fatal accident and the consequent grounding of the fleet.

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\*See p 73.

One of the most constant sources of trouble, however, was the unexplained variations in performance which afflicted the Sycamore rotor blades (see p 66) A modification consisting of a new coating for the blades only added to the trouble as it did not achieve the constant blade performance improvement required and its abandonment was followed by a critical shortage of unmodified blades. (64) That radical changes of this kind could be carried out only at Filton, where the rotor blades could be subsequently whirled and balanced on a special test tower, added to the problem.

A quite separate joint service decision in London to colour all helicopter rotor blades medium sea grey on top aggravated the difficulty because the result in Malaya was an increase in internal blade temperature of 25 degrees Fahrenheit compared with white painted blades. (65) Meanwhile although the manufacturers were making strenuous efforts to solve the Sycamore blade problems, they were proving very difficult to identify. One line of experiment was an attempt to devise a finish which would exclude the damp Malayan atmosphere. Eventually a modification involving an adjustment to the cordwise C of G was made and shortly afterwards, in February 1959, a Sycamore suffered the first complete blade failure in flight with fatal consequences for all on board. Two months later an exactly similar incident led to the grounding of the whole Sycamore force for a complete re-examination of the rotor blade problem. (66) Almost exactly a year later a new standard of rotor blade was ready for testing at Seletar and between March and July 1960 the Sycamore progressively resumed its original role in Malaya.

However much helicopter operations in Malaya might be coloured for individuals by such traumatic occurrences as the Whirlwind tail cone failure and the two complete Sycamore rotor blade failures, the fact remained that the helicopter force had been created in response to an urgent operational requirement and without the opportunity for adequate planning. The assembling of the required number of aircraft was only one aspect of the problem; the absence of organised pilot training at the start was largely offset by the experience and flying background of the pilots selected for the task (nearly all were over 35). The lack of technicians with helicopter experience was partly overcome by the expertise of the RAF engineering branch, assisted from time to time by representatives from the aircraft and engine manufacturers; hydraulic controls and metal blades, for example, were fitted to Mk 2 Dragonflys to convert them into Mk 4s by air-men who had never previously worked on helicopters. (67)

The technical problems in the Whirlwind would have had less impact had there been an adequate spares backing; in November 1955, for example,

seven out of 17 Whirlwinds were unserviceable awaiting spares from the United Kingdom. (68) There had been no data however from which to construct a satisfactory spares supply system and no time to establish one; nor were the manufacturers geared to meet the demand or experienced enough to foresee the problems which might arise. The Sycamores were not plagued by the same general technical unreliability and their spares supply was not placed under the same degree of strain. What made the defects in their main rotor blades so much more serious was that the remedy could be applied only at Filton and as the wooden blades were largely hand made no rapid increase in production was possible to meet changes in standard of finish.

In sum, in terms of the all important factor of regular availability, the Whirlwind in one of its best years, 1956, achieved a serviceability rate no higher than 41 per cent and the entire Whirlwind force was out of the line on four occasions in 1957 for technical reasons. (69) Before its long grounding in 1959 the Sycamore had a decidedly better record: in 1957, an average year, its overall serviceability rate, was 63 per cent. (70)

#### ADDITIONAL HELICOPTER ROLES IN THE MALAYAN CAMPAIGN

Once the helicopter force in Malaya had reached the minimum size needed to meet the requirements of the Director of Operations - that is, broadly speaking by late 1954 - its task was to maintain the roles already developed for as long as the war went on. The Sycamores progressively replaced the Dragonflies of No 194 Squadron between October 1954 and August 1956 and by late 1955 No 155 Squadron was in operation at full strength with Whirlwind Mk 4s. The roles of tactical trooping, casualty evacuation and communications were successfully fulfilled, and - characteristically with helicopters - further roles were added from time to time.

Apart from crop spraying, which had already proved its strategic value in the anti-terrorist war, by far the most important new role was the use of helicopters in urban areas when disorder or rioting was occurring or threatened. The Dragonfly had shown the importance of aerial patrolling during the Maria Hertogh Muslim riots of 1950 (see p 42) and during the much more serious political riots in Singapore in October 1956 three Whirlwinds of No 155 Squadron played a very important part in giving aid to the civil power in collaboration with the police and the Army, flying 136 sorties for a total of 90 flying hours.

After eight years of emergency regulations in Singapore including the death penalty for carrying arms, helicopters could operate without fear of

opposition. The weapons they used were of three kinds: tear gas to disperse crowds, indelible dye to make participants identifiable later and propaganda leaflets. In addition, helicopters could often disperse crowds, and prevent them from reforming later, entirely by their own action and without summoning the ground forces; a crowd of 200 students, for example, stoning vehicles on the Bukit Timah road was dispersed by the use of tear gas and indelible dye.

The helicopter's greatest advantage was its ability to monitor the situation continuously from a platform immune from retaliation and to direct police and Army patrols rapidly to wherever they were needed, so generating an awed respect for the security forces and their capacity for rapid response. The part which the helicopter played in Singapore in 1956 was therefore of considerable significance, and the results were to have far reaching consequences. 'The successful suppression of these political riots,' wrote the officer in charge of the Singapore Government's Information Service, Mr G G Tompson, 'enabled the leaders to be removed and Lee Kuan Yew to meet the political challenge as prime minister in 1961-62: otherwise the story would have been quite different.' The riots were thus 'a critical point in the history of Singapore'. (71)

Before the riots of 1956 helicopters had not been written formally into Singapore's internal security contingency plans and there was the seemingly inevitable problem of radio incompatibility. But from then on helicopters were invariably called upon to assist the police whenever the situation demanded, (72) and in September 1957 two Sycamores were detached to Hong Kong in readiness for the October elections; there was no trouble however. In the same year a modification was developed which permitted the safe launching from the Whirlwind of tear gas grenades in clusters of eight in a three second period with a 10 yard accuracy from heights of between 100 and 200 feet. (73)

One local modification found necessary was a type of stretcher cage fitted beneath the Dragonfly in which to carry dead terrorists back for identification. It was no longer necessary to decapitate them and send only their heads back, as had once been done (see p 31 ), but with the security forces beginning to gain the upper hand after 1953 there were enough of the terrorists to be transported to make their carriage outside the aircraft eminently desirable in a tropical climate. A special body carrier was therefore constructed to be fixed beneath the fuselage, making loading and unloading simple and expeditious. (74)

Among the many communications flights carried out by the helicopters those for the Director of Operations were of special interest. In Malaya the terrain offered infinite opportunities for ambush and for General Templer to travel by road was a difficult and dangerous procedure involving large troop

deployments to secure the route and the use of a heavily armoured convoy, in all an operation which was expensive in manpower, uncomfortable and, not least, bad for the morale of those being visited. Additionally, the High Commissioner's taste for arriving at remote places by helicopter, usually unannounced for security reasons, resulted in a degree of alertness and purposeful activity whenever a passing helicopter landed unexpectedly, perhaps through fuel shortage, unserviceability or crew fatigue. (75)

### The Paratrooping and Search and Rescue Roles

Paratrooping had been foreseen as a helicopter role at an early stage of operations and successful experiments had been carried out in the S-55s of No 848 Squadron during their initial performance trials in Malaya in 1953. (76) In fact, however, at the same time as the helicopter demonstrated its value as a paratrooping aircraft, it also virtually eliminated the parachute as a method of delivering troops in strength - it was obviously better to land them by helicopter wherever possible.

Since the first use in Malaya of paratroops from fixed wing aircraft during Operation Helsby in February 1952 (see p 45 ) considerable thought and training had been devoted to developing and improving the techniques of parachuting into jungle and a very satisfactory method had been discovered of using abseil gear to reach the ground once the parachute canopy had been lodged in the tree tops. (77)

Few opportunities, however, occurred for major paratrooping operations against the terrorists after 1954 because an expanding helicopter force was proving itself capable of landing a greater number of specialist troops in the jungle more quickly and with less risk of personal injury than could be parachuted from the fixed wing transport aircraft previously used.

When paratroops were used on combined operations they were usually the precursors of troop carrying helicopters, but if it was necessary to achieve an extremely accurate drop into a very small target area, the helicopter could be used to great effect, particularly when the objective was rescue and no clearing existed for the helicopter to land. Thus the technique for parachuting into trees became a specialised element of casualty evacuation and rescue operations, and proved to be of the greatest value on a number of occasions.

Drops were made from Whirlwinds at a height of 1,000 feet with a forward airspeed of about 20 knots heading into wind and using static line parachute deployment. Ground speed was thus insignificant, the dropping zone was in full view of the paratroops and the drops could be made with full parachute

deployment in the vertical position without swing or oscillation. Great accuracy could therefore be achieved with the minimum of practice by aircrews or ground troops. The beam fitted to the cabin roof beneath the gearbox for static line attachment was not used except by the despatcher because of the risk of the static line being fouled during the drop. Instead, an additional attachment point was fitted on the main fuselage member at the forward port side of the cabin. A felt cover was fitted to the cabin floor, the sliding door removed and the starboard undercarriage members covered with masking tape; no other preparation was required. On operational drops no more than three paratroops and a despatcher could be carried because each paratrooper had up to 80 lb of arms and equipment with him including the abseil gear for lowering himself to the ground after his canopy had lodged in the tree tops. (78)

It was the troops of 22 Special Air Service Regiment who developed and became the main exponents of jungle paratrooping. They supplied jungle clearing parties for the construction of helicopter landing zones and parachute trained doctors for the emergency treatment of casualties where no helicopter landing zone existed. In June 1956, however, a Far East Air Force Jungle Rescue Team was formed at the Far East Parachute School at Changi from volunteers and trained in parachuting into the jungle. (79) It corresponded to the Desert Rescue Teams in the Middle East and the Mountain Rescue Teams which were formed much later in the United Kingdom.

One example of their work may be recorded as it shows something of the conditions under which the rescue helicopters were operating. (80) In August 1957 a Valetta crashed at 4,000 feet up a jungle covered ridge in central Malaya after completing a leaflet drop. The wreck was found by an AOP Flight Auster and it seemed scarcely possible that there could be any survivors. The FEAF Jungle Rescue Team, however, was flown to Kuala Lumpur to join the Special Air Service rescue team. A combined party of 12, including a doctor, were then flown by Whirlwind to near the site of the crash and parachuted into the trees. All completed the drop without injury and reached the wreck only two hours later.

So severe had been the impact of the crash that no part of the aircraft was immediately recognisable but closer inspection revealed the badly burned front portion beneath the twisted and wholly collapsed fuselage. Of the three aircrew and four RASC despatchers there was no sign until a roughly built shelter was discovered 30 yards from the wreck and then another 300 yards away with two of the RASC men inside. The other two had also survived but were attempting to walk out of the jungle. They were found by helicopter, supplied and told to rejoin the others. The three aircrew had

all been killed but the four despatchers in the back of the aircraft had survived because they had received an emergency warning from the captain and were strapped into their rearward facing seats. All were burned to some extent as the aircraft exploded shortly after they left it. They then moved away from the crash, contrary to normal survival training, because they were afraid that there were terrorists in the area, and had been unable to find their way back although the second shelter they built was only 300 yards away.

The distance to the nearest road was some 10,000 yards, two days' travel for a patrol and seven to ten days' with casualties. Eight members of the rescue team began preparing a helicopter landing zone using plastic explosives and mechanical saws supplied by helicopter parachute drop, and at the end of the second day six more men were parachuted in to help. By noon on the third day the landing zone was ready to receive a helicopter, and a Sycamore, operating from a nearby detachment specially set up for the occasion, began a shuttle service bringing in members of the Court of Inquiry and taking the casualties out one at a time (the altitude was 4,000 feet).

On the fourth day the helicopter continued the shuttle intermittently, as the cloud base varied, lifting out the Court of Inquiry members and some of the rescue party while awaiting the return of the two survivors who had attempted to walk out (the helicopter could not afford to stop its engine to wait on the landing zone). At noon on the fourth day the two arrived back at the crash site and in the late afternoon the helicopter was able to get in and out of the landing zone twice more to lift them out.

The remaining members of the rescue team had to walk out because at that point the helicopter pilots declined, once the operational urgency had been removed, to attempt the very difficult landing zone approach again. In this they were acting wholly in accordance with established principle in the theatre, but it was also a decision of peculiar significance: acting on their own initiative, they had decided that once all the survivors had been taken out further risk to the aircraft was no longer justified. The need to conserve the aircraft, and its appreciation by all concerned, is therefore one of the insights which this rescue operation provides; it also illustrates the problems caused by the terrain and the use of underpowered helicopters, and not least the skill of the pilots and the degree of stress under which they worked.

For those operating helicopters in Malaya, paratrooping from them was important mainly in the rescue role as an extension of the casualty evacuation task and became indistinguishable from what was known elsewhere as 'search

and rescue' over land. In December 1957 serious flooding in Ceylon led to a request for international assistance. Three Sycamores of No 194 Squadron were embarked on the American aircraft carrier Princeton and taken to Ceylon where they flew 105 hours in seven days on supply and evacuation duties, subsequently returning to Singapore by the same means. (81)

As the Malayan emergency drew to its close, the helicopter force was reduced in numbers and moved from Kuala Lumpur to Butterworth in August 1959. Trooplifting operations continued at a declining rate, but casualty evacuation remained a responsibility with, as an added task, a sea rescue standby for the Australian fighter squadron then stationed at Butterworth. The Sycamores could undertake winch operations over the sea and in February 1960 those at Butterworth were fitted with SARAH (Search and Rescue Aerial Homing) radar equipment which permitted search and rescue aircraft to home on a survivor. (82)

Thus the role of search and rescue was naturally assumed by the tactical helicopter force, having been its second (but not necessarily secondary) role throughout its life in Malaya from the time when it grew out of the Casualty Evacuation Flight, itself specifically established in 1950 for that role alone. This sequence of events, the quick transition from an identifiable search and rescue role to a much larger - but unquantifiable - tactical army support requirement was repeated in other overseas theatres, notably Cyprus.

#### SQUADRON FORMATIONS AND DEPLOYMENTS IN FEAF

The RAF Whirlwind squadron, No 155, was formed at Kuala Lumpur in September 1954 with most of its personnel, including the squadron commander, Sqn Ldr N H Jackson-Smith, drawn from No 194 Squadron which was already in residence there. In formal terms the new squadron's roles were identical with those of No 194 Squadron although the intention was to use it mainly for trooplifting. However, the various technical problems already described prevented it from taking its full part in trooping until the second quarter of 1955. In June 1955 the Naval Mk 1 Whirlwinds which had been attached to the squadron in the forlorn hope of helping it through its early difficulties returned to Naval SAR duties in Europe (83) and the Mk 4 Whirlwinds, now under Sqn Ldr L L Harland, began to make their main contribution to the trooping task alongside No 848 Squadron.

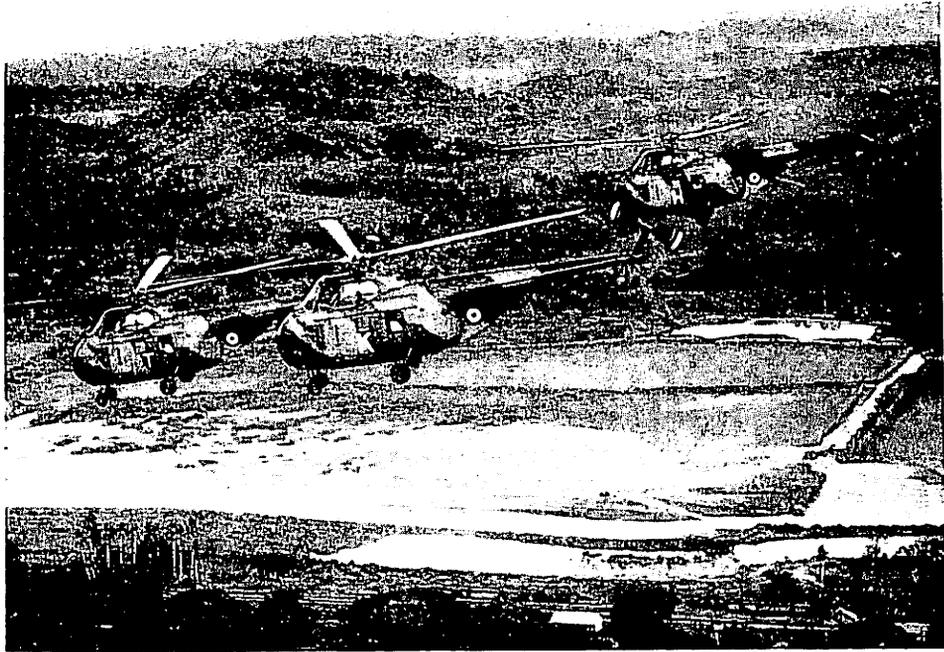
By the end of 1955 the 20 Whirlwinds of No 155 Squadron with the 10 Sycamores and four Dragonflies of No 194, and the remaining S-55s of No 848, were just able to meet all reasonable demands for helicopter support. The

improvement in availability also permitted a degree of decentralisation with the result that more permanent detachments could be located near the major scenes of operation, able to respond to opportunity demands - a far better practice than that of allocating temporary detachments for the duration of individual pre-planned operations. In May 1955, for example, three Whirlwinds and one Sycamore were deployed at Kluang in Johore in support of the 17th Gurkha Infantry Division, and one Sycamore was detailed to Ipoh in Perak in support of the 1st Federal Infantry Brigade. Operations in south, central and north Malaya were thus covered; (84) all the helicopters involved however remained under the direct tasking control of the Joint Operations Centre established in February 1954 at Kuala Lumpur.

In March 1956 the Whirlwind/S-55 force was redeployed to facilitate second line servicing: the Whirlwinds of No 155 Squadron were withdrawn from Kluang to Kuala Lumpur and No 848 Squadron was moved back from Kuala Lumpur to the Naval servicing base which was still at Sembawang whence it continued to provide the Kluang detachment in the south until December 1956. By then the S-55s had reached the end of their useful life and a series of accidents compelled the withdrawal of No 848 Squadron after an exacting tour of nearly four years in Malaya. (85)

The disestablishment of the S-55 squadron at the end of 1956 left 17 Whirlwinds of No 155 Squadron and 14 Sycamores of No 194 Squadron to meet all demands for helicopter support in Malaya, a target which they just succeeded in achieving. The demand for helicopter support began to fall away in 1957 as the situation in Malaya improved, a decline which - as fortune would have it - coincided with the growing technical problems with the Whirlwind.

Concurrent pressures to supply helicopters to the Middle East and to build up SAR units at home led the Air Ministry to carry out a worldwide survey of new requirements, which showed that there was a net shortage of Whirlwinds. Priorities had therefore to be adjusted. No 224 Group (which had replaced Air Headquarters Malaya on 31 August 1957 following Malayan independence) responded by offering in October 1957 to reduce their Whirlwind establishment by five, and after a further plea from the Air Ministry in November agreed to a total reduction of nine, leaving eight Whirlwinds and 14 Sycamores. (86) Shortly afterwards the Air Ministry decided that since the Whirlwind was limited by inadequate performance in Malaya and the Sycamore by cabin space for SAR work at home, it would be better to withdraw the Whirlwinds from Malaya and use them to replace the Sycamores in the SAR units at home, leaving the Malayan tasks to be carried out by Sycamores alone.



*Top:* Whirlwinds Mk 4 of No 155 Squadron near Kuala Lumpur in 1956. *Below:* a Sycamore Mk 14 of No 110 Squadron paying a regular visit to a jungle fort in north Malaya in the closing days of the Emergency. (Pilot: Flt Lt B. Cann.)

The latter had by this time acquired an excellent reputation in Malaya. In spite of continuing problems with rotor blade distortion, evidently caused by the high-temperature, high humidity atmosphere, the Sycamore's general serviceability rate was high - while that of the Whirlwind was very unsatisfactory and getting worse. Earlier fears about the low ground clearance of the Sycamore rotor had been dispelled by experience and the operational payload was scarcely less than that of the Whirlwind.

FEAF Headquarters readily agreed to the changeover and the Whirlwind rundown was due to be completed by early 1959. (87) By March 1959 No 224 Group was able to advise FEAF Headquarters that when RAF Kuala Lumpur was transferred to the Royal Malaysian Air Force later in the year and RAF helicopters moved to the RAAF base at Butterworth to support residual operations near the Thai border, the whole helicopter support task, including tactical troop deployment, could be carried out with an establishment of 12 Sycamores. (88)

In the following month, however, the second of the two fatal Sycamore crashes caused by main rotor blade disintegration and the consequent grounding of the whole Sycamore force for a radical reappraisal of the rotor blade problem put a temporary stop to these plans. (89) As operations in Malaya still depended on the helicopter for troop deployment and casualty evacuation there could be no question of withdrawing the Whirlwinds from the Far East whatever the pressures in Europe or the Middle East. The five remaining Whirlwinds had therefore to stay in Malaya and even be reinforced by three from the United Kingdom. Nos 194 and 155 Squadrons were disbanded at Kuala Lumpur in June 1959 and together reformed as No 110 Squadron with five Whirlwinds. In August 1959 the squadron moved to RAAF Butterworth with an establishment of eight Whirlwinds, the remaining 13 Sycamores being stored at Seletar awaiting a solution of the rotor blade problem. (90)

The arrival of No 110 Squadron marked the beginning of the last chapter in the story of helicopter operations in Malaya and also formed a link with the second great occasion on which helicopters provided essential support to the ground forces in the Far East - the operations in Borneo.

One Whirlwind remained at Kuala Lumpur in support of mopping up operations in eastern central Malaya until the end of 1959, while the squadron's remaining seven Whirlwinds, based at Butterworth, carried on with the main trooplifting and casualty evacuation task near the Thai border.\* By the

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\*Casualty evacuations were now called aeromedes.

beginning of 1960 operations were concentrated in the north and the troops employed were mainly Malay, Australian and New Zealand. The helicopter crews, although still faced with the same difficult terrain, were no longer under the unremitting pressure of earlier years. The war had been won and although trooplifts and aeromedes continued in some degree until early 1963 the emergency ended formally in August 1960 when the atmosphere became more relaxed. Seaside Butterworth was much more congenial than the humid claustrophobic atmosphere of Kuala Lumpur and the flat open paddy fields were a welcome relief from the sinister jungle. Most families lived on Penang Island, then and until after the Borneo campaign a most popular leave centre.

In February 1960 the Sycamores began to emerge from their enforced retirement, trials being held at Kuala Lumpur with a new batch of rotor blades. The tests were satisfactory (91) and in the course of the next four months the Sycamores began once more to replace the Whirlwinds a year later than originally planned, the last of the Whirlwinds leaving in June 1960 and the thirteenth and final Sycamore arriving on the squadron in the following September. The modified Sycamore blades, combined with a new clearance to use an extra 2" engine boost, were now giving a very satisfactory performance. (92)

Of special interest among Sycamore operations between the summer of 1960 and the end of 1962 were: the rescue in July 1960 (in conjunction with the FEAF Jungle Rescue Team) of two Australian pilots who had ejected into the jungle after a collision; and the lifting three months later of 200 men of the East Anglian Regiment by shuttle with four aircraft. In July 1962 a record lift of 582 troops and 9,300 lb of freight was carried out by nine Sycamores. By the end of 1962 however operations had been reduced to the basic tasks of aeromed (a total of 822 had been carried out since the unit moved to Butterworth) and the regular communications flights around the jungle forts, a task known as Fort Express. Additionally, every six months or so two Sycamores were required to take part in internal security exercises in Singapore, helicopters having been included in these since the 1956 riots. (93)

From 1958 to 1960 as Sycamores replaced Whirlwinds (1958), Whirlwinds replaced Sycamores (1959) and Sycamores replaced Whirlwinds again (1960), aircraft type conversions for new pilots were included in the normal squadron operational training responsibilities. In addition, No 110 Squadron attempted some experimental night flying training in June 1961 - the first helicopter night flying for those pilots who had undergone basic training at CFS before it became part of the syllabus. As for a formal CFS categorisation scheme, none was applied to No 110 Squadron until July 1962 (when crews found little

difficulty in reaching a very satisfactory standard), although there had been periodic standardisation visits by a CFS helicopter team since 1955. (94)

There was a short hiatus in September 1962 when a fatal accident was found to have been caused by tail rotor blade disintegration. (95) All Sycamores tail rotor blades had then to be replaced by sets with a different blade finish - final proof, if any was still needed, that the use of wooden components in Malayan atmospheric conditions was a recipe for trouble.

In October 1962 one Sycamore was detached to Gan in support of the RAF Regiment which had been sent to the Maldives in response to civil unrest there (Operation Flair). The aircraft returned to Butterworth in February 1963. A Sycamore was again sent to Gan in September 1963 for SAR duties where it remained until June of the following year to be activated if required, although the crews were withdrawn in the previous October. The aircraft was never called upon to function in the SAR role. (96)

For the helicopters in Malaya 1963 was a period of transition between the end of Malayan operations and the start of the Borneo campaign, and throughout that year No 110 Squadron had concurrent responsibilities in both areas. The operations in Borneo began in December 1962 with the Brunei revolt and on Christmas Eve two Sycamores were flown to Seletar and taken to Brunei by Beverley to support the ground troops there. (97) The build up of helicopters in Borneo was to come mainly from the United Kingdom but the initial two Sycamores from No 110 Squadron - itself the resident helicopter garrison - were reinforced by a third in January and developed gradually into a permanent detachment continuing throughout the year. In addition, in July a long term detachment of six Whirlwinds Mk 10 from No 110 Squadron began operations at Kuching in Sarawak.

The second generation of RAF operational helicopters was now beginning to appear in the form of Belvederes and Whirlwind Mk 10s, turbine engined helicopters to replace their piston engined predecessors (Phase 3). The Mk 10 Whirlwinds began to arrive on No 110 Squadron in July 1963 and replaced the Sycamores on the Brunei detachment in September, moving to Labuan in February 1964. (98)

As Seletar was the new main helicopter base in the Far East No 110 Squadron found itself operating the Brunei and Kuching detachments through Seletar, while continuing to meet the Malayan support commitment from Butterworth.

Trooplifts were still continuing in the north of Malaya and in April 1963 a detachment of Sycamores was sent to Kroh in support of joint Malayan/Thai troop operations over the Thailand border; by July the cumulative total of aeromedics had reached 1,221. (99)

From July 1963 Whirlwind Mk 10s gradually replaced the Sycamores, although the latter continued to support Malayan operations until September 1964 when they were finally withdrawn from the Far East with the exception of two retained at Seletar until May 1967 for VIP communications duties.

In January 1964 Seletar became the squadron base and Butterworth the detachment for the disappearing Malayan commitment, reduced by the latter part of 1964 to a search and rescue standby - with Whirlwind Mk 10s - on behalf of the Australian fighter squadron at Butterworth. Support for the jungle forts came to be provided by the new Royal Malaysian Air Force using Alouette helicopters and Pioneers, and RAAF Iroquois helicopters also began to carry out some of the tasks. The RAF Butterworth detachment was finally withdrawn to Seletar in October 1964 except for one Whirlwind Mk 10 left behind for SAR duties. All effort was now directed to Borneo. (100)

### Helicopter Crewman

From 1950 to 1965 helicopter crewmen were found from among servicing personnel. The need for them had been officially recognised at the time of the Casualty Evacuation Flight (1950-52) and they were formally included in the establishments of Nos 194 and 155 Squadrons at corporal or junior technician level. The shortage of helicopter ground crews, however, meant that this part of the establishment was rarely filled. As late as November 1954 No 194 Squadron still had no crewmen posted to it to fill its eight vacancies, and was selecting and training technicians as crewmen from among its own servicing personnel. (101) With the arrival of the Whirlwind with its passenger compartment separated from the pilot the need for crewmen became all the more urgent, but power limitations still prevented them from being carried on the final stages of operational sorties, and with the aircraft away from base the technician function of the crewman was still regarded as of first importance - a situation which still continued even with the growing frequency of maritime SAR tasks after 1960 when No 110 Squadron was based at Butterworth. The technical personnel chosen were trained to a perfectly acceptable standard on the squadron - winch operations were included in the training - and it was not until the end of 1965 that they were replaced in the Far East by senior NCO aircrew in the form of retrained flight engineers. (102)

### Summary

Between 1952 and 1960, the formal end of the Malayan emergency, the total number of troops lifted by helicopter exceeded 110,000. In the communications role 19,000 passengers and two and a half million pounds of freight were carried. Between 1950 and 1960 almost exactly 5,000 casualties were

evacuated by helicopter in Malaya, numerous lives being saved in the process. (103) In addition, helicopters had been largely responsible for carrying the offensive to the terrorists' jungle hideouts, a major factor in their ultimate defeat.

So ended an era not merely for Malaya, but also for the helicopter which had begun its service as a very doubtful proposition and at best a useful adjunct to ground operations, and finally became established as an essential element in fighting the guerrilla kind of war.

#### THE INFLUENCE OF THE MALAYAN EXPERIENCE ON THE CHOICE OF THE NEXT GENERATION OF HELICOPTERS

From 1953 until the end of the Malayan emergency the normal helicopter roles in Malaya remained on the one hand casualty evacuation, communications (passengers and light freight mainly for the jungle forts), VIP transport and special tasks; and on the other tactical troop movements, logistic re-supply and heavy freight lifting (eg earth moving and construction gear to build light aircraft strips and the jungle forts). In both cases the choice of helicopter was natural and inevitable: the Dragonfly and its successor, the Sycamore, for the lighter tasks, the S-55 and its successor, the Whirlwind, for the heavier lifts.

There was however little chance at that stage of influencing the numerical balance between the larger and smaller types of helicopter because at no time was there enough of either to meet all demands. By the time that success was in sight in Malaya mounting demands for helicopters elsewhere led to a shift in priorities. In consequence, the choice of helicopters for Malaya continued to be dictated by the shortage of resources. Nevertheless, the theories generated by the Malayan experience as to the kind of helicopters needed were to have a profound influence on the next major stage in helicopter development.

The surprisingly disappointing performance of the Whirlwind Mk 4 in Malaya was one of the factors influencing the timely decision to abandon the larger and more powerful (but heavier) Leonides Major piston engined version and obtain instead the Gnome turbine engined Mk 10 which was to give many years of excellent service in the RAF. The need for a medium sized helicopter able to carry 15 fully armed troops or 5,000 lb of freight was confirmed and provided much of the impetus which finally brought the Belvedere into existence. The Whirlwind Mk 10 and the Belvedere made up the RAF helicopter contribution to the Borneo campaign, in the course of which the helicopter was once again seen to be a crucial factor in operational success.

Argument tended to centre on the size of the helicopter in relation to the number for which financial resources were available; very little attention was paid to cruising speed in the 1950s. Unlike the American experience in Korea where little or no vertical performance was needed in a largely treeless terrain and where operations were normally conducted at or above the officially permitted aircraft all-up-weight, VTOL performance was what mattered in Malaya and ranges were generally very short. It was seemingly irrelevant, therefore, that an aircraft which could climb 200 feet vertically out of the jungle could then fly at only 60 knots.

Thus the British military requirement was for VTOL performance, payload and cabin space, and it was left to civil operators with their concern with flying time (ie expense) per pound weight or per passenger to demand higher cruising speeds. The relationship between cruising speed and the weight lifted in a given time by a given number of helicopters came to be recognised by the military only some years later when the shuttle type of operation became standard. Until then larger and more powerful helicopters were seen as the whole solution.

It was this attitude which explains, at least in part, why no steps were taken officially to propose the redevelopment of the autogiro with VTOL capability. It also explains by contrast the enormous civilian effort to build and demonstrate the Rotodyne. Meanwhile, in the early 1950s, RAF and Naval hopes were centred on the development of the twin engined, twin rotor Bristol 173 which seemed to be the aircraft most likely to provide the lift capacity required for both the trooplifting task and the anti-submarine role, and from which the Belvedere eventually emerged. Both the Gnome engined Whirlwind and the Belvedere appeared in 1960 and it was on these that the development of helicopter operations in Phase 3 were mainly to depend.

## CHAPTER 4

### WIDER POLICY DECISIONS

So far, helicopter policy decisions have been considered only in relation to the urgent requirement for helicopters generated by the Malayan emergency. Admittedly, the demonstration of the helicopter's potential by the Casualty Evacuation Flight and the pressure exerted by the Director of Operations in Kuala Lumpur did produce a great upsurge in helicopter production and an increase in general interest, and in due course similar demands for helicopters were put forward in Cyprus and - on a smaller scale - elsewhere.

It would be wrong, however, to conclude that RAF activity in this field was inspired solely by operational pressures. Rather do these pressures seem to have been a justification for the very considerable effort, frustrated mainly by lack of money, already being made by the Air Ministry to introduce the helicopter in a wide variety of roles. The sudden expansion of the helicopter force which occurred in 1953 and 1954 justified earlier hopes, thwarted by the inadequacies of the R-4 and R-6, but it still fell far short of what the Air Ministry intended. That the helicopter was only reluctantly adopted by the Air Ministry was therefore a gross oversimplification of a complex problem, one aspect of which was the conflict of priorities which the RAF had still to resolve.

Air Ministry policy at the start of the second phase of military helicopter development can therefore be understood only against the background of its earlier efforts to develop the helicopter before the Malayan emergency introduced a note of urgency. In October 1945 the War Office could do no more than ask quite simply for two types of helicopter, one light, one load carrying; development in Britain had not yet reached the stage where the requirement could be stated with greater precision. (1) The Air Ministry accordingly asked the Ministry of Supply to put three types of helicopter in the 1946-47 research and development programme: a two seater AOP helicopter, an eight to ten seater, and a flying crane with a ten ton lift capability. (2)

In January 1947 an operational requirement was issued (OR 232) for an AOP helicopter based on projects in hand at the Bristol Aeroplane Company and at Fairey Aviation Ltd (the Sycamore and the Gyrodyne), but there was no project then in being which might meet the other two requirements. (3) The Land/Air Warfare Committee was therefore asked by the Air Ministry to define its needs more precisely. However, in December 1947 Service interest in the Bristol and Fairey projects was withdrawn as a result of the

economy measures being recommended by the Defence Research Policy Committee (DRPC). (4) The War Office concurred in this decision and it was agreed to wait until a suitable helicopter had been produced to meet civil needs and buy it 'off the shelf' if necessary. (5) It was therefore financial stringency which produced the situation in which the RAF found itself at the beginning of the Malayan emergency when it had no suitable helicopters available.

Early in 1948 the Ministry of Supply offered to allot one of the three Sycamores, then on order, for evaluation. The offer was gratefully accepted. (6) By mid 1951 the Hoverflys at Middle Wallop, with which No 657 AOP Squadron had been endeavouring to keep alive the use of helicopters for AOP work, had been grounded for over six months because of old age and the total absence of spares. (7) In replacement the Air Ministry offered three Sycamores in late 1951, enabling No 1906 Flight to continue - ostensibly in the AOP role, although in practice these essentially civilian passenger aircraft (with the military designation Mk II) were used, until the appearance of the Skeeter in 1957, mainly for carrying VIPs and for light liaison tasks during Army exercises. For the earlier part of this six year period (1951-57) they were almost the only military helicopters in the United Kingdom apart from the embryonic SAR squadrons which were building up slowly through 1953 and 1954 and the CFS helicopter unit which also dated from 1954. They did much to stimulate enthusiasm among senior officers, successive Chiefs of the Imperial General Staff being regular passengers as well as the AOCs-in-C of Fighter Command and the AOCs of No 81 Group in whose formation they were established. (8)

The Army's policy for helicopters was defined in successive Land/Air Warfare Policy Statements. No 9, issued in 1949, laid down a requirement for a general purpose helicopter with casualty evacuation, communications and the carriage of light freight as its main roles (9) and this requirement eventually formed the basis for the order for three Dragonflys for the Casualty Evacuation Flight in Malaya. This order however was the result of force of circumstances and the Dragonfly came nowhere near to meeting the requirements laid down by the Air Ministry (OR 280 issued in 1950 in response to Land/Air Warfare Policy Statement No 9) which called for a very advanced performance particularly under tropical conditions. (10) The Sycamore and Whirlwind were likewise makeshift attempts to meet an urgent military commitment and the Air Ministry was well aware that neither could ever meet the requirements of OR 280 even if the Whirlwind was re-equipped with the Leonides Major engine (a development which in consequence was temporarily abandoned in September 1953). (11)

### The General Purpose Helicopter

By this time, however, experience had shown that OR 280, as it stood, was not the best or most economical way of meeting the full requirement for a general purpose helicopter, and it was decided that the needs of both the Army and the RAF could best be met by two types: one able to perform small scale casualty evacuation and light liaison tasks for the Army, and a second and larger twin engined helicopter for the more rigorous casualty and troop transport requirements. The Sycamore Mk 14 was accepted for the lighter roles, and OR 325 was issued in April 1954 for a general purpose version of the twin engined twin rotor Bristol 173. (12) There were therefore two further types still to be found: the two seater AOP aircraft and the 10 ton crane lift.

### The AOP/Light Liaison Helicopter

As early as July 1948 the Air Ministry had asked the Ministry of Supply to keep it informed on the development of the Cierva Skeeter which seemed to be a possible contender in the AOP role. (13) The prototype which flew in 1948 was not a success and the Mk 2 version which followed was rather larger and considerably modified. The Air Ministry was understandably anxious not to commit itself to a production order without convincing evidence that the aircraft would be successful - a reluctance which no doubt contributed to the feelings of frustration evident at the War Office, where the slowness of helicopter development was the target of some criticism.

Development of the Skeeter, however, turned out to be a very slow and sad story mainly owing to severe ground resonance problems which led to the loss of two of the three prototypes. In November 1952 the War Office revised its 'outline user requirements' for an AOP helicopter and reissued them in a paper entitled 'Military Characteristics of an Ultra Light Helicopter', (14) which called for a small, simple and robust helicopter with an advanced performance for the AOP, reconnaissance and communications roles. The resulting OR 319 (Ultra Light Reconnaissance Helicopter) was sent by the Air Ministry to the Ministry of Supply for action in July 1953. Seven aircraft firms produced design tenders, the winner being Fairey Aviation whose design was selected because the Ministry of Supply considered that it was the only one which could be produced in time to meet the target date of June 1957. The order, however, was cancelled, partly on economy grounds, and attention returned to the Skeeter which by 1954, although still in prototype, had been equipped with the Gipsy 10 engine and at last showed signs of having reached an acceptable stage of development at AAEE, Boscombe Down. It was, however, January 1957 before the first delivery could be made to No 1906 Flight of No 657 Squadron for AOP work. (15)

## The Heavy/Medium Lift Helicopter

When proposals for a 10 ton crane helicopter and a 10 passenger transport helicopter were shelved in 1947 - in the hope that both might be developed by civilian enterprise - the two projects were referred back to the Land/Air Warfare Committee for a more detailed definition of the requirements. (16) At the same time the Air Ministry maintained its interest in the development of the single engined three rotor Cierva Air Horse as a possible future contender for the Army's heavy lift requirement. It seemed however to be too small for the purpose and the Ministry of Supply was told by the Air Ministry that although the Army had referred to it hopefully in Land/Air Warfare Policy Statement No 7 a much larger capacity would be needed. (17) In 1948 the Air Ministry's interest in the Air Horse was reaffirmed and the Ministry of Supply was asked to continue reporting on its development and particularly on the results of its initial flight trials. (18) The first prototype flew in December 1948 but crashed in March 1950; as a result there was a serious setback to development and after considerable redesign and ground running work the project was abandoned in 1953.

From the experience gained with the Air Horse, it was evident that the development of a helicopter to meet the heavy lift requirement was a long way off - it proved in fact to be even further away than was thought at the time. Meanwhile, the War Office had produced a more detailed requirement calling for a lift of 10,000 lb over a 75-100 nautical mile radius of action; this was put before the Land/Air Warfare Transport Sub-committee in August 1951. (19) At about the same time British European Airways (BEA) announced their intention to issue a requirement for a large passenger helicopter and, as their requirement seemed to match that of the Army, the Air Ministry agreed to enter into consultation with BEA in the hope of producing a joint requirement. (20)

A considerable amount of work was done along these lines in 1952 and although a draft operational requirement was produced no action could be taken to issue it until a paper stating the helicopter requirement for the Services had received the approval of the DRPC. At a meeting in October 1952, however, the DRPC decided that in view of the research and development costs it could not approve the development of a helicopter to meet the heavy lift requirement. (21) So ended the Air Ministry's first attempt to hasten the development of a helicopter in this class.

In the years after 1945, therefore, the financial restrictions to which the Air Ministry was subject had twice been the cause of severe cutbacks in the research and development programme, in 1947 and again in 1950. The production of offensive aircraft inevitably took precedence over helicopter

development and there could be no question of risking funds on helicopter projects before they had been proved successful by industry. This policy was fully justified in the case of the Air Horse, and the Fairey Gyrodyne, into which the Air Ministry might have sunk considerable funds before finding that both were failures in their existing form. (22)

All this activity was quite separate from - though coincidental with - the urgent steps taken to provide helicopter support for Malaya. The Air Ministry's reluctance to be stampeded into committing itself to unsatisfactory helicopters was thus based on practical experience rather than on what might appear to the recent convert to be a distaste for a radical new development.

To sum up: the Air Ministry had not wanted the unsatisfactory Dragonfly, but had been compelled to accept it, replacing it with the Sycamore as soon as possible. Even before the Whirlwind Mk 4 had arrived in Malaya and seemed likely to prove a fiasco, OR 325 had been issued (April 1954) and the Bristol 173 selected, not as a heavy lift helicopter but as a general purpose aircraft - to do the task required of the Whirlwind. The Sycamore too had been provided for the AOP task pending the fulfilment of OR 319 (the ultra light helicopter) with the Skeeter as a doubtful 'long stop'; the 10 ton heavy lift project had been abandoned on the grounds of cost. With so much accomplished the Air Ministry could turn its attention to its own pressing requirements in the helicopter field: anti-submarine, search and rescue, pilot training and communications aircraft.

The communications role was in fact the first task to be identified in practical terms, as the result of a tentative inquiry in June 1950 from the Secretary of State for Air to DCAS about VIP transport between Whitehall and Northolt. (23) The idea was quickly discouraged on the grounds of expense. The SAR role, however, was an obvious need, but there was still no firmly established military requirement on which to base a positive demand. (24) The Air/Sea Warfare Development Unit (ASWDU) was another clear contender and the SAR function was expected to emerge in conjunction with it.

Two years later the picture was little clearer, but official attitudes had changed considerably: it was now recognised that there was an immediate need to put an adequate number of helicopters into service not only to gain wide operating experience but also to stimulate industry to undertake the design and production of more advanced types. (25)

At an Air Council meeting in June 1952 the whole field was surveyed again and a number of tentative conclusions were reached which give some indication of official intentions at the time. The Sycamore would be found a suitable role at home although its rotors were thought to be too low for Malayan operations.

That there was now a definite requirement for helicopters in various parts of the world was accepted. Indeed, VCAS said that the RAF must experiment in the helicopter field and help in encouraging the aircraft industry to develop new types, adding that if more helicopters were ordered than were actually needed, there would be no difficulty in disposing of them to other countries where there was already a market for them.

Plainly the restraining factor in helicopter development was the difficulty in formulating a precise enough justification for their use in advance of practical experience. However, it was decided that in addition to the Malayan requirement which seemed to justify a general transport squadron (18 S-51s and 6 S-55s), the order of priority was the Air/Sea Warfare Development Unit (already formed with three Sycamores), a Search and Rescue Flight each for Fighter and Coastal Commands and, somewhat doubtfully, No 1906 AOP Flight with Sycamores. (26) A transport squadron in Transport Command was accepted as a reasonable proposition, but the establishment of a full squadron in Malaya was held to cover that need, at least for the time being. In addition, VCAS proposed an evaluation of the Bristol 173 in the maritime and army support roles, in conjunction with the BEA study for a 30/40 seater civil helicopter, with the Army bid for a 20,000 lb lift helicopter in mind. There was still some hope that the Fairey Rotodyne, then in an early stage of development, might show the way in this respect. (27)

Such was the state of official opinion when, in 1953, events began to race ahead of policy, starting with the rapid build up in Malaya already described. At this point, however, the reliability of the helicopter was challenged at a high political level. The Prime Minister (Winston Churchill) asked for accident figures for the year ending April 1953. (28) and a list was submitted showing two Dragonflies destroyed in Malaya and four Sycamores at home. The RAF rate was 18.75 major accidents per 10,000 hours (6 in 3,200 hours). Three of these accidents involved fatalities; in one case a soldier walked into a Sycamore tail rotor during relief operations in Holland in February 1953 when all available helicopters were sent there to help in the aftermath of disastrous floods. On 15 July 1953 the Prime Minister followed up his original inquiry with a request to the Secretary of State for Air for a report (in not more than 1,000 words) on the feasibility of using large parachutes stowed in the rotor pylon to protect helicopters from the consequences of engine failure below 300 feet. It was further suggested that the engine itself might be jettisoned by an emergency lever, so slowing the helicopter down, a 'good bump' being preferable to a fatal crash. (29) These inquiries, however, had two salutary effects: they reminded large sections of the staff that helicopters could no longer be ignored, and they led many to brief themselves rapidly on the auto rotative characteristics of the helicopter at various heights and speeds in order to refute such absurd suggestions.

Two further events in mid 1953 contributed to the atmosphere of urgency which was beginning to pervade more and more departments. Lord Dowding announced his intention of raising in the House of Lords the question of establishing SAR helicopters in the Suez Canal Zone, (30) and he was advised by the Air Staff that the C-in-C Middle East had asked for one helicopter each to be provided for the Canal Zone/Sinai, Aden and Jordan/Iraq.\* (31) A few days later the Minister of Supply wrote to all departments concerned with helicopters asking for a meeting to discuss probable future requirements; development at home, he said, had suffered because too few helicopters had been ordered. (32) In particular, the design studies for the 40/50 seater helicopter submitted by the five leading helicopter manufacturers (Bristol, Fairey, Saunders Roe, Percival and Westland) to meet a BEA requirement should be co-ordinated with the needs of other potential users.

The reply from the Minister of Defence (Earl Alexander) was distinctly unenthusiastic; he pointed out that neither the Royal Navy nor the RAF would require in the foreseeable future a helicopter larger than what would be termed 'medium' and that the only possible military requirement for a helicopter of the size proposed was 'a not very clear one for a heavy helicopter for the Army'. (33) Lord Alexander pointed out that the Chiefs of Staff had not given a very high priority to helicopter development and hinted that if the radical review of defence expenditure then being carried out led to cuts, helicopters would be among the first to suffer.

Nevertheless, the meeting which the Minister of Supply had proposed did take place on 30 June 1953 and the three Service ministries as well as those of Defence, Supply and Civil Aviation were obliged to state their current attitudes. The Ministry of Supply felt that the Americans were forging ahead in helicopter development mainly because substantial orders were being placed for helicopters, while the United Kingdom had nothing more than a few hopeful projects and some unco-ordinated aspirations on the part of the Services and civil aviation.

The Admiralty restated its firm requirement for SAR and anti-submarine helicopters, the former need being met by the S-51 and S-55 and the latter by either the projected Bristol 173 or, if that was too large and expensive, the S-55. The possibility of a 40/50 seater troop transport was envisaged, but not as an Admiralty responsibility.

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\*AOC No 205 Group in the Canal Zone had asked for SAR helicopters in the previous year, but had been told that there were not enough available.

The Army reiterated its ultra light helicopter requirement, mentioned the slightly larger casualty evacuation helicopter (confirming that this was an Air Force responsibility) and reported that a working party was expected to confirm within three months a War Office requirement for a heavy lift helicopter for tactical use.

BEA considered the Rotodyne too noisy and the RAF said that its take-off performance would not meet the military requirement. The Bristol 173, in BEA's view, was too small for economic operation; the RAF said that discussions with BEA had revealed a difference in their technical requirements, the military need being for powerful vertical lift while BEA required speed (see above p 94 ).

Mr Profumo for the Ministry of Civil Aviation, however, professed to have detected a certain community of interest between the Services and suggested that the Bristol 173 should be ordered for the good of the export market; BEA might be able to order 10, financial problems notwithstanding, in order to get the aircraft into service. Mr Nigel Birch for the Ministry of Defence warned of impending cuts in defence expenditure which would leave little room for helicopters. Mr Low for the Ministry of Supply reiterated that helicopter development could be undertaken only if there was more than one user, and that if the Services did not share in the costs it would be uneconomic to develop a large helicopter for civil purposes.

The course taken by the discussion tended to encourage a suspicion already existing in RAF circles that the real purpose of the meeting was to persuade the Services to support research and development on behalf of civil aviation as well as themselves, (34) whereas Air Staff policy was to await the successful development of a civil aircraft and then buy it for the Services.

At the end of this important and revealing meeting the surprising conclusion was agreed that while technical experts from all parties concerned would continue to explore the possibility of moulding the various requirements for a large helicopter into one development project, an order would be placed for the Bristol 173 and the various departments involved would co-ordinate their production demands. (35)

So, the heavy lift helicopter, stifled in 1952 by the DRPC, was thrown back into the melting pot at the very point where a joint agreement was all that was needed to obtain full backing for its production. The opportunity was not to recur within the time scale of this history and by the time that BEA had begun to buy its own larger passenger helicopters from the USA in the 1960s, the financial restrictions on the RAF were so severe that an intention

to purchase, reformulated annually, was withdrawn at the moment of decision (also annual) and some 24 years later there was still no heavy or even medium lift helicopter in service.

However, the political decision taken at the time to go ahead with the Bristol 173 (neither a medium nor a heavy lift helicopter), apparently on purely commercial grounds, had a most significant consequence: after many vicissitudes it resulted in the eventual appearance in 1961 of the Bristol 192 or Belvedere, just in time to play a major part in the Borneo campaign and in operations in the Aden area.

By 1953 tension between the Army and the RAF was considerable and tending to increase. A formal bid by the Army early in that year for the more rapid development of experimental transport helicopters had received an equally formal reply from the Air Council: the Army's desire to obtain wider experience of the helicopter in all theatres was well understood, but the restrictions imposed by the defence budget coupled with the inadequacies of technical development in the helicopter field made it premature to proceed with the formation of helicopter transport units at the inevitable expense of combat units. (36) Within the ministry, the Air Staff was making the point that although the helicopter front line was small, the RAF was far from indifferent to the possibilities which the helicopter opened up, and it was therefore of prime importance to spend money on research and development rather than on large numbers of current aircraft for which there was no essential task. (37) The cause of the tension between the Army and the Air Force was thus clearly revealed.

In mid 1953 therefore the known operational commitments, apart from Malaya, consisted of the development of the newly established SAR unit in Fighter Command based at Linton-on-Ouse, the Air/Sea Warfare Development Unit at St Mawgan (from which was to be formed a SAR unit in Coastal Command), the provision of three SAR helicopters for the Middle East Air Force as a result of prodding from Lord Dowding, and the maintenance of No 1906 AOP Flight at Middle Wallop, which the Army was clearly prepared to defend, come what may (even if it was used mainly for VIP transport).

Almost at once two further commitments appeared. Some action had to be taken to put training on a better footing than that provided by the ad hoc civil contracts or the unsupervised unit type pilot conversions which had been organised in the absence of formal Service arrangements. Secondly, the question of VIP transport was brought suddenly to the fore at the end of May 1953 when the Duke of Edinburgh expressed a wish to the Captain of The Queen's Flight (Sir Edward Fielden) to fly by helicopter from Buckingham Palace to Pirbright and Woolwich. The Chief of the Air Staff, when con-

sulted, replied that if a formal request was made he would advise the Secretary of State that while there were only single engine helicopters available, flights by VVIPs such as the Duke of Edinburgh over central London involved dangers which, although slight in terms of risk, would nevertheless not be justifiable, especially just before the coronation. (38)

The Duke of Edinburgh, however, obtained a helicopter from the Admiralty and flew to Pirbright, to the embarrassment of the Secretary of State for Air who had not been consulted by the Admiralty. (39) Urgent arrangements were therefore made to ensure that a helicopter would always be available in future, since it was obvious that the request would be repeated, and a few months later in early 1954 a RAF helicopter appeared in The Queen's Flight, borrowed from the Central Flying School.

In the previous December agreement had been obtained from the London County Council for the former Festival site on the south bank of the Thames to be used by Service VIP helicopters, while it remained available and subject to permission being sought on each occasion. (40) VIP helicopter transport was thus established on an official basis.

All the same, it remained official policy that since helicopters were 'the most expensive form of mechanical transport in existence' they were to be employed only on tasks which could be shown to be essential and not merely desirable. (41) The Air Staff was informed that the cost of providing the general purpose transport squadron desired by the Army, so increasing the existing force of 34 helicopters by 50 per cent, was equivalent to that of half a squadron of Swifts (at 22 UE). (42) In retrospect the equation might seem an excellent reason for providing helicopters, but in 1953 it justified an automatic, immediate and total rejection of the proposal. However, the opportunity was taken to emphasise once again the Air Ministry's keen interest in research and development and the Air Staff's confident expectation that the results would lead to a soundly based expansion of the helicopter element in due course. (43) In the meantime, a strong bid for helicopters to be established for civil defence purposes was not unexpectedly thrown out by the Chiefs of Staff Committee. (44)

As far back as February 1952 Flying Training Command had put in a bid for a helicopter establishment at the Central Flying School (CFS) and the Royal Flying College at Manby for the study of instructional techniques and procedures. (45) The Malayan situation, however, had led to so severe a shortage of helicopters that there was no way of satisfying the requirement at the time, though note was taken of it as a future commitment. In late 1953 it was decided that with Sycamores replacing Dragonflies in Malaya, a unit

could be set up in CFS, equipped initially with three Dragonflies, to develop a training plan and the instructional techniques for pilot training; the CFS helicopter unit accordingly came into existence in May 1954.

Between mid 1953 and mid 1954 the Air Ministry was engaged in a hectic round of consultations as they juggled with conflicting priorities - on the one hand the overriding needs of the Malayan emergency, and on the other the replacement of the Air/Sea Warfare Development Unit's Sycamores with S-55s or Bristol 173s (the latter were nowhere near ready). At the same time the conflict between the build up of the MEAF, Fighter and Coastal Command SAR units, the priorities of CFS helicopters and pilot training facilities, and the demands of VIP transport and The Queen's Flight continued against the background of a chronic shortage of aircraft and the continual failure to meet promised delivery dates. In May 1954 the Vice Chief of the Air Staff found himself having to explain to an angry Secretary of State for Air that the promise of helicopters for the Middle East made to Lord Dowding in the previous year had still not been honoured because of the need in the light of Malayan trials experience to modify the Mk 11 and 13 Sycamores to produce the Mk 14. (46) Delivery was promised for September.

#### Army/RAF Helicopter Responsibilities

In December 1953 the Air Council made a series of major policy decisions which defined the place of helicopters in the Royal Air Force, and at the same time took the fundamental step of passing responsibility for the operation of light helicopters to the Army. (47) The intention was to counter the false impression felt to be current that the RAF was unduly backward in the helicopter field and not sensitive enough to the demands of the Army. After due discussion the dramatic proposal put forward by the Deputy Chief of the Air Staff was accepted: that 90 ultra light helicopters should be provided to replace the 112 AOP Austers in the AOP and light liaison roles and that they should be flown and controlled entirely by Army personnel. In addition, the existing No 1906 AOP Flight should continue with its three Sycamores until they had to be withdrawn.

The reduction in aircraft numbers (from 112 to 90) was to be balanced by giving the Army access to RAF Pioneers or Beavers and to communications helicopters, the latter being established at the rate of two Sycamores at each RAF command headquarters, eight in Germany and two at Hendon for Air Ministry use. (Of these communications helicopters only the two at Hendon received financial approval and even they did not become available until helicopters were added to the Metropolitan Communications Squadron at Northolt seven years later.)

It was also agreed that positive action should be taken over the Army's desire to study the use of tactical troop/cargo helicopters in forward areas by creating a new unit in Transport Command, initially with four Whirlwinds which would be replaced in due course by Bristol 173s. The unit was to be available for exercises on the continent as required and would study freighting techniques with the Army. It would also act as an emergency pool, so releasing the RAF from its dependence on the Admiralty and the United States in such circumstances.

On the RAF side continued support was affirmed for the four categories of research and development: ultra light, basic training, general purpose and anti-submarine. Considerable increases in the front line establishment were also agreed: the number of SAR Sycamores in No 275 Squadron, Fighter Command was to be increased from eight to 16; the eight SAR Whirlwinds planned for No 22 Squadron in Coastal Command were to be replaced by Bristol 173s, as were the three Whirlwinds planned for the Air/Sea Warfare Development Unit. (48) Two Sycamores were to be established in the SAR role at the Armament Practice Camp at Sylt, and in anticipation of future training requirements 10 ultra light helicopters were included in the total package whose cost - £4½ millions - would have to be found at the expense of some other project. The Air Council hoped that its action in placing AOP and light liaison helicopters under Army control and in creating a tactical helicopter unit in Transport Command would remove a long standing source of friction between the War Office and the Air Ministry. (49) It did not.

On 24 May 1954 War Office frustration at the continued absence of battle-field helicopters boiled over into a frontal attack on the Air Ministry launched by the Secretary of State for War (Mr Anthony Head). (50) On this occasion the requirement put forward was for helicopters to replace road vehicles against the background of a nuclear war, the Army arguing that as it was not fair to expect the Air Ministry to give up other aircraft to provide helicopters for another Service, that other Service (the Army) should have full authority to buy (and control) its own. Head discounted the Air Minister's claim that aircraft were his sole responsibility on the grounds that the helicopter was only 'a very distant cousin of the aeroplane' and would be used 'exclusively for functions which are the close and domestic affairs of the Army'. The echoes of 1912-17 and of the Fleet Air Arm controversy of 1937 were not lost on the Air Minister and the attack was repulsed. (51) Further evidence of the Army's intention to gain

complete control was provided by an article in the Manchester Guardian of 8 May 1954 - in itself proof that there was no intention on the Army side of confining the discussion to an 'in-house' debate.\*

History was now repeating itself with the Army in the role played by the Navy after the First World War. Within three years (in 1957) the establishment of the Army helicopter force (officially for AOP and light liaison duties), accompanied by a further Air Ministry initiative which passed the responsibility for operating the Beavers to the Army, was to justify following in the footsteps of the Fleet Air Arm in 1937 and lead to the formation of the Army Air Corps.

Another example of the delicate state of Army/Air Force relations at this time was the question of obtaining landing sites in London for VIP helicopters. In addition to the clearance given to the South Bank site for civilian use (see p 104) Buckingham Palace had been cleared for royal flights under pressure from the Duke of Edinburgh. However, No 657 AOP Squadron, established with Sycamores and Army pilots, was in the habit of flying Army VIPs into Burton Court, Chelsea, a site which after official examination was declared to be definitely unsuitable. The Secretary of State for Air, being responsible for these RAF aircraft, felt it necessary to bring Army pilots into line with generally accepted safety standards, but thinking that a ban would be resented in view of the Army's mistaken belief that the RAF was lukewarm about the provision of helicopters for Army purposes, invited the Minister of Transport and Civil Aviation to originate the letter which he would otherwise have sent himself. (54) The Army, however, continued to fly VIPs into Burton Court until the Westland heliport at Battersea opened on 23 April 1959.

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\*An insight into the situation in the Air Ministry at the time is provided by the use to which the Air Staff put a detailed requirement from SACEUR for the provision of helicopter borne radar aids to navigation for the NATO bomber force, to be available for instant deployment throughout the AIRCENT tactical area in Europe by day and night, and in all weathers, in large, low flying helicopters. (52) There was scarcely any need to comment on the absolute impracticability of meeting this requirement in the foreseeable future, and the request was forwarded by the Chief of the Air Staff to the Air Minister as ammunition in the controversy over RAF control of helicopters in forward areas. (53)

A further source of conflict was the projected heavy lift helicopter. In 1954 there were high hopes of the Fairey Rotodyne which many confidently expected would go into service with the civil airlines. The RAF, however, was sceptical about its usefulness to the Service, mainly because it did not believe that the Rotodyne's hovering performance and vertical lift would meet the Army's requirements. (55) Moreover, at night with tip jets in action it would resemble a huge Catherine wheel and make an unprecedented amount of noise; it could hardly therefore be described as tactically discreet. In addition, the RAF was very concerned about using such a technically complicated machine in forward areas. (56)

However, on 25 September the War Office informed the Ministry of Supply directly of their staff requirement for a heavy cargo helicopter, pointing out that the characteristics sought were close to those of the proposed Rotodyne. (57) The Air Minister then circulated his copy of the Army statement to the heads of the Air Staff branches in the Air Ministry with the comment that it appeared to be the Army statement of requirement promised 'within three months' time' at the meeting held on 30 June 1953. (58) In the event the Rotodyne was not purchased and the second prototype was never built.

The RAF still pinned its hopes firmly on the Bristol 173 while waiting for the heavy lift requirement to be formulated adequately and practical evidence to be produced that a suitable helicopter was likely to be available. (59) As the Bristol 173 meanwhile seemed likely to fulfil a variety of existing roles there was considerable anxiety in the Air Ministry (well justified as events were to prove) that the Navy would again go to the head of the production line, as it had done with the Dragonfly and Whirlwind, by placing firm orders for large numbers of the 173 before the RAF could obtain Treasury approval to buy it for the various purposes it had in mind (the Air/Sea Warfare Development Unit, the SAR role, Malaya and the projected transport unit in Transport Command). (60)

In April 1954, therefore, the Air Staff issued its operational requirement for the Bristol 173 (OR 325) without waiting for a meeting of the Operational Requirements Committee (ORC), using as its excuse the plea that a Naval order for 65 aircraft was probably on its way to the Ministry of Supply. (61) Two months later a further operational requirement (OR 326) was issued for the turbine engined version of the 173, which was expected to be available in 1958/59, the grounds being that the piston engined version would have neither the range required by Coastal Command, nor the single engine performance required for long unescorted sea crossings.\* (62) With BEA also

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\*This was the beginning of the Belvedere story.

interested in the turbine engined version, Bristol Aircraft suggested dropping the piston engined version in order to concentrate on the turbine engined aircraft, but the Air Ministry was not prepared to agree at that stage. (63)

By late 1954 Sycamores were in use with the Air/Sea Development Unit and No 275 SAR Squadron, Fighter Command, Whirlwinds Mk 2 in No 22 SAR Squadron, Coastal Command, and Dragonflys in the Central Flying School (Instructional) Development Flight (one being detached to The Queen's Flight). By early 1955 three further major deployments had been initiated: in the Middle East (Cyprus and Jordan, in the Arabian Peninsula and Aden, and in Kenya at Eastleigh). At the same time the Joint Experimental Helicopter Unit (JEHU) came into being.

#### The Joint Experimental Helicopter Unit

The formation of the Joint Experimental Helicopter Unit with the task of developing troop and cargo carrying techniques in tactical situations was a matter of considerable delicacy. The Air Council had agreed in 1953 to the formation of a RAF unit in Transport Command for this purpose when allotting helicopters to replace Austers in the AOP squadrons (see p 105 ). Throughout 1954 as the Army attempted to take over responsibility for the whole tactical helicopter field, the RAF argued cautiously against any division of supply and, especially, servicing facilities, and most vigorously against any attack on the principle of Air Force control of aircraft (including helicopters). (64)

The immediate problem however was how to equip all the new helicopter units being formed at the very moment that the operational demands of the Malayan emergency were taking first priority and the Treasury was exercising a rigid control over all orders for helicopters. (65) Every priority in fact seemed to be overriding. Building up the SAR units at home, already delayed, was a constant battle for aircraft allocations; the Middle East Air Force was demanding not only the SAR helicopters promised to Lord Dowding for Cyprus in 1953 but additional aircraft for casualty evacuation in the Mau Mau operations in Kenya; and there were further demands still for SAR helicopters for Aden and Sylt.

In addition, the Treasury's refusal to allow the RAF communications helicopters to be ordered, (66) as planned in the Air Council decisions of March 1954, meant that the CFS (Instructional) Development Flight was spending much of its time attending to high priority bids for VIP transport. Consequently, in July 1954 the Deputy Chief of the Air Staff was compelled

to say that at the end of a long argument lasting many months the alternatives were - short of stopping all development and instructional work on helicopters in the RAF - either to establish two helicopters in The Queen's Flight or to be prepared to tell the Royal Family that the RAF could not meet their requirements. (67)

In the event, two Whirlwinds were established in The Queen's Flight, the flow of helicopters to Malaya was maintained, and the projected Transport Command Evaluation Unit (Army troop/cargo development) was given equal priority with the home based SAR units. (68) Even so, it seemed improbable that its first two Whirlwinds would be available before the last quarter of 1955.

The Army's attitude at this time was revealed in a report on the Chief of the Imperial General Staff's conference in 1954 on heavy lift helicopters. (69) The Deputy Chief said that heavy lift helicopters should be very simple to control - 'he envisaged a man standing in the corner of the field with a flag' - and he thought it would be unnecessary to have anything on the lines of 'wireless like they have in Fighter Command'. Navigation should be restricted to map reading.

Air Force comment was broadly to the effect that if, as was envisaged, helicopters were to replace lorries, all weather capability would be needed, ie full instrumentation, radio and navigation aids. Elaborate maintenance base facilities would also be needed and the running cost of the 450 helicopters proposed would be very high. Privately, the RAF conclusion was that the impossibility of imitating in the United Kingdom the American practice of operating large fleets of helicopters in clear day weather was not understood and that to drive this lesson home the proposed RAF helicopter transport development unit should be set up as soon as possible. If necessary, the Army should be allowed to set up its own development unit, the RAF retaining control of all air traffic and navigation aids in forward areas. (70) By November 1954, therefore, the Joint Chiefs of Staff had agreed to the formation of an inter-Service unit to be known as the Joint Helicopter Evaluation Unit, (71) later renamed the Joint Experimental Helicopter Unit (JEHU). Although this action removed the need for a Transport Command Evaluation Unit in the RAF, it was still hoped that Transport Command might be able to justify helicopters as a logical extension of the medium range transport force and for spares delivery at home. (72) This line of argument did not prevail.

The Army now had authority to order aircraft for the joint unit, although it was to be manned by equal numbers of Army and RAF pilots, with a colonel

in charge and a squadron leader as second in command. Servicing would be undertaken by the RAF. Formation was to take place in two phases, the first in early 1955 and the second in 1956. The two sections were initially (and predictably) called platoons, but in due course as co-operation developed, the more easily understood and appropriate title of flight was adopted. With competition for Whirlwinds intense at this stage of the Malayan build up, the only helicopters which could be obtained were Sycamores, and the first flight duly formed on 1 April 1955 with six; the second formed a year later with six Whirlwind Mk 2s.

In 1957 the decision was taken to transfer from the Air Ministry to the War Office full responsibility for AOP and light liaison aircraft, the dividing line being drawn at an aircraft all-up-weight of 4,000 lb. It was this decision which opened the way for the formation of the Army Air Corps. In the same year, as the result of the findings of a government committee - the Bingley report - the role of air transport in support of the Army worldwide received acceptance and in consequence the RAF was made responsible for, inter alia, helicopter tactical troop and cargo lift in forward areas, a task which was assessed as requiring 12 Bristol 192s. This assessment was in itself a step forward of the greatest significance as it was the first occasion on which a helicopter task had received the formal definition on which the RAF could base its aircraft demands.

The JEHU's position in the light of these two developments clearly required redefinition and in July 1957 the Secretary of State for War proposed modifications in its charter. (73) His proposals would have had the effect of altering the JEHU's current task of determining whether helicopters might solve the Army's (and perhaps the RAF's) problem of mobility, organisation and administration in the field, to one of defining the optimum methods of operating a force of VTOL and STOL aircraft for logistic support in the field. The JEHU would also have had to take account of a possible Army requirement for a 4/5 seater utility aircraft, both VTOL and STOL, for use in the tactical role.

The Air Ministry was markedly unenthusiastic about these proposals, as they were seen as a manoeuvre to circumvent the 4,000 lb weight limitation imposed on Army controlled aircraft, with the JEHU being used as 'a stalking horse' to cover the Army's approach to its final target (control of all tactical helicopters). (74) There was also a danger that the way was being prepared for the possible addition of fixed wing (STOL) aircraft to the JEHU establishment.

Additionally, in the Air Ministry view, nothing of value seemed to have been demonstrated by the JEHU in the course of two years' work on the

tactical employment of helicopters which the RAF had not already learned from operations in Malaya and Cyprus, and to make advances in such techniques as instrument flying and night operations specialist facilities would be needed which the unit did not possess. (75) Field trials, it was felt, could be carried out, when required, by existing RAF tactical helicopter units or, where appropriate, by the Army's own new light liaison units at the Army Air Corps Centre. The acceptance of the Bingley report and the setting up of the Army Air Corps was seen by the Air Ministry not as a reason for strengthening the JEHU but for disbanding it and using other units to carry out the investigations required, after due consultation with the Land/Air Warfare Committee. (76)

In the event a compromise was reached. The JEHU was kept in being for a further two years, its Sycamores being replaced by more Whirlwinds as the supply position permitted, and it gradually assumed the character of a tactical helicopter support squadron, which was what it in fact became at the end of 1959, but in the shape of No 225 Squadron RAF, to the disappointment of the Army Air Corps. (77)

#### IMPLEMENTATION AND DEVELOPMENT

Between 1955 and 1960 the main problem was to resolve the conflict of priorities which arose in the course of implementing the plans already made for the creation of new helicopter units, some of which needed far more support than had been expected - a notable example being Cyprus where the planned SAR flight suddenly developed into a full tactical helicopter squadron. Meanwhile the Malayan commitment continued and a new task appeared in the form of helicopter support for the units involved in the British atomic weapons tests on Christmas Island and in Australia. This requirement had to be met from the United Kingdom as FEAF had no spare capacity. At the same time far reaching decisions on replacement engines and helicopter types were being taken which were to set the scene for the third phase of RAF helicopter development.

The year 1955 was a period of unprecedented growth in helicopter units, with the Air Staff seemingly the target of intense pressures from every direction and often from a very high political level.

The situation was still far from satisfactory. With Malaya remaining the first priority, the JEHU had to be content with Sycamores instead of Whirlwinds, (78) although the SAR Sycamores promised for the Middle East

in 1953 were at long last being delivered. In the same area there were new SAR commitments in Aden and Nairobi,\* (79) which delayed the build up of the Fighter Command SAR squadron (No 275) begun with two Mk 13 Sycamores. The squadron was thus forced to borrow two Hiller 360 helicopters from the Naval training squadron to keep its pilots in flying practice. Meanwhile, the shortage of Whirlwinds was also delaying the build up of the Coastal Command SAR squadron (No 22) and two Sycamores had to be borrowed from the Air/Sea Warfare Development Unit (ASWDU) to save it from disbandment. (80)

The shortage of Mk 2 Whirlwinds was due in part to the Malayan emergency and the need to convert Mk 2s to Mk 4s for that theatre, and in part to a chronic shortage of Whirlwind engines, itself partly caused by the unexpectedly short life in Malaya of the reconditioned Wasp engines (only 100 hours at one stage). (81) Another cause was the hope - in the event unfulfilled - of obtaining more S-55s from the United States for service in Malaya (see p 78 ), which had the effect of delaying orders for the Coastal Command and JEHU Whirlwinds as well as for those needed in Malaya.

A further complication appeared when the Foreign Secretary (Harold Macmillan) informed the Air Minister that France had asked for 20 Whirlwinds for use in Algeria and strongly urged that Britain should accede to this request. (82) The Air Ministry replied that there seemed to be no way of doing so in the light of the Malayan situation, especially as the United States would surely refuse the British bid for 30 more S-55s when it was discovered - to everyone's surprise - that Westland apparently had spare export capacity. (83) The discussions were complex and involved the Prime Minister, but it was eventually agreed that as the United States had raised no objection, (84) eight Whirlwind Mk 2s should be delivered to the French in the last quarter of 1955. (85)

Apart from the problem of Whirlwind supply, however, there were many other difficulties for the Air Ministry to resolve, always against the background of a highly critical situation in Malaya: the Whirlwind's performance defects and chronic spares shortage, Sycamore deliveries to replace the Dragonflies in No 194 Squadron and build up the Middle East Sycamore units, and the need to prepare a full case in the hope of reversing the Treasury's refusal to sanction communications helicopters in the Commands.

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\*With the withdrawal from the Suez Canal Zone the SAR Sycamores intended for Abyad (Sudan) and Fayid were reassigned to Nicosia and Amman.

After a detailed survey of this last problem the Air Ministry Aircraft Establishments Committee concluded that there was a case for 34 communications helicopters divided between 2nd TAF, No 90 Group and the following commands: Bomber, Fighter, Coastal, Transport, Home, Maintenance, Flying Training and Technical Training. Some of the helicopters were to be available for sharing with the Army, in particular the eight allotted to 2nd TAF in Germany.

In an attempt to make the case more acceptable, it was suggested that a lower figure than 34 might be put forward initially to allow experience to define the requirement more accurately. (86) In the event financial approval was not given for the purchase of any communications helicopters, but the course of events does at least indicate that the Air Ministry can hardly be accused of lack of interest in helicopters.

Meanwhile, the CFS helicopter unit formed in April 1954 to develop instructional and handling techniques, and train flying instructors and, eventually, helicopter pilots had lost one of its three Dragonflies to The Queen's Flight and was spending much of its time flying VIPs in the other two, when they were serviceable.\*

#### Relations with the Royal Navy

No sooner, however, had relations with the Army been stabilised - for the time being at least - by the formation of the JEHU than the Air Ministry discovered in April 1955 (a particularly hectic year) that the Navy appeared to be taking steps which would have the effect of altering the agreement on the control of shore based squadrons with a maritime role, a responsibility which had belonged to the RAF since its formation.\*\* The occasion was a paper by Admiral Creasy, Commander-in-Chief, Home Station (designate) on 'The Tactical Employment of Helicopters', which stated that Home and Channel Commands would require helicopters for 'minesweeping, anti-submarine, communications, and control of merchant shipping'. (88)

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\*The unit was due to receive two Sycamores at the end of 1955 and might need three if it was to undertake all pilot training. (87)

\*\*Relations between the Navy and the Air Force had been the subject of a special investigation by a sub-committee of the Salisbury Committee in 1923. Its conclusions were accepted by the government (see Hansard, 2 August 1923). RAF responsibility in this area was confirmed by the Inskip Committee which separated the Fleet Air Arm from the RAF in 1937.

The Commander-in-Chief, Coastal Command (Air Chief Marshal Boothman) pointed out to the Air Ministry that the Sea/Air Warfare Committee had agreed that carrier aircraft when temporarily shore based should be operated and controlled by the appropriate RAF command, and that in any case the units proposed in Admiral Creasy's paper would have to be established specifically for employment in the Home and Channel Command areas where carriers would be most unlikely to operate. The inference was that responsibility for these minesweeping and anti-submarine operations, when of necessity shore based, belonged to the RAF, and Air Chief Marshal Boothman added that in any case operational control of aircraft so employed would reside in Coastal Command. He also drew attention to the implications of allowing established principles to be overturned in respect of helicopters merely because they were considered 'unconventional', as the same argument could later be applied to fixed wing aircraft which 'may eventually acquire devices for partial or complete vertical take off'. (89)

There seemed however to be no hard evidence of Naval intentions which would justify a direct approach to the Admiralty to resolve the issue, and in view of the obvious similarity between possible Naval intentions and the Army's recent efforts to gain control of helicopters, it was felt unwise to reopen the argument so soon after the agreement to form the JEHU.

On the other hand, to do nothing might well allow a Naval order for large helicopters to create a fait accompli, while at the same time leaving the RAF in its usual position of second place in the production line behind the Navy. (90) It was decided therefore to prepare an Air Ministry paper on the subject. (91)

A month later RAF fears were confirmed by an article on 'Mine-sweeping Helicopters' by the Naval correspondent of The Times published on 25 May, and although the Chief of the Air Staff confirmed to the Secretary of State for Air that a RAF paper on the subject was in course of preparation, (92) subsequent events were as predicted. By June the Air Ministry was explaining to Coastal Command that the four Bristol 191s (formerly 173s) for the Air/Sea Warfare Development Unit could not be delivered before the end of 1957 and that if the Navy did not cancel their order for 65 191s the four for the RAF trials would be delayed until the first quarter of 1958. (93) The 22 general purpose versions of the aircraft (B 192s) planned for the RAF would be similarly delayed, as the Naval version had gained design priority. (94)

In May 1956 the First Sea Lord (Lord Mountbatten) wrote personally to the Minister of Defence (Sir Walter Monckton) saying with unmistakable irony

that the helicopter minesweeping trials had been a complete success but because of the government approved Inskip award, which he said forbade the Navy to use aircraft for operational purposes from shore bases, the trials had been necessarily conducted from the deck of an LST. Pointing out that the Chief of the Air Staff had no power to alter a government decision even if he wished to, he agreed that 'economical and sensible' progress was being frustrated because the correct procedure would involve an infringement of the Inskip award. What therefore did the Minister think should be the Admiralty's next step? (95) No more was heard about RAF responsibility for minesweeping by helicopter.

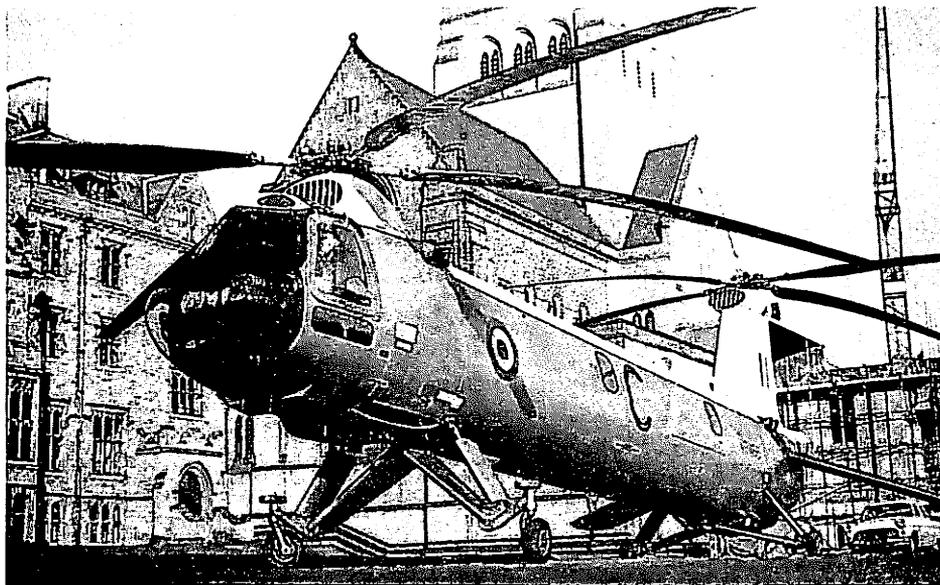
#### Development of the Bristol 192 (Belvedere)

Development of the Bristol 173 had come a long way since the Air Ministry had identified it in 1953 as the project most likely in principle to fulfil the Army's requirements for a general purpose helicopter and had issued OR 325 in early 1954 as the target which it should meet. The inadequacy of the two Leonides engines had long been apparent and their replacement by the Leonides Major was known to be no more than a short term expedient to enable trials to commence. Accordingly, four of the Leonides Major piston engined types were ordered against OR 326 (the land based maritime helicopter); they were however to be restricted to development work with the ASWDU because of their lack of single engine safety performance.

Hopes for the future fulfilment of OR 325 and OR 326 rested with the Gazelle turbine engined version (96) and an order for 65 of this type (considered the most likely helicopter to have fully adequate performance in all roles) was given design priority and led the Bristol Aeroplane Company to defer to Naval specifications in respect of fuselage shape, undercarriage type and size, etc.

The result was rather grotesque. The original 173, built for passenger use with a low undercarriage and a level fuselage with windows along both sides, was replaced by an aircraft with a short fuselage (to fit an aircraft carrier lift), insufficient headroom for standing (the new version would not be required to carry passengers), a sharp nose up cant (to permit torpedo loading from the front) and an enormous undercarriage designed to allow the aircraft to be dropped at 12 feet a second on to a carrier deck rolling at 10 degrees.

Such was substantially the shape which the RAF inherited for the B 192 when the Naval order was cancelled in 1956. The two three bladed Sycamore rotors used on the 173 had each had a fourth blade added and the transmission



**Top:** the prototype of the Bristol 173 (1954) - developed from the Sycamore and with Sycamore rotor blades (front rotor blades reversed) and powered by two Leonides engines, it was the forerunner of the Bristol 191 and 192 (the Belvedere). **Below:** the Bristol 192 pre-production version of the Belvedere with two Napier Gazelle turbine engines and four bladed rotors, but still with wooden Sycamore blades and fully manual controls. Used for service trials.

had undergone considerable development to accommodate the increased gas turbine engine power now planned.

Problems however had been encountered with the interim Leonides Major engine (mainly oil cooling difficulties) and the latest performance estimates for what was now a heavier aircraft but still with piston engines were beginning to look less and less attractive, particularly its lack of single engine safety.

Predictably the Navy was rapidly losing interest in an aircraft which, with its weapon load, was thought to be too heavy for the carrier lift and too large unless the rotor blades were removed. When the usual transmission development problems were added to engine overheating difficulties after hovering trials in November 1956, the Navy took the opportunity to cancel their 65 aircraft altogether, a decision which was swiftly followed by the cancellation of the three B 191s destined for the Royal Canadian Navy. (97)

On the RAF side there were, in July 1955, firm orders for 21 Bristol 192s (half to replace Sycamores in Malaya and half for Coastal Command SAR) and for four Bristol 191s for the ASW DU. (98) There was no intention then to reduce these orders and it was argued that an increase might be needed if the proposals for the long term defence of Malaya after the Emergency were to be implemented - in the event they were not. (99)

Every effort was therefore made to hasten the incorporation of the Gazelle turbine engine in the B 191 and B 192 so that as few as possible of the piston engined version would have to be accepted (and later fitted with turbine engines). At the same time a number of suggestions were put forward which would have led to more B 192s being ordered: 10 aircraft were proposed for the anti-submarine and minesweeping duties then in dispute with the Navy; (100) twin engine reliability made the B 192 a candidate for The Queen's Flight; and it could also be used to re-equip the JEHU and for a freighting unit in Transport Command. (101) None of these suggestions received financial approval, but the attitude of the Air Staff was once again clearly revealed and similar proposals were revived when the cancellation of the Naval order for B 191s threatened production of B 191s and B 192s for the RAF unless a further 16 aircraft could be ordered. (102)

Meanwhile, however, the Navy had decided to buy a turbine engined version of the American S-58 (later known as the Wessex) which Westland were proposing to build under licence from Sikorsky. It was also intended at that time to use the Rolls-Royce Dart engine and Westland suggested that any problem over lack of research and development funds could be circumvented

by spreading the cost over the production aircraft, thus transferring it to the Naval vote and overcoming Ministry of Supply objections on the grounds of research and development expenditure. (103)

The RAF, however, was dismayed by the Navy's unilateral cancellation of the B 191, which had been a joint project, and at finding itself under pressure to follow the Navy in backing the single engined Wessex and itself abandoning the B 191 and B 192. (104) The Air Staff argued strongly against doing so, pointing out that it was about to bring into service the first helicopter in the RAF to have completely adequate performance in all roles and theatres, together with twin engine reliability, and an aircraft which was the most advanced helicopter in the world in its class.

The Air Staff also questioned the propriety of the Navy's action, especially as the first reason given for cancelling the B 191 had been its inadequate performance in the piston engined version, but when the Gazelle engine promised more than the required performance the argument shifted to the S-58's better deck handling characteristics. The Air Staff therefore argued that the RAF's order for B 191s and B 192s should be increased by 16 if that was the only way of keeping the project going, (105) and pointed out that as the turbine engined S-58 had a less adequate performance than even the piston engined B 192 the RAF would still prefer the latter, even if research and development support for the Gazelle engine was withdrawn. (106)

This new threat had come about because of a recommendation by the DRPC that expenditure on helicopter development should be cut by £2m as part of the current attempt to reduce defence costs.\* (107)

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\*The rise in government expenditure on helicopter engine and airframe development by industry over the years 1946-57 is shown below: (108)

<u>Year</u>	<u>£, 000</u>
1946-47	115
1947-48	180
1948-49	127
1949-50	280
1950-51	192
1951-52	189
1952-53	573
1953-54	1,164
1954-55	2,916
1955-56	4,000
1956-57	4,100

Research and development expenditure thus approximately doubled each year for the first five years of Phase 2 of helicopter development, (1952-56).

The RAF, however, was successful in its campaign to keep the B 192 programme in being, and was also able to save the Gazelle engine. This the DRPC then recommended for the Naval S-58s, so creating the Wessex Mk 1. (109)

In March 1956 the planned distribution of B 192s was eight each for No 22 Squadron SAR and for FEAF, five for training and nine for the JEHU, a total of 30. The ASWDU allotment was cancelled and with it the B 191. Twelve of the 30 B 192s which the RAF was hoping to order were to be fitted with Leonides Major piston engines initially, because to wait for the Gazelle turbine engine would mean a delay of 12 months. (110) In the event only 25 B 192s were ordered for the RAF (including substitution for the bid for four B 191s), with one more for the Ministry of Supply, but the Air Staff considered that any attempt to justify more would not be successful in the prevailing economic climate. (111) No requests were therefore made for the training and JEHU tasks, (112) and by mid 1956 the Air Staff had resigned itself to a long, hard battle to obtain even the 25 B 192s asked for - the minimum number which would allow production to go ahead and the maximum which would have any chance of winning financial approval. The struggle was longer and harder than most had expected and over the ensuing four years the B 192 was almost constantly in danger of cancellation.

Apart from more general considerations of national prestige and the development of industrial expertise in helicopter design, the justification for continuing the work necessary to bring the Belvedere into being rested mainly on the recommendations of the 1956 joint service Bingley committee, set up to consider future transport requirements in cold and limited (non nuclear) war. Its recommendations endorsed by the Chiefs of Staff, included a force equivalent to 12 Belvederes for deployment to the theatre involved as part of the tactical transport force, (113) the Belvedere being now seen exclusively as a tactical transport helicopter.

In June 1956 the Air Council agreed in principle that provision should ultimately be made for a mixed force of twin engined helicopters and Pioneer type aircraft in Transport Command, (114) but within months of that decision the Air Staff was involved in a complex debate over the rival merits of the Belvedere and Wessex. (115) On the one hand, it was argued that the Wessex performance was not far short of that of the piston engined Belvedere, while on the other hand it was estimated that 12 Belvederes with Gazelle engines would equal 20 Wessex and that up to 45 Wessex would be needed to lift the same payload in tropical conditions. (116) Equipping the whole Belvedere force, however, with Gazelles would be more expensive than equipping the 14/11 mix at first intended. But against the Wessex was the

fact that it would be at least a year, and possibly two years later than the Belvedere in coming into service. (117)

The battle raged to and fro in early 1957 across the whole spectrum of policy considerations, from air transportability to tactical suitability and political expediency. The Ministry of Supply joined in with a recommendation that the Belvedere should be retained and that all those ordered should be equipped with the Gazelle engine, and added that certain technical problems had arisen with the Leonides Major engine. (118) Among the many financial estimates prepared was one which concluded that it would be more expensive to the Air vote to cancel the Belvedere in favour of the Wessex and more difficult to justify publicly. (119)

Performance comparisons between the Gazelle and Leonides Major versions of the Belvedere were made in every conceivable combination of circumstances, an example being the payload which each could carry in tropical conditions at 5,000 feet over a range of 100 miles, the conclusion being 5,500 lb in the case of the Gazelle and 850 lb in the case of the Leonides Major. Even in standard temperature conditions at sea level with one engine failed the Gazelle version was expected to carry 3,200 lb over 250 miles and the Leonides Major version only 440 lb over 50 miles. (120)

In April 1957 the Air Council finally decided to ask for 25 Belvederes, all with Gazelle engines. (121) The financial arguments continued, however, and in November 1957 the case for 25 aircraft had to be defended against a detailed calculation that 22 might be enough. (122) In reply, training requirements and wastage rates (assessed at one a year for seven or eight years), together with the unforeseen commitments, which experience had shown to be the normal lot of successful helicopters, were used to justify the order for 25 aircraft to produce the 12 UE for the overseas deployment specified in the Bingley report.

In early 1958 a new problem was put to the Air Staff: how could the Belvedere task be carried out if the order for these aircraft was cancelled to save research and development costs? (123) The question was made no easier to answer by the fact that the War Office was understood to have thrown over the whole tactical force plan agreed by the Bingley committee, on which the requirement for the 12 Belvederes was based.\* (124) The Air Force answer was that there was no alternative way of meeting the task laid down (or any similar task) which did not involve a much larger expenditure on new heli-

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\*The Air Staff suspected that the Army, knowing that there would be no Belvederes allotted to the JEHU, saw the RAF's purchase of that aircraft as a threat to its control of tactical Whirlwinds, and perhaps S-58s, which in 1957 it was still hopeful of gaining.

copters, and that it would be very difficult to explain to the Public Accounts Committee why the Belvedere project was being abandoned at such a late stage. (125) Alternative ways, however, had still to be explored, including such absurdities as the provision of 72-108 Whirlwinds with Leonides Major engines, (126) but without War Office adherence to the Bingley report any references to the Belvedere were necessarily somewhat vague.\* To clarify the position DCAS had written in the previous month to DCIGS asking the Army to confirm that it still required the Belvederes and in the numbers ordered, (128) but DCIGS replied with no more than a short statement of confirmation but with no explanation. (129)

It was, therefore, only with the greatest difficulty that the order for 25 Belvederes for the RAF (and one for the Ministry of Supply) was kept in being until three pre-production versions of the aircraft became available in late 1960. Even then financial restrictions continued to play a part as development money was cut off before the final work was finished.

As a result, this 'ugly duckling' entered the RAF with not only the topographical peculiarities inherited from its earlier association with the Navy but also several uncorrected design faults as well. Nevertheless, it represented a historic milestone as it was the first helicopter in the RAF to be free of the problems which had plagued its predecessors: the severe restrictions placed on payload and operating profiles, especially in the tropics, by the performance limitations of their piston engines. The power/weight ratios of its turbine engines enabled the Belvedere to operate with such a huge reserve of power that in temperate conditions it rarely needed to use more than half the power available with both engines running. The limiting factor now was no longer engine power but the design strength of the transmission. Even at high altitudes in full tropical conditions, therefore, it suffered no limitation of payload or deterioration in performance, but merely a loss of single engine safety at the critical moments of take off and landing at maximum all-up-weight in the most severe conditions.

The Belvedere was also the first helicopter to equal and even exceed in service the most optimistic advance estimates of its performance, a fact which went a very long way to compensate for its lack of refinement in other

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\*For example, the Belvedere had, it was merely said, the ability to put down 'comparatively large bodies of men in inaccessible areas, eg the Arabian Peninsula and the Horn of Africa' and a 'reasonably good ferry range', and would be of 'great value in internal security and other small operations'. (127)

respects, eg manual throttle RPM control, awkward fuselage shape, sundry maintenance problems and, in particular, its unreliable engine starting system.

The foresight and determination which the Air Ministry showed in bringing the Belvedere into service was therefore ultimately justified, and in the event its arrival was most happily timed as the availability of 12 Belvederes for overseas deployment enabled it to play a very significant and exclusive role in Aden and to contribute most notably to the Borneo operations of 1962-66.

#### Development of the Whirlwind

It was in Malaya that the Whirlwind's inadequate performance acquired critical importance, a problem which was only partially alleviated by the drastic steps taken in 1954 to enable the aircraft to fly at all (see pp 71-73 ). Consequently, it was in Malaya that the demands for the re-engining of the Whirlwind originated once the initial difficulties had been overcome in 1955. There was, however, no engine available in adequate numbers or with the necessary spares backing to meet the demand. A few Wright Cyclone piston engines had been obtained for the Navy to produce the Whirlwind Mk 3, but this expedient was of no help to the RAF in the time scale required and the spares shortage was acute. At that time, too, enough Bristol 192s were expected to be available by 1957 to meet the Malayan problem, (130) and it was also thought that they would replace the Whirlwinds in Coastal Command.

By 1957, however, the B 192 was being thought of as a tactical transport helicopter and it was therefore necessary to deal with the inadequacies of the Whirlwind Mk 2 in the SAR role, the best hope seeming to be the Leonides Major engine. The problem was now considerable because the Whirlwind had become firmly established in No 22 SAR Squadron in the south of England and was due to be withdrawn from Malaya to replace the Sycamores (with their smaller cabins) in No 275 Squadron in the north of England (see p 113 ). The need to provide eight Whirlwinds to support the atomic weapons trials in Christmas Island led to the formation of No 217 Squadron and confirmed the fact that the Whirlwind was here to stay and needed to be improved. A trial of the Whirlwind Mk 2 in Cyprus, where the Governor (Sir John Harding) was asking for a tactical troop lift helicopter, showed that even there the temperature and height factors made the Whirlwind virtually useless, and gave added impulse to the demands for re-engining.\* (131)

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\*The Cyprus requirement was eventually dealt with successfully by the Sycamore.

In response to a plea from Coastal Command the Air Ministry reported in June 1957 that a detailed case would be prepared for re-engining the Whirlwinds with Leonides Major engines as soon as the results were known of the intensive flying trials being conducted by the Navy with the Naval Whirlwind Mk 7 which had been fitted with that engine. (132) At the time there seemed to be a fair prospect of success, as the Whirlwind gearbox could absorb an output of only 700 hp and the 850 hp Leonides Major engine would therefore have the additional reliability of a derated engine and still provide more power than the existing Pratt and Whitney engine of only 600 hp. The fact that the new engine was substantially heavier seemed of little importance in the context of the problems which had arisen from the Whirlwind's significant lack of power. The surplus power from the Leonides Major engine could also be an advantage in the 'hot and high' conditions of Malaya, but its greatest attraction was that its use in the Whirlwind would reduce the compensation payable to the manufacturer following the decision to use the Gazelle engine in the B 192 and not the Leonides Major for which materials had already been purchased. (133)

With hindsight it is easy to see that it would have been an expensive mistake to have re-engined the RAF Whirlwinds with the Leonides Major engine and that serious consequences would have followed from attempting to meet the demands of the Borneo campaign with aircraft so equipped. At the time, however, most of the available evidence seemed to show that the Leonides Major engine was the appropriate choice and there was considerable pressure from all those operating Whirlwinds to give priority to the re-engining programme.

In the Navy the decision was taken early and Leonides Major Whirlwinds went into service in place of aircraft with Pratt and Whitney engines. The experience, however, was unhappy, and not only was the improvement in performance too small to justify the upheaval and expense, but the engine was also technically troublesome and, as a result, there were long delays in the re-engining programme and several aircraft were eventually lost in the sea.

The RAF, on the other hand, mindful that both the Whirlwind and the Sycamore would soon have to be replaced, and that its original operational requirement for a small tactical troop carrying helicopter had not yet been met, was considering the possibility that a much smaller turbine engine than those currently developed might be used to power the small types of helicopter in place of the heavier piston engine then in use. In November 1957 ACAS (Training) suggested that the turbine engined version of the Sycamore then being designed by the Bristol Aeroplane Company (B 203) might be considered as a replacement for both the Whirlwind and the Sycamore,

arguing that the Whirlwind with the Leonides Major engine would be too heavy for the larger tasks and too large for the smaller tasks. (134) A few months later details became available of two small private venture turbine engines which seemed suitable for the size of helicopter needed to replace the Whirlwinds and Sycamores. One of these projects was a completely new engine offered by Armstrong Siddeley and designated P 181; the other was a version manufactured by de Havilland of the American GEC T 58 which had already been developed and installed in a number of American helicopters.

The advantages of fitting either of these engines in the Whirlwind were enormous: both the full performance required for SAR and - in all significant respects - that specified in the draft operational requirement for the projected Whirlwind/Sycamore replacement due in 1963/65 would be achieved. The expense of substituting a turbine engine for the Leonides Major would therefore be fully justified as it would remove the need for a completely new helicopter. (135)

The comparison between the Whirlwind's capability with the Leonides Major and the de Havilland Gnome engines was dramatic. Not only was there a weight saving of 765 lb, but in temperate summer conditions the extra power (1,000 lb shaft horse power) enabled the take off weight permitting vertical climb to be increased to the aircraft permissible fuselage all-up-weight, a further saving of 165 lb. In addition, the cruising speed was increased from 70 to 90 knots, the net result being a payload increase in a rescue task at 50 miles' range from 1,000 lb to 1,800 lb. (136) The excess of shaft horse power available in temperate conditions over transmission limitations indicated that full performance would be maintained in 'hot and high' conditions of considerable severity.

Consequently, at the end of 1958 the RAF abandoned its interest in the Leonides Major engine at the very last moment and decided to re-engine its Whirlwinds with de Havilland (later Rolls-Royce) Gnome engines. (137) Thus was born the Whirlwind Mk 10, which entered RAF service in No 225 Squadron in late 1961 (a year after the formation of the Belvedere Trials Unit), just in time to join the Belvedere at the start of operations in Borneo. With the Belvedere it formed the main element in all RAF helicopter operations in the 1960s, except those in Aden, and continued in the SAR role beyond the end of 1975. The Gnome engine installation incorporated computer controlled fuel supply maintaining constant free turbine speed for varying power demands. The Whirlwind Mk 10 was thus the first RAF helicopter in which the rotor speed was controlled automatically rather than by means of a manual twist grip throttle operated by the pilot.

## SUMMARY OF THE SITUATION IN 1960

In the first phase of its development the helicopter had shown that, in theory at least, it had the capacity to improve substantially the flexibility and capability of any unit engaged in tactical situations unsuited to motor transport. In the second phase this capacity had been generally recognised as an essential element in nearly all forms of military activity. In the RAF, however, the helicopter had come to maturity in a period of the greatest difficulty. The development of the nuclear deterrent and the emphasis placed on the bomber, fighter and maritime roles, combined with ever present financial stringency, produced a very unfavourable climate for the development of what some still saw as an aeronautical aberration.

### Inter-Service Relations

The arrival of the demonstrably practical helicopter had produced a reaction on the part of the other two Services reminiscent of what had taken place between 1912 and 1918. On that occasion the situation had been resolved by the formation of the Royal Air Force, a step taken with the full backing of government. No such support was given now and, left to itself and beset by many other problems, the RAF was by no means certain that it wished to embrace the whole helicopter element. The Fleet Air Arm, in one sense, had not been its concern since 1937; nor did there seem to be any sound reason for re-establishing a new version of the old Army Co-operation squadrons to undertake with ultra light helicopters the AOP and light liaison tasks. On the other hand, this was clearly a line of thought which could not be allowed to go too far, and the dividing line between Army and RAF responsibility was therefore arbitrarily drawn to exclude anything much larger than the Skeeter or Fairey ultra light helicopter, ie at 4,000 lb weight. The problem was thus shelved for the time being, but not solved, as an artificial limit of this kind would inevitably be eroded as helicopter technology developed. The seeds of trouble sown in the 1950s germinated in due course: the developed Skeeter became the Scout and Wasp, which turned into anti-tank and anti-submarine weapons carriers; the Scout replacement became the cargo/troop carrying Lynx and so the dividing line between Army and RAF responsibility became progressively more difficult to distinguish - a situation which promised conflict at some future date.

### Operational Achievements

Within the area of activity which seemed proper to the RAF there were grounds for satisfaction, in that all urgent operational demands had been met, although only just. The Malayan operations had been satisfactorily concluded and helicopter support maintained throughout by one means or another. The

nuclear weapons trials in the Pacific had been supported by a Whirlwind squadron and in Cyprus the struggle against terrorism had been transformed by the arrival of tactical helicopters. A limited casualty evacuation service had been provided in Kenya; SAR detachments had been set up in Malaya, Cyprus, El Adem, Jordan and Sylt, and a squadron of Sycamores had been sent to Northern Ireland in 1959. In England a basic SAR service with somewhat limited performance was provided by two permanent Whirlwind squadrons deployed along the east and south coasts; in addition, The Queen's Flight had two Whirlwinds and the Metropolitan Communications Squadron was on the point of opening a VIP and staff helicopter service from Northolt.

### The Development of Roles

At the end of the 1950s the JEHU had been transformed into a tactical helicopter support squadron. Thus the tactical helicopter role was officially accepted as an RAF task, whereas previously SAR, casualty evacuation and, exceptionally, communications had been the only roles which the RAF could specify in its applications to the Treasury for new helicopters, except when the Army was already committed to a conflict and the application was therefore too late.

All helicopter deployments in the 1950s - in the Far East, the Middle East, Aden and Northern Ireland - began as casualty evacuation or SAR and went on to play an essential part in tactical operations, living up to their reputation in that role. The lesson was obvious and gave added impetus to helicopter development in both the technical and philosophical spheres. What was not appreciated so readily was that tactical demands overseas, being more urgent than the SAR standby role and therefore usually taking precedence, soon ceased to be regarded as a diversion of effort from the primary task. All the overseas units became de facto tactical units and the SAR task was carried out as a secondary role when circumstances allowed.

Only in the United Kingdom (excluding Northern Ireland) did this reversal of role not take place, the obvious reason being the absence of any operations requiring tactical helicopters. Communications flights were therefore the only diversion which the SAR standby helicopters had to resist and such resistance was not difficult. Thus the SAR units in the United Kingdom, originally established for Coastal and Fighter Commands, retained their exclusive SAR status when those commands disappeared and their role continued to be regarded as completely distinct from that of the tactical helicopter units of which the first to be established was No 225 Squadron at the end of this second phase of helicopter development.

In the overall picture, however, these SAR units had been relegated to second place and in the 1950s their formation and build up were substantially delayed by the shortage of helicopters caused by the proliferation of tactical tasks overseas carrying a higher priority. With hindsight it can be seen that it was the exclusive nature of its SAR role, as developed in the United Kingdom in the 1950s, and maintained automatically in subsequent years, which eventually enabled the United Kingdom SAR force to generate its own operational requirement for a new type of helicopter - the Sea King - without reference to the needs of the tactical helicopter force, rather than having to content itself with a modified version of an aircraft suited to tactical operations.

Some confusion, in fact, arose from the differing attitudes of the SAR organisations maintained by the RAF and the Navy, the latter being operated more in the manner of the RAF units overseas. In 1954, for example, the Minister of Transport and Civil Aviation asked the First Lord of the Admiralty why Naval SAR helicopter services were not available on Sundays and public holidays, and for periods of about two weeks at Christmas, Easter and in August, while the RAF's SAR service was continuous. (138) The First Lord replied that Naval SAR services were provided on an ad hoc basis by helicopters disembarked from ships and, as such, were part of a training and not an operational command. (139) In other words the SAR service so provided was a peacetime bonus rather than a formally established commitment and the manpower and technical backing was provided accordingly. This difference in approach to SAR in the United Kingdom was to reappear from time to time in later years.

### Training

By the end of the second phase of helicopter development the Central Flying School helicopter unit had been in existence for six years. Originally established in 1954 to develop helicopter instructional and handling techniques and train a nucleus of flying instructors, (140) it had compiled the official air publication dealing with helicopter pilots and instructors, and including a categorisation scheme, and was currently training and testing helicopter instructors for all the Services in accordance with the CFS charter.

It was also responsible for training RAF helicopter pilots. The original conception in 1954 had been that when Service pilots were trained by the Services themselves, and no longer by the aircraft manufacturers on an ad hoc basis, a joint Service organisation was obviously desirable. With the small numbers involved the acceptance of this idea seemed to be guaranteed by the economies it would produce. (141) But in the event it appeared that the intensity of Naval feelings on the matter had been sadly underestimated.

Later, in 1957, when the Army Air Corps came into being, a further formal attempt was made to arrange joint Service pilot training and a joint Service committee was formed to agree basic principles. - However, no agreement could be reached even on the location of a joint unit, the Army and the RAF being prepared to defer to each other if necessary and accept either South Cerney (CFS) or Middle Wallop (AAC). But neither was willing to accept Culdrose where the Navy was determined to remain (and with a Naval captain in charge). Helicopter pilot training therefore remained irredeemably single service.

#### Aircraft Type Development

Through all the pressures, and occasional dramas, of this second phase the Air Ministry had succeeded in avoiding the temptations of committing itself to ill founded, if initially attractive, courses of action over the many helicopter projects being urged on it from various quarters. Although there were very few staff officers in the Air Ministry with helicopter experience, the Air Staff emerged from this hectic period with no costly millstones round its neck. On the contrary, the RAF was entering the 1960s with two splendid examples of helicopter technology: the Belvedere with its remarkable lifting capacity and the economic and efficient Whirlwind Mk 10, backed by the cheap and reliable Sycamore which maintained essential operations during the changeover period and thereafter remained available for the less onerous training and communications tasks well into the 1970s.



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### Key

AC	Air Council
ACAS	Assistant Chief of the Air Staff
ACC	Aircraft Control Centre
AHB	Air Historical Branch
AMSO	Air Member for Supply and Organisation
AUS	Assistant Under Secretary
CA	Controller of Aircraft
CAS	Chief of the Air Staff
CEE	Controller of Engineering & Equipment
CIC(FE)	Commanders-in-Chief Committee, Far East
COS	Chiefs of Staff
DC	Defence Committee of the Cabinet
DCAS	Deputy Chief of the Air Staff
DCIGS	Deputy Chief of the Imperial General Staff
DFS	Directorate of Flight Safety
DO(FP)	Director of Organisation (Forecasting and Planning)
DOR(A)	Director of Operational Requirements (A)
D Pol(AS)	Director of Policy (Air Staff)
FEAF	Far East Air Force
JEHU	Joint Experimental Helicopter Unit
MEAF	Middle East Air Force
MIS	Monthly Intelligence Summary
MOS	Ministry of Supply
ORB	Operations Record Book
PM	Prime Minister
PRO	Public Record Office
SACEUR	Supreme Allied Commander Europe
SEACOS	South-east Asia, Chiefs of Staff

Key (contd)

SF	Security Forces
SHAPE	Supreme HQ Allied Powers Europe
SofS Air	Secretary of State for Air
SofS War	Secretary of State for War
VCAS	Vice Chief of the Air Staff
WIS	Weekly Intelligence Summary

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